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2003 - EV001

THE EFFECTS OF NATURAL AND SYNTHETIC CHELATES ON IRON UPTAKE FROM PHOSPHOGYPSUM BY WATER HYACINTH

Megan Kathleen Bartlett

F. W. Springstead High School, Spring Hill, Florida, United States of America

I hypothesized that natural chelate citric acid would help water hyacinth plants take up iron more than synthetic chelate EDTA would because, as a main root exudate for iron chelation, plant transport systems would have a high affinity for it. I put 28L of water, 2.72kg of phosphogypsum and 7 water hyacinths in 12 plastic tubs. I put 5.21g of EDTA in four tubs, 3.43g of citric acid in four tubs and nothing in the last four. They grew for 8 weeks in a greenhouse, then I tested them for iron content at the environmental lab with an Atomic Absorption machine. Pieces of plant from each tub were dried in a drying oven overnight, then 1g of each was mixed with 5ml of water and 10ml of nitric acid and put on a hot plate at 100C for two hours. Then, each was filtered and the liquid that passed through was taken up to volume (100ml). The concentrations were too high for the machine, so 10ml of each sample was put in 100ml of water. The samples and several standards (to ensure accuracy) were put in the AA machine. The iron concentrations are as follows (in ppm):

Control tubs:CON-1 1780ppm, CON-2 988, CON-3 508,CON-4 2420 Citric tubs:CIT-1 414ppm, CIT-2 2210, CIT-3 2020, CIT-4 2620 EDTA tubs:EDTA-1 2560, EDTA-2 1260, EDTA-3 6940, EDTA-4 4480 My hypothesis was incorrect. Iron concentrations in the EDTA tubs were on average) 2x those in the citric acid tubs and 2.5x those in the control tubs. EDTA- iron bonds are also stronger than citric acid-iron bonds, but iron is the metal citric acid has the highest affinity for. Most likely, the difference is because EDTA- metal bonds are broken before metal uptake so the EDTA level remains constant, while the citric acid-metal complexes are taken whole into the plant, lowering the citric acid level.

2003 - EV002

MULCH ADO ABOUT NOTHING, OR IS IT? A QUANTITATIVE ANALYSIS OF ARSENIC LEVELS IN LANDSCAPE MULCH

Katharine Blaire Taylor

Palatka High School, Palatka, Florida, USA

The most widely used preservative for pressure-treated lumber is Chromate Copper Arsenate (CCA). Arsenic, a toxic chemical, leaches from the wood into the environment. Concern over this and the pressure from environmental groups led the wood products industry to voluntarily agree to phaseout the commercial production of CCA-treated wood by 2004. However, there is concern over the disposal practice of recycling this wood as mulch.

 This project evaluates various brands of mulch to determine if they contain arsenic and, if so, if the arsenic will leach from the mulch.

 Several brands of mulch were purchased. Each mulch was placed in a labeled bucket and mixed in a vinegar and water solution for ten days. Samples of each liquid and of each of the mulches were then collected and labeled. The samples were taken to the laboratory for analysis. Both the solid and liquid samples were analyzed in an Atomic Absorption Spectrophotometer (AA) to determine the arsenic concentrations.

 The average concentration of the dry mulch samples was 0.40 milligrams per kilogram. The leachate concentration of the liquid samples averaged 6.84 micrograms per liter. The dyed mulches had about a 50% higher arsenic concentration in the leachate than did the regular mulches.

 Finally, since the mulches and the leachates were found to contain arsenic, it can be concluded that the hypothesis - if mulch is contaminated with arsenic, then the arsenic will be measurable in the mulch itself and will be detectable in the leachate - was proven to be true.

Awards won at the 2003 ISEF

Award of Merit of \$250 - Society of Exploration Geophysicists

2003 - EV003

DO PESTICIDES, INTENDED TO CONTROL MOSQUITOES, HAVE A NEGATIVE AFFECT ON BUTTERFLY LARVAE AND ADULTS

Jarrod Thomas Fostier

Wildwood High School, Wildwood, FL, U.S.A.

The purpose of this project is to observe the effect of pesticides, sprayed to control mosquitoes and the potential outbreak of the West Nile Virus, on the butterfly larvae population in the Wildwood, FL area.

 To do this project, this researcher will first go to a local Butterfly Garden and observe and identify the butterflies and butterfly larvae. This researcher will count and derive an estimate of the larvae population in the area. For the following eight weeks, this researcher will observe and count or estimate the number of butterfly larvae on Sundays and Wednesdays, before spraying and again on Tuesdays and Fridays, after spraying. The city sprays for mosquitoes every Monday and Thursday night, unless it rains.

 This researcher's hypothesis predicts that the pesticides will have a terminal affect on the larvae, causing a severe depletion in the potential butterfly population. After repeated observation of the butterfly larvae, before and after spraying, this researcher concluded his hypothesis was correct. Indeed, the pesticide did harm the butterfly larvae. It actually killed nearly every one of the larvae in the garden. This researcher documented approximately three hundred less larvae after spraying, over eight week's time.

2003 - EV004

THE EFFECT OF CERIUM OXIDE NANOPARTICLES ON POLYCHLORINATED BIPHENYL (PCB) TOXICITY IN CULTURED BRAIN CELLS

Andrew Gordon Cook
Lake Highland Preparatory School, Orlando, Florida USA

Nanobiology applies engineering concepts nanotechnology to biological systems, providing novel opportunities to intervene in biological functions or disease processes. The present research merges the science of nanoscale materials with cell biology to intervene in polychlorinated biphenyl (PCB) neurotoxicity.

 An estimated one billion pounds of PCB has been released into the environment, making them the most widely distributed class of chlorinated pollutants. Because of their persistence, the impact of PCBs on fragile ecosystems and human health is of great concern.

 Mixed organotypic cultures of rat brain cells containing neurons, astrocytes, and microglia were exposed to different concentrations of PCB mixtures (Aroclor 1242 & 1254, 1ug-30ug/ml medium) for 24 hours. Live/Dead Assays with propidium iodide demonstrated that concentrations of PCB as low as 5ug/ml medium resulted in dramatic increases in cell death. Examination of neuronal signal transduction with the calcium indicator dye Fura-2, suggested PCBs altered neuronal calcium signaling in a biphasic manner. At high concentrations, basal and neurotransmitter-stimulated signaling was dramatically enhanced, suggesting an excitotoxic response. Pre-treatment of cultures with Cerium Oxide nanoparticles on day 10 of culture preserved normal neuronal signaling in PCB-treated cultures and blunted excitotoxicity. In contrast, at low concentrations of PCBs, calcium signaling was decreased or abolished. Effects of nanoparticles on low doses of PCBs are presently under study.

 Susceptibility of brain cells to low doses of PCBs seem to confirm many medical studies which report that exposure to low levels of PCBs causes significant mental decline in humans. Sensitivity of brain cells to these chemicals even after two decades of discontinued use points to still existing environmental dangers of PCBs. Present research indicates potential benefits of nanotechnology in resisting damage by this chemical pollutant.

Awards won at the 2003 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by the Environmental Protection Agency
Second Place Award of \$250 - Society of Environmental Toxicology and Chemistry

2003 - EV005

AN ANALYSIS OF THE EFFECT OF PHOSPHATES ON THE SCIOTO RIVER

Winifred Margaret Lo
Upper Arlington High School, Columbus, Ohio, USA

As of 2001, seventy-three percent of the Scioto River's pollution problem is caused by nutrient enrichment. The purpose of this experiment was to investigate how phosphates could harm the river by fueling the growth of harmful algal blooms (HAB), looking specifically at algal effects on dissolved oxygen (DO) and reactive phosphate. Water samples from the Olentangy River Wetland (ORW) were used to represent a "normal" water system. Both samples from the Scioto River and the ORW received 100mL freshwater algae and 100mL of a concentration of orthophosphate. These samples were observed over an eight-week period of experimentation. It was found that excess phosphates cause a delay and decrease in algal growth in the Scioto River. There was a direct relationship with the amount of phosphates and growth time to the pH levels of the water samples. This resulted in an increase in alkalinity 75% of the time. Also, reactive phosphate levels had a dramatic decrease in measurements during the growth period, and slowly increased over the period of death of the algal populations. No conclusions can be drawn from the results of the DO data, though it is believed the algae might decrease DO concentrations. In conclusion, the Scioto River is at risk of developing HABs. Unless the problem with nutrient enrichment is dealt with by the City of Columbus, HABs could potentially cause the death, extinction, or dangerment of several mussel, fish, and macroinvertebrate species that live primarily in the Scioto River system.

2003 - EV006

ANALYSIS OF HYDROGEN SULPHIDE IN SMOKE AND SEWAGE

Man Sum Chi
Hong Kong Chinese Women's Club College, HKSAR, China.

Hydrogen sulphide is a poisonous gas and can cause death in concentrations over 600 ppm. Its concentration in different samples of smoke and wastewater were analyzed and scrubbing solution tested to remove hydrogen sulphide from the wastewater.

 The contents of the samples were complex and their concentrations of H2S were very low, so the conventional titrametric and calibration technique were found to be inadequate; hence an ion selective electrode (ISE) Ag/Ag2S electrode was made, a standardized HS- solution was prepared and these, together with Gran plot were used to determine the concentration of HS- in smoke and sewage samples.

 It was found that mosquito coils and joss sticks did not produce any H2S. Direct smoke contained more H2S than passive smoke. The H2S level of the smoke from one cigarette was well below the lethal level. Industrial sewage of higher acidity had a higher H2S content than that of domestic sewage.

 The self-made Ag/Ag2S electrode is economical and provides a fast and effective means of detecting HS- ions. Very

low concentrations of H₂S (10⁻⁵ to 10⁻⁶ M) can be accurately found. Scrubbing solution can remove H₂S in wastewater. This is appealing from an environmental perspective, since the reagent iodine can be reused many times.

Investigation into the comparative H₂S toxicity levels of different brands of smoking products and the invention of a compact instrument for measuring H₂S concentration directly would be of value.

2003 - EV007

THE EFFECT OF AERATED BARLEY STRAW LIQUOR ON SELENASTRUM CAPRICORNUTUM A GREEN ALGAE

Elizabeth Jean Welsh
Proctor High School, Proctor, Minnesota

Eutrophication is a problem for many of Minnesota's lakes. Chemical algaecides have been used in the past. Selenastrum capricornutum is a green alga often used as a biological indicator. This study is to determine if concentrated and diluted barley straw liquor inhibits the growth of Selenastrum capricornutum, a green algae. Also if the rotting time and aeration of barley straw will affect the resulting liquors ability to inhibit algal growth. The hypotheses are that barley straw liquor will inhibit the growth of Selenastrum capricornutum and that the liquor concentration will affect the inhibition. Also, inhibition will be the greatest after two weeks of rotting for the non-aerated, but longer for the aerated buckets. Five plastic buckets with 10 grams of barley straw and one liter of 0.1% fertilized water were allowed to sit in a grow lab over five weeklong intervals. Fertilized and plain water were used as controls. One hundred and ten, 40 milliliter liquor samples were inoculated with one milliliter of algae and incubated in a grow lab for seven days. The chlorophyll a concentration was determined. The results show that barley straw liquor does significantly inhibit Selenastrum capricornutum with a p-value of less than 0.05 and that the rotting time and concentration of barley liquor does have and affect, p less than 0.001 using a Univariate ANOVA test. Aeration, however, did not have an overall affect on the inhibition of algae. Barley straw can be used to inhibit algal growth even in oxygen-limited situations.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV008

WHICH ENVIRONMENTAL FACTOR HAS THE GREATEST IMPACT ON DISSOLVED OXYGEN?

Sara K. Sullivan
Union Scioto High School Chillicothe, Ohio United states

Dissolved oxygen (DO) is the small amount of oxygen dissolved in water. DO is essential for the respiration of fish, aquatic animals, microorganisms and plants. To maintain a healthy aquatic ecosystem, an adequate amount of DO must be present in water. Naturally occurring environmental factors such as barometric pressure, water turbulence, water temperatures, and turbidity can influence DO levels. This project was designed to determine which environmental factor exerted the greatest impact on the DO levels in three local streams. It was hypothesized that turbidity would exert the greatest influence in the DO levels in water. Turbidity is a measure of the suspended solid matters that affects the clarity of water. High turbidity levels may cause bodies of water to lose their ability to support a healthy aquatic ecosystem. Twenty-one water samples were collected over a seven-week period from each of the three area streams. DO readings in each sample were calculated using a commercial water testing kit. Using a different testing kit, the turbidity levels of each sample were also calculated. Barometric pressure, water temperature, and surface water velocity were also gathered. A regression analysis was performed in order to determine the relationship between each variable and the DO in each sample. The analysis revealed that turbidity had the greatest impact on DO. As turbidity increased, the DO decreased. The long-term monitoring of DO in bodies of water can be a valuable tool in evaluating and maintaining the health of any aquatic ecosystem.

2003 - EV009

INVESTIGATING THE EFFECT OF INCREASE RAINFALL ON THE INHIBITORY EFFECT OF COMMON

PaCha Leena Yang
John A. Johnson Senior High School St. Paul, MN USA

Rhmanus cathartica, (Common buckthorn) as become one of the most prolific environmental problems in North America. Preliminary experimentation to confirm the allelopathic effect of Rhamnus catharica constructed tissue leachates, did not have an inhibitory effect in bioassays with Lolium multiflorum (ryegrass seeds), compared to the strong effect observed in tests ran in previous experiments (Yang/Her 2001).

Formulated null hypothesizes states that various environmental factors have an influence over the production of this allelochemical. The null hypothesis was formulated on the basis that there was a considerable change in one environmental factor, the amount of rainfall this year compared to the rainfall of previous years, where constructed leachates produced strong inhibitory affects. The formulated hypothesis states that Rhamnus cathartica shrubs' are affected by the increase in rainfall which may produce floods, resulting in less production of allelopathic compounds.

Biotic root and leaf materials were taken from these different environments. Aqueous extracts of the biotic tissues were used in bioassays with Lolium multiflorm (Annual ryegrass) seeds to determine their inhibitory affects.

Two potted sets of shrubs, each with different applications of water, represented last year's and this year's rainfall (being twice compared to the average).

The hypothesis and null hypothesizes of this project was supported in the findings when using One-way Analysis of Variance to analyze true random samples of the collected data (growth of ryegrass seeds) of over 3,000 petri plates. Understanding factors that may influence the production of inhibitory compounds in Common buckthorn shrubs may prove to help decrease the production of those chemicals.

2003 - EV010

ARE SEDIMENTS FROM THE SAINT LUCIE ESTUARY, FLORIDA, U.S.A. HAZARDOUS?

Sylvia Stella Stoffella

John Carroll Catholic High School, Fort Pierce, FL, USA

These experiments were conducted to assess heavy metals, nutrients, and chemical properties of the sediment located in the North and South Forks of the St. Lucie River, FL. These properties can affect marine life. Heavy metals, nutrients, and sediments can accumulate in a water body through run-off from housing developments and agricultural farms. Sediments samples (0-427 cm depth) were obtained from both forks. Each 15 cm section of sediment was analyzed for available nutrients (K, P, Mg, Ca, Mn, and Na), total and available heavy metals (Cd, Cr, Ni, Zn, Pb, and Cu), pH, and electrical conductivity (EC). Samples were replicated three times for heavy metals and nutrients and two times for pH and EC. pH of sediments from both forks was more acidic in lower depths and neutral to alkaline in upper depths. The sediment from both forks had EC that varied from 1.94 to 3.02 uS/cm. Available nutrients and Na concentrations varied within sediment depths. These nutrients may be released into water if sediments become disturbed (hurricanes, rainfall, etc.). The increased nutrient concentrations may alter pH, EC, and salt levels, and also increase algae blooms that can reduce dissolved oxygen levels. Sediments (in several samples) from both forks contained total heavy metal (Cd, Cr, Ni, Zn, and Cu) concentrations that exceeded the Threshold Effect Level (TEL), which is considered hazardous by the FL Dep. Env. Protection (FDEP). Each heavy metal had available concentrations that were lower than the total concentrations and never exceeded their respective TEL. The FDEP should take into consideration the available as well as total concentrations for heavy metals when establishing threshold levels for hazardous sediments.

2003 - EV011

THE IMPLICATIONS OF THE FLOW OF BACTERIA IN THE ATMOSPHERE ON TERRESTRIAL ECOSYSTEMS: A THREE YEAR STUDY

Timothy Calvin Borden

Canterbury School, Fort Myers, Florida, United States of America

African dust storms are acting as transport mechanisms for the flow of bacteria in the atmosphere. Annually, as much as one billion tons of African dust blows off the Sahara desert. I examined the potential environmental impacts of bacteria transported by these African dust storms on terrestrial ecosystems. After researching African dust storms and obtaining satellite images from the National Aeronautics and Space Administration, I found that African dust was impacting the Americas and the Mediterranean. I obtained air samples that were taken during African dust storms in St. Thomas, United States Virgin Islands and Erdemli, Turkey. I also obtained air samples during clear atmospheric conditions in the Caribbean. All of the air samples were collected by contacts at the United States Geological Survey. I isolated and identified bacteria by amplifying the 16S rDNA sequence of each bacterium using Polymerase Chain Reaction. The bacterial 16S rDNA was sent to the University of Florida for sequencing. Using the GenBank Blast search, I compared the isolated bacterial DNA to the DNA of identified bacteria. After identification, I reviewed the general characteristics, origin, and pathogenicity of these bacteria in order to predict their ecological repercussions. Bacteria isolated from all locations were compared and analyzed. The results suggest that there is an increase in the number of pathogenic bacteria with the presence of African dust. Additionally, trends emerged pertaining to the origin, genus, and phylogenetic relationship of these bacteria. The implications of bacteria, traveling through the atmosphere, represent a new frontier of environmental research.

Awards won at the 2003 ISEF

Honorable Mention Awards - American Meteorological Society

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

First Award of \$200 - Patent and Trademark Office / U.S.Department of Commerce / Patent and Trademark Office Society

2003 - EV012

BIOBASED GREASE: THE GREASE OF THE FUTURE AVAILABLE TODAY

Joseph Michael Searcy

Colquitt County High School, Moultrie, GA USA

In this project the researcher engineered a biobased grease (containing at least 51% organic products) with an extreme pressure (EP) agent to compare with conventional greases with toxic EP agents. The researcher wanted to find a more environmentally acceptable EP agent to use with an organic base oil and thickener to form a biobased grease equal to or better than conventional synthetic greases. The student developed a frictional wear tester to compare different greases and EP agents. After the researcher chose his best grease, it was then tested and compared to commercial petroleum grease. The research and recorded data prove the grease engineered by the researcher was the most desirable of the two greases. The outcome of these tests, and the benefits biobased grease has on the environment (it's cheaper, safer, and uses no petroleum) put it in the running as a grease of the future.

Awards won at the 2003 ISEF

Third Award of \$200 and matching grant to winner's school - Bureau of Reclamation/U.S. Department of the Interior

One all expense paid trip to London International Youth Science Forum, \$3,000 in savings bonds, \$300 from the Association of the United States Army, a gold medallion and Certificate of Achievement. - U.S. Army

First Awards of \$3,000 - U.S. Air Force

2003 - EV013

PHYTOREMEDIATION: A COMPARATIVE ANALYSIS OF THE CHINESE BRAKE FERN AND INDIAN MUSTARD ON UPTAKE OF ARSENIC FROM THREE TYPES OF SOIL

Kevin Michael Cronin

Sarasota High School, Sarasota, FL, United States

The purpose of this study was two-fold: 1) Which of two plants, the Chinese Brake fern (*Pteris vittata*) or the Indian mustard (*Brassica juncea*) accumulates the

highest amounts of arsenic (As) from arsenic-contaminated soils? 2) Does phytoremediation by the fern or mustard plant in arsenic contaminated areas with different soil types effectively remove arsenic from each of those different soil types?

 Young ferns and mustard seedlings were grown in three types of soil: fine sand (38 ppm As), silt (28 ppm As), and sediment (20 ppm As). The soils were collected from sites near wood treated with chromium, copper, and arsenic. A control fern and mustard were grown in soil with <5.0 ppm of arsenic. After 6 and 8 weeks, the plants were harvested and arsenic concentrations in the fern fronds and mustard leaves were determined by a graphite furnace atomic absorption spectroscopy and in the soils by inductively coupled plasma-atomic emission spectrometry.

 In all three soil types the fern accumulated arsenic at least 20 times more than the mustard. Arsenic concentrations in the fern ranged from 851 to 1770 ppm after 6 weeks and increased to 1435-2720 ppm after 8 weeks. Arsenic concentrations in the mustard ranged from 12 to 39 ppm after 6 weeks, and increased after 8 weeks to 15 and 19 ppm in the silt and sediment, but decreased to 36 ppm in the fine sand. In the six-week trial the fern in the sediment did not live. The control fern accumulated 14 ppm and the mustard accumulated 2 ppm. Arsenic concentrations increased in the plants, except for the mustard in fine sand, in arsenic-contaminated soils with higher arsenic levels. The data suggested that the high accumulation of arsenic by the fern, without manipulation, makes the fern best suited for remediation in all areas containing these types of soil.

2003 - EV014
SUSPENDED SEDIMENTS IN BURNS VALLEY CREEK PHASE III: EFFECTS ON TROUT HABITATS AND DIETS

Erik Dale Mundahl
Winona Senior High School, Winona Minnesota, USA

This study was designed to determine whether suspended sediment has a negative effect on trout in Burns Valley Creek. It was hypothesized that high suspended sediments would affect trout directly by eliminating habitats such as pools and coarse substrates needed for trout feeding, spawning, and resting, and that trout would be affected indirectly by depending heavily on caddisflies as an important food resource, even though these prey have been shown to be affected negatively by suspended sediments in previous years.

Turbidity, transparency, total suspended solids (TSS), and stream discharge were measured at three stream sites during a 5-month period and invertebrate availability and fish diet preferences were examined using Ivlev's Electivity Index (E). Fish survey data from 2000-2002 at the three stream sites were used to calculate a coldwater index of biotic integrity (IBI) which was compared to sediment load, cover area, TSS, and turbidity using regression analysis. In streams that had high suspended sediments, such as Main Burns Valley Creek, trout cover was significantly reduced (85-90%), deep (>60 cm) pools were lacking, and the coldwater IBI was significantly (P<0.02) negatively correlated with temperature, sediment load, TSS, and turbidity. Trout in this stream system selected against caddisflies (E=-0.30 to -1.00), but preferred the more tolerant crustaceans (E=+0.40). High suspended sediments at Main Burns Valley Creek are adversely affecting trout by depositing large quantities of sediment in pools, and creating an overall poor habitat. Consequently, the quality of the stream is reduced and the number of trout present is limited.

2003 - EV015
WHAT IS THE EFFECT OF HEXAVALENT CHROMIUM ON GREEN MUSSELS (PERNA VIRIDIS)?

Mary Elizabeth Hill
Center for Advanced Technologies, St. Petersburg, FL, USA

In 1999, the green mussel, Perna viridis, was first observed in Tampa Bay, Florida. The green mussel, being the nuisance and nonindigenous species that it is, coupled with its exponential reproductive abilities, has the potential to affect the Gulf of Mexico and the west coast of Florida much like the northern, fresh water zebra mussel (Dreissena polymorpha). The presence of a thriving non-native species within an estuary may cause several negative impacts on both the habitat and native species.

Lately, there have been several ideas as to how to solve the problem of the nuisance species, Perna viridis. One theory involves the possibility of harvesting the green mussel as a food source for humans. The green mussel is farmed, harvested, and marketed in Asia and even in Asian markets here in Florida.

 This project was designed to test the safety of the green mussel as a food source for the United States. A colony of mussels was collected from Tampa Bay waters and stabilized in a laboratory environment. A flowing water aquarium system was created using Tampa Bay water infused with Hexavalent Chromium at a higher level than normally present within gulf waters. The levels of Chromate were monitored using Chromium Indicator powder and a Colorimeter. Mostly, the mussels died off rather quickly, within little more than a week's time. And when tested, it was visually difficult to distinguish any difference between the control mussels' and the experimental mussels' Chromate levels. However, after the data from the Colorimeter was analyzed, it was clear to see that the exposed mussels had picked up at least a small amount of the Chromate.

2003 - EV016
REDUTION OF ESTROGENIC ACTIVITY THROUGH THE WASTE WATER TREATMENT PROCESS.

Tyer Lee Jorgenson
Buena High School, Sierra Vista, Arizona, United States of America

The purpose of the first part of this project was to find where in the Sierra Vista Waste Water Treatment Facility estrogenic activity is removed. Samples were collected from different points in the treatment process. Using the ES2 binding assay it was found there was a reduction in estrogenic activity where there was biochemical activity. The information was then compared to data from a treatment system in Tucson, Arizona. It was shown the new system in Sierra Vista removed 96% of the estrogenic activity compared to 77% removed in the conventional system in Tucson. The second part of the project aimed to determine by which mechanism the amount of estrogenic activity was reduced during soil percolation, physical or biochemical. Soil percolation was simulated with half meter columns filled with soil. Recharge water was collected and run through the column and the effluent was collected. The column influent was then poisoned and run through the column. After the biochemical activity was stopped with the poison more poisoned recharge water was run through and the effluent was collected. Once again, using the binding assay, it was shown the biochemical activity in the soil is responsible for removing the estrogenic activity in the water with a p-value of .001.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV017

WILDFIRE STERILIZED SOILS AND RHIZOSPHERE RECOVERY

Michael Richard Olson

Gold Beach High School, Gold Beach Oregon, USA

The intensity of wildfires may kill standing vegetation and damage the soil rhizosphere. Many people believe this causes soils to be 'sterile'. Forest microbiologists feel that total sterility of wildfire soils is not plausible in a forest environment. The goals of my project included:

 - determine if rhizosphere life was present or absent in burned soils

 - determine the soil nutrients in three levels of burned soils

 - determine if biomass production in revegetated soils was enhanced by mycorrhizal inoculum

Three sites with differing burn intensities (low, moderate, severe) within the Biscuit Fire zone were selected for study. All were located on Dothan sandstone within the same drainage basin. Presence of rhizosphere life was determined by measurement of soil respiration rates using a static alkali absorption technique and isolation of soil macroinvertebrates using Berlese funnels.

 Soil tests included pH, nitrates, phosphates and organic matter. Revegetation of soils in the Biscuit Fire zone involved seeding with native grass seed and treatments with mycorrhizal inoculum. Tests were run to determine if such treatments enhanced seed germination rates or biomass production.

 Results indicate a potential decline in productivity on moderate and severely burned soils in the fire zone.

2003 - EV018

A COMPARISON OF WATER QUALITY IN BEAR AND BUCK CREEK IN RELATIONSHIP TO PHOSPHATES, DISSOLVED OXYGEN, AND TURBIDITY

Dawn Nicole Dietrich

Eastern High School, Pekin, Indiana, United States

The purpose of this project was to determine the water quality of Bear Creek and Buck Creek by testing and comparing dissolved oxygen, turbidity, and phosphates. It was hypothesized that differences in water quality could be determined to due location. Testing was completed using a homemade turbidity tube, a T1-83 calculator, a dissolved oxygen probe, and a colorimeter that was purchased from Vernier Software and Technology. Five sites were selected from two creeks in Southern Indiana using a topographic map and were tested five times each. Knee waders and gloves were worn at all times while sampling the water in both creeks. The geographical location of the sites were determined by using an Etrex Global Positioning System from GARMIN. Water was collected by submerging baby food jars under the water. A Vernier dissolved oxygen probe and temperature probe were dipped into the jar to collect the data. Turbidity was tested by pouring water into the turbidity tube until the white and black disc in the bottom of the tube could not be seen. The water samples were then brought back to the school lab in a cooler and placed in the lab's refrigerator. Phosphates were tested by using a colorimeter from Vernier, along with PhosVer 3 powder pillows and a Phosphate Standard Solution from Hach. The data was recorded and statistically analyzed using Student's t-test; none of the results were found to be significant. Based on the data collected, there was no difference in water quality due to location. This suggests that the hypothesis was not supported.

Awards won at the 2003 ISEF

Tuition scholarship of \$5,000 per year for 4 years for a total value of \$20,000 - Indiana University

2003 - EV019

CPR FOR SPARTINA ALTERNIFLORA

Marshall Richard Johnson

Houma Junior High School, Houma, Louisiana, 70361, USA

PROBLEM: Can brown marsh(Spartina alterniflora) be revived?

HYPOTHESIS: Adding fresh water can revive Spartina.

PROCEDURE: Samples of marsh grass were collected at GPS coordinates

N 29.21.574 and W 90.36.567. Plant samples were placed in plastic cups and massed using a triple beam balance. Three trials were conducted simultaneously. Three plants received no water, three plants received fresh water, three plants received 11 parts per thousand saltwater, three plants received 16 parts per thousand saltwater, and three plants received 22 parts per thousand saltwater. Plants were placed under a Wisconsin Fast Plant light bank and fluid levels were checked and maintained daily. Every seven days the plants were massed and those results were recorded in the log book along with various observations. Salt solutions were prepared with Instant Ocean powder and salinity levels were measured using a refractometer. This entire procedure was conducted over a period of six weeks.

RESULTS: Plants exposed to 22 parts per thousand saltwater showed the greatest percentage of mass increase. Plants exposed to freshwater had the greatest number of new sprouts.

CONCLUSION: Exposure to any type of water produced new growth with the greatest mass increase occurring in plants treated with 11 parts per thousand saltwater. The greatest new growth (new shoots) occurred in freshwater.

APPLICATION: According to my experiment, the salinity level that would revive marsh grass the best after a hurricane would be 22 parts per thousand. So, one could grow Spartina alterniflora in a greenhouse using this salinity solution and then successfully replant it in marsh areas that were depleted.

2003 - EV021

NUTRIENT RUN OFF - HOW CAN SWAMP PLANTS IMPROVE OUR WATER?

Andrew James Stewart

Karabar Distance Education Centre, Queanbeyan, NSW, Australia

The study of a plant's ability to remove nutrients such as nitrates is vital to the design of artificial wetlands that reduce pollution in waterways. Clean water is

becoming one of our most rapidly depleting resources.

The conductivity technique was found to be a reliable method to determine the nitrate level in water and to measure a plant's ability to remove this nutrient.

The wetland plant used for this study was carex appressa which has a wide habitat, from the temperate areas of Australia to tropical New Caledonia.

From a series of tests an average 4.8 kilogram plant (green weight) reduced a 10 litre solution of 410 parts per million ammonium nitrate to 135 parts per million in 5 days (55ppm per day). After five days, the consumption of nitrate abruptly dropped to 4 parts per million per day. Initially the plants were rested for 5 days in fresh water and it was found that this cycle could be repeated. However, a further trial showed that the rest period was not required.

For the conditions of this experiment, it was found that an increase in the starting concentration of Ammonium Nitrate resulted in a larger reduction of Ammonium Nitrate.

The results suggest if water is stored for more than five days, the nitrate uptake will drop by a factor of 14. A wetland system that maintains a high level of nitrate would theoretically require one fourteenth of the area of land to treat the same amount of nitrate.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV022

THE USE OF MODIFIED ALUMINA REFINERY RESIDUES (BAUXSOL TRADEMARK) FOR ACID SULFATE SOIL REMEDIATION

Estelle Lela Weber

Wollumbin High School, Murwillumbah, NSW, Australia

Acid Sulfate Soils (ASS) form when pyrite and iron monosulfides in soil are exposed to atmospheric oxygen and moisture, oxidising to produce sulfuric acid, thereby lowering the soil pH and increasing the concentrations of some potentially hazardous trace elements. These soils, which affect about 100,000,000 ha of land worldwide, are highly unsuitable for plant growth and acid water runoff can cause fish kills in waterways.

Previous work has shown that Bauxsol can neutralise acid, trap potentially hazardous trace elements, and improve nutrient retention in sulfidic mine wastes. This study is designed to determine whether similar improvements in plant growth can be achieved on ASS using Bauxsol.

Pot trails using ASS from a severely acid scalded soil showed, for the first time, that the addition of as little as 10% Bauxsol resulted in similar growth of wheat to that achieved in pure potting mix; few seedlings sprouted in the untreated ASS and most of those died shortly after germination. Large scale field trails, involving vegetables and native shrubs, showed that the addition of Bauxsol had similar benefits, even for test soils contaminated with monosulfides, to increase acid production rates. The findings of this study indicate that the use of Bauxsol provides major benefits for ASS revegetation. Such use of industrial residues is an excellent example of "Green Technology" that could help solve many global environmental problems.

Awards won at the 2003 ISEF

First Award of \$1,000 in Soil - American Society of Agronomy

Second Award of \$1,500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV023

THE CONCEPTION OF DOUBLE SAFETY FERTILIZER AND ITS EXPERIMENTS

Xiaofeng Liu, Fuzhou No.1 Middle School

Fuzhou, Fujian, China

Chemical fertilizers cause a serious problem of the environmental pollution and human health endangerment. For example, on producing super-phosphate, the by products (hydrogen fluoride, arsenic and residual acid, etc.) are very harmful. Using large amount of chemical nitrogen fertilizer causes accumulation of nitrate and nitrite in crops especially in vegetables, and nitrite is one of the dangerous factors for inducing cancer. Chemical nitrogen and phosphorus application also bring water pollution seriously. Hence it is necessary to invent a new kind of fertilizer, which reserves the efficiency of fertilizer, but without pollution to environment and jeopardy to human health. It is called Double Safety Fertilizer (DSF), or New Fertilizer Chain (NFC) Fertilizer.

In order to get the Double Safety goal, rock phosphate is ground into extra fine powder (1-10 micron) to substitute super-phosphate, and mixed with dry powder of Azolla Plant which has strong nitrogen fixing capacity, and also some potassium chloride to form granular fertilizer (DSF).

To evaluate the efficiency of DSF, experiments including six groups of crops: three of hollow greens, one of rice, one of Chinese cabbage and one of peanuts applied with DSF were compared with chemical nitrogen, phosphorus and potassium at the same rate. The yields were calculated, and the analysis of nitrogen, phosphorus and nitrite content in crops were also conducted.

Results showed that DSF can substitute chemical nitrogen, phosphorus and potassium at the same rate. It also significantly reduces the accumulation of nitrite in vegetables (more than 80%). So it attains the goal of Double Safety. Furthermore it has also a great possibility for industrial production, which will be further investigated.

2003 - EV024

MERCURY ANALYSIS OF COAL MINING LEACHATES IN UNRECLAIMED AND RECLAIMED LOCATIONS IN SW INDIANA USING LOW LEVEL DETECTION AND MULTIPARAMETER RELATIONSHIPS

Aaron M Ritter

Bedford-N.Lawrence High School, Bedford, IN 47421 USA

Elemental mercury occurs naturally in coal, and when burned, is released into the atmosphere. Most mercury studies focus on atmospheric deposition from precipitation. Mercury in waterways converts to methylmercury and enters the food chain. This researcher studied mercury leaching from surface mining in Pike County, Indiana. The problem was determining how much mercury leached out of old piles and pits and entered streams. In this study, streams were sampled from reclaimed areas, unreclaimed, and a control unmined watershed. Other parameters included mined area, watershed size, stream discharge, pH, total suspended solids, total dissolved solids, and conductivity. Mercury was analyzed by this researcher with supervision at STL Labs, N. Canton, Ohio. The

technique uses cold vapor atomic fluorescence to detect to nanograms/L in water and sediments. Water samples were analyzed for total mercury and filtered mercury. Results showed sediment Hg loads up to 12x water mercury(35ng/L vs 3ng/L). When discharge increased, mercury levels increased in 80% of the streams. There is also correlation of mercury(especially filtered) to total dissolved solids. Surprises were that the control site had lowest TDS but most mercury, reclaimed mine sites had higher mercury than unreclaimed sites, and mercury levels in water were close to other state streams. While mercury levels were still lower than the E.P.A. standard(0.002mg/L), some sites exceeded the National Toxics Rule limit for wildlife. In conclusion, the coal spoils do not generate acute levels of mercury, but do generate long-term chronic exposures for wildlife.

Awards won at the 2003 ISEF

Honorable Mention Awards of \$50 - Society for Mining, Metallurgy, and Exploration, Inc.

2003 - EV025

WATCH THE BURN: PROMOTING FIRE RESISTANCE IN GRASS LANDSCAPES

Kendra Rose Kailey

Merino High School; Merino, Co 80741; USA

In 2002, 71,160 fires burned about 7.1 million acres, nearly doubling the ten-year average. The drought in the U.S. has been increasing and fires are ravaging the dried fuel. The purpose of this project is to find out if fertilizer, detergent, or a surfactant/wetting agent would reduce fire damage to Sand Drop Seed grass and a homeowner's landscape. There were five plants per experimental group. A 7% solution of the three substances was made. Each experimental group received 250 ml of each solution. The hypothesis is that the surfactant/wetting agent will burn less than the control and the other two experimental groups. The combustion of the grasses was measured with a burn test. Photosynthesis rate was measured with a carbon dioxide analysis test. Moisture content was also determined. The heat content of the vegetation was measured with calorimetry. The grass receiving the detergent treatment was the least combustible. It burned 8% less than the control grass. The detergent group had the highest photosynthesis rate of 0.6 ppt/minute, which was 33% higher than the control. The highest moisture content was the control grasses at 76% with the surfactant/wetting agent and detergent groups next at 73% and 72% respectively. The calorimeter test was inconclusive. Because the detergent treatment had the highest photosynthesis rate at 0.6 ppt/minute, retained 72% of its moisture, and had a lower burning percent, it would appear that the detergent might be an application to be used by a homeowner to protect their property from fire intensity and damage.

2003 - EV026

PHYTOEXTRACTION: A PLANT-BASED ENVIRONMENTAL BIOTECHNOLOGY

Gabriel Centray Hemphill

Arkansas School for Mathematics and Sciences, Hot Spring, AR, USA

Phytoextraction is an emerging biotechnology that employs the use of higher plants for the remediation of contaminated environments. Both fundamental and applied research has unequivocally demonstrated that certain plant species possess the the genetic potential to degrade, metabolize or immobilize a wide range of contaminants.Despite this tremendous potential, phytoextraction is yet to become a commercial technology. Progress in the field is precluded by limited knowledge of basic plant remedial mechanisms.In this project, the process of biological remediation was tested using the plant species, liquidambar styraciflua, or sweet gum. Thirty sweet gum trees were obtained and were divided into two experimental and one control group. The plants were then treated with high concentrations of lead, iron, and copper. One group was treated with 0.25 M of metal solution and the other with 0.5 M. It was hypothesized that the process of phytoextraction would work with the liquidambar styraciflua plant species, some metals would be preferred over others, and that metal concentration would have a perceptible influence on uptake capacity in the plants. With extensive experimentation these hypotheses were supported through harvesting of various plant parts of the trees and chemical analysis using corresponding chemical testing kits. By measuring how much of the metal the plants absorbed, it can be determined whether the plants are effective hyperaccumulators or not. With this in mind, future research will be made in testing whether other plant species in Arkansas can extract heavy metals from the soil.

2003 - EV027

AN ECOLOGICAL SURVEY OF DICTYOSTELID POPULATIONS IN THE CIBOLA NATIONAL FOREST OF NEW MEXICO, USA

Jeremy Micah Denlea

St. Pius X High School, Albuquerque New Mexico, USA

Dictyostelid cellular slime molds (dictyostelids) are single-celled, eukaryotic, phagotrophic bacterivores usually present in terrestrial ecosystems. A general observation is that dictyostelid diversity and geographic distribution decreases as latitude increases. No ecological survey of dictyostelids has ever been performed in New Mexico. The goals of this project are to conduct the first survey of dictyostelids west of the Mississippi River, to categorize these dictyostelids, and to document their geographic distribution.

 I hypothesize that the number of dictyostelid species found in the Cibola National Forest will be as expected for a location at 35°N latitude. Also, that the geographic distribution of dictyostelid populations in the Cibola National Forest will not be significantly different from an existing survey of North Carolina's dictyostelid populations, also at 35°N latitude.

 In the final analysis, my hypotheses were only partially correct. There were nine separate species of dictyostelids identified in the Cibola National Forest (Dictyostelid aureo-stipes, D. discoideum, D. giganteum, D. lacteum, D. minutum, D. mucoroides, D. purpureum, D. septentrionalis, and D. sphaerocephalum). The number of dictyostelid species found was significantly less than expected for 35°N latitude. There was not a significant difference in the diversity of the Cibola National Forest's dictyostelid populations compared to North Carolina's dictyostelid populations.

Awards won at the 2003 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV028

DNA DAMAGE CAUSED BY UVR

Marla Maxine Valentine

Murphy High School, Mobile, AL, United States of America

This project attempts to demonstrate the effects of UVB radiation on DNA. UVB radiation damage to DNA is an increasing problem because of the depletion of the ozone layer. UVB rays cause the DNA structure to break apart. A common marine alga was used to demonstrate this effect. Enteromorpha algae are native to estuaries. It is known as either enteromorpha intestinalia or enteromorpha compressa. Samples of algae were exposed to direct sunlight with and without UVB radiation. Glass plates were used to block UVB radiation . The controll sample was kept in darkness to limit exposure to UVR. DNA was extracted from samples of algae and visualized on an agarose gel. The effect of UVB radiation wass seen on small, broken pieces of DNA as opposed to longer more complete strands of DNA in control samples. With the ability to determine the safest level of expousure.

2003 - EV029

THE EFFECT OF DIFFERENT TYPES OF ANIMAL WASTE ON THE COMPOSITION OF BIOGAS

Sherri Michelle Cook

James Wood High School, Winchester, Virginia

Waste from sheep, horses, and cows were placed in simple batch anaerobic digesters for a week in order to collect biogas in balloons, with natural gas being the control of the project. The biogas was then analyzed using a Gas-Chromatograph Mass-Spectrum and an Infrared Spectrophotometer. These instruments provided the data for the experiment. The horse waste produced biogas that contained the greatest amount of carbon dioxide and methane. The cow biogas contained the second most amount of methane and the least amount of carbon dioxide. The sheep biogas contained insignificant amounts of both methane and carbon dioxide. Horse biogas would be best if separated, using the carbon dioxide as coolant and the methane as a car fuel. Cow biogas would not have to be separated to be used as a cooking or heating source, but could be used as a vehicle fuel if the methane is purified. The sheep biogas does not have a plausible future as a fuel. The purpose of this project was to more specifically analyze biogas and to determine why or why not the biogas was flammable in my previous project. By determining the composition of the biogas, a better type of waste can be decided on and also a better application of the waste can be decided, such as using the biogas for the methane as a fuel, or for the carbon dioxide as a coolant.

Awards won at the 2003 ISEF

\$10,000 per year scholarships, renewable annually - Florida Institute of Technology

2003 - EV030

PLANTS THAT PURIFY

Michael John Archuleta

Branson School, Branson, CO, USA

I did this project because I was interested in plants and water contamination. I knew that plants give us oxygen and purify the air. Therefore, I wanted to show that plants purify water.

 I used Philodendron and Dieffenbachia plants to compare the levels of purification. My control (tests 1A and 1B) included 2000 mL of pond water without a plant. Tests 2A and 2B included 2000 mL of pond water with the Philodendron plants. Tests 3A and 3B included 2000 mL of pond water with the Dieffenbachia plants. I used three containers for each test. All tests ran at the same location, length of time, and temperature. The results for my control showed no change in bacterial levels, nor in nitrate and nitrite levels. Tests 2A and 2B with the Philodendron plants showed a significant decrease in levels of coliform bacteria, nitrates decreased 50% and nitrites were no longer present. Test 3A and 3B with the Dieffenbachia plants indicated that lower levels of bacteria were present, but the nitrate and nitrite levels decreased by the same amount as the philodendron plant tests.

 Based on my results the hypothesis is correct in that the coliform bacterial levels and the nitrate and nitrite levels decreased after seven days. Using tests A and B, I was able to observe that the smaller Philodendron plants had higher amounts of coliform bacterial levels when compared to the larger Dieffenbachia plants.

2003 - EV031

LUBRICANTS: FINDING THE IDEAL VISCOSITY OF A RENEWABLE OIL

Heidi Sue Schmidt, Beaumont School

Cleveland Heights, Ohio, USA

The purpose of this experiment is to expand on a previously proven problem and determine the ideal viscosity of a renewable oil. In doing so, its performance as a lubricant can be compared to that of a petroleum-based oil with a similar viscosity to further prove evidence that reveals the possibility of renewable oils replacing petroleum-based oils.

 A variety of renewable oils were tested using a viscosity testing setup that allowed the oils to drip into a graduated cylinder using a specific amount of pressure until the desired volume was obtained and the time was recorded. By obtaining values for all the variables in this experiment, viscosities were determined by using the Hagen-Poiseuille equation. Since Canola oil had previously been determined to be the ideal oil, its viscosity was compared to known viscosities of petroleum-based oils. It was determined that a 10W oil had a similar viscosity and was then tested under the same conditions as the Canola oil had been in the previous experiment.

 Similar temperatures, visual analyses, and low diameter changes all prove the similar lubricating characteristics that a 10W oil and Canola oil share. From the data collected, it can be concluded that the ideal viscosity of a renewable oil when used as a lubricant is between 4cSt and 6 cSt at 100 degrees Celsius. Lastly, the results of this experiment could prove beneficial to the environment and the country's economy as the thought of replacing petroleum-based oils with renewable oils appears more and more realistic.

2003 - EV032

THE EFFECT OF PARTIALLY PROCESSED SEA WATER USE ON THE REDUCED WASTE OF FRESHWATER

Theodore Duke Hellmann

James W. Robinson, Jr. Secondary School, Fairfax, VA, USA

Freshwater is becoming an increasingly precious commodity in all nations. Desalination of water is a practice generally expensive in terms of both power and money. Despite this, all but 17.4 percent of the water consumed by American households is essentially used once and thrown away. If this water is just wasted, why not simply use what is already essentially waste water? Salt water refined from sea water was tested in dishwashing and clothes washing, high-waste household activities, to see if there was an intolerable difference in performance. Dishwashing was found to be completely compatible with the use of partially processed salt water and clothes can be washed but not rinsed in it.

2003 - EV033

DIAGNOSTICS AND MAPPING OF THE BIOGAS FLOW FROM THE SURFACE OF THE REMEDIATED LANDFILL SITES

Ivan U. Kouzel

Students' Ecological Center, Minsk, BELARUS

Field studies at the 23-old remediated landfill site showed a lot of areas with the absence of vegetative cover ("bald spots"). Besides, there was especial red film on the bottom side of the overlying stones.

The purpose of the study is to find the ways to minimize the contribution of the landfill sites to environmental pollution.

I have chosen an experimental plot with an area of 600 m2; then I made surveying of heights and estimated biogas flow from the soil surface. When detailed picture was received, I chose typical site and fulfilled a soil pit.

Results and conclusions. It was found out that the soil profile at the remediated landfill sites contains the next arrangement of soil layers: upper black humus-like layer under the vegetative cover; specific "red layer", with the function of methane consumption and gley laying on the contact with the waste mass. I've also described correlation between soil layers. Biogas mappings showed that the areas with the most intensive biogas flow and the "bold spots" are fair.

Applications: Diagnostics and mapping of the biogas flow from the surface of the remediated landfill sites will allow to find the sites for biogas wells location. Biogas pumping from the landfills will improve growth of plants and protect atmosphere from biogas components. Besides, pumped biogas can be used.

Further experiments: we plan to continue monitoring at the landfill site and to create air filters in terms of the "red layer".

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV034

THE EFFECTS OF SATURATING RAW TREATMENT WATER WITH CARBON DIOXIDE TO ASSIST THE CHLORINE TREATMENT PROCESS - PHASE II

Terry Lynn Sansing

Mills University Studies High School, Little Rock, Arkansas, U.S.A.

The purpose of this project was to determine if the addition of carbon dioxide (CO2), in either gaseous form (CO2) or in calcium carbonate would assist the chlorine in treatment water in destroying the microorganisms present in the water. It was expected that the CO2 would assist the chlorine, but in different ways according to which form was used. The pure gas could lower the pH of the water, while decreasing the amount of oxygen present, and therefore counteract the aerobic, high pH environment bacteria. The calcium carbonate would also lower the oxygen levels in the water, while producing the exact opposite effect on the pH, destroying the aerobic acidophiles. The 33% saturation carbon dioxide gas resulted in an average plate count of 3.75 bacterial colonies, or 5.0 bacterial colonies if anomalous readings were removed. The 66% saturation of gaseous carbon dioxide resulted in a count of 30.75 colonies, or 41.0 colonies if anomalous readings are removed. The 100% gaseous saturation resulted in 0.0 colonies being present in all plates. On all of the calcium carbonate plates, 33%, 66%, and 100% saturation, there were TNC (Too Numerous to Count) colonies, meaning 100+ present on the plate.

2003 - EV035

DROUGHT AND WASTEWATER RECYCLING IMPACTS ON DISINFECTION BYPRODUCT FORMATION AND SPECIATION

Jonathan David Ramaley, Warwick High School

Newport News, Virginia, U.S.A.

The objective of this experiment was to determine if using reclaimed wastewater to supplement drinking water reservoirs would increase the levels of disinfection byproducts (DBPs) in disinfected water during severe drought and to compare those results to previous studies from non-drought periods. Studies have shown that certain DBPs may be associated with spontaneous abortions, certain cancers and other health concerns.

 This experiment had two groups: Group 1 was 50% reclaimed wastewater and 50% reservoir water and Group 2 was 100% reservoir water (the control). These groups were allowed to stand one week in a greenhouse to simulate reservoir storage. Both groups were split into six trials each and sodium hypochlorite (chlorine disinfection) was added to each and stored for three days. It was hypothesized that the brominated species would increase during drought periods due to a higher salt content in the water, and that wastewater recycling would not affect trihalomethane formation during drought. After three days, samples were taken to the Newport News Waterworks lab for trihalomethane (THM) analysis using gas chromatography. Results showed the brominated species increased during drought compared to non-drought periods. Wastewater recycling had an effect on THM formation, increasing the brominated species significantly at probability levels ranging from 0.01 to 0.001. Total THM formation potential also increased significantly at a 0.05 probability level during drought. These brominated compounds are the species believed to be associated with adverse health effects, indicating that wastewater recycling could increase health risks, particularly during droughts.

2003 - EV036

STORY OF A RIVER : WATERSHED ANALYSIS AND MANAGEMENT

Eddy Leal, Academia del Perpetuo Socorro
San Juan, Puerto Rico

Increased changes in land use have raised concern that some watersheds may be irreparably harmed, to the extent that they will no longer be suitable for fishing and swimming. The Bayamón River, which contains rural and urban areas, was divided into five stations, in order to establish a water quality-monitoring program. The methods used to analyze water quality were total coliforms, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, total petroleum hydrocarbons, temperature, total suspended solids, color, and turbidity. Results were analyzed statistically using Barnett's test for outliers, t-test ($t \leq 0.05$), Pearson's coefficient of correlation, and Trendline. Additional samples are being collected at the mouth of the river; they are being tested for total coliforms, dissolved oxygen, total suspended solids, and turbidity. Analyses of results thus far indicate that the river studied complies with the chemical and physical criteria established by the Puerto Rico Environmental Quality Board (PREQB), but not for total coliforms. No association was found between land use and the quality of the river This was possibly due to confounding factors as increased stream flow and the small length of the river. The vegetation found at the periphery of the river possibly serves as a natural barrier against sediments and pollutants. The additional samples being collected at the ocean coast are to determine whether the river is affecting the quality of the ocean coast. These findings should aid in creating awareness of the importance of maintaining strict analyses and management in the water resources.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV037

HOW DOES GAMMA RADIATION AFFECT NITROGEN FIXATION, RESPIRATION & FERMENTATION?

Laura Muna
Wisconsin Career Academy, Milwaukee WI

Nitrogen fixation is the most important of cycle of matter. I wanted to study the effect of gamma radiation on nitrogen fixation which forms as a result of a nuclear explosion, leakage or experiment. I decided to use clover plant and rhizobium bacteria while I set the experiment. That is because these two organisms live together (mutualism). Rhizobium bacteria is the best model to effect of γ - radiation because of rhizobium nodules on the roots of clover plant. To observe the effect on nitrification I completed the experiment in 3 parts. First I exposed the inoculated clover seeds and regular clover seeds to 500, 1000 , 5000, 10000, 20000, 40000, 60000, 80000 , 100000 , rad of radiation . All inoculated seeds were planted. Then %50 of the of the regular clover-seeds were inoculated with rhizobium and planted, rest of the seeds used as control group for both sets and planted to vermiculate as soil and fertilizers with no nitrogen. Chickpeas and the yeast cells are also exposed the same dose of radiation given above. As a result, up to 20,000 rad bacteria survived and the nodules decreased, but after 40,000 rad the bacteria were dead and there were no nodule formation observation. I have also observed similar effects on aerobic respiration and fermentation, as well which is indicating that nuclear reactions releasing gamma rays destroy the nitrogen balance in the nature, also it affects the percentage of oxygen and carbon dioxide by decreasing the number of plants.

2003 - EV038

TWO POTENTIAL PHOSPHORUS REMEDIATION STRATEGIES UTILIZING OKLAHOMA FODDER CROPS AND WTR TREATMENT

Chelsea Nicole Zdansky
Moore High School, Moore, Oklahoma, USA

The purpose of this project was to determine if there is an environmentally safe way to remove phosphorus from the soil to prevent water contamination. In Oklahoma one of the most detrimental problems is the phosphorus contamination of rivers due to chicken litter. Two methods were used in this project. In the first method cold season native crops were grown in soil that was contaminated with chicken litter. The plants were tested when they were forty days old and eighty days old for phosphorus content. The phosphorus content of the soil was also tested at the same time. The soil was tested using the water soluble test and the Mehlich III test. The plants were trimmed to one and a half inches. Then they were burned to ashes, dissolved, and boiled in nitric acid. The plant tissue samples were diluted and tested using the spectrophometer. The second method involved water treatment residue(WTR). The WTR was applied in varying percentages to 100g of soil contaminated with chicken litter, and water was applied weekly. The WTR was tested for phosphorus content using the water soluble test and the Mehlich III test. The results showed that my hypothesis was correct, and both of the methods worked and removed the phosphorus from the soil. However, the method using the WTR would be more effective due to the fact that it takes less time than the plants. Other plants may be used such as warm season crops or common grasses to see if any remove the phosphorus more effectively.

2003 - EV039

THE DEVELOPMENT OF AN ENVIRONMENTALLY FRIENDLY ENZYME BASED ANTIFOULING SYSTEM

Vaishali Kiran Grover , Miami Coral Park Senior High School
8865 S.W 16th Street, Miami.FL 33165. USA.

The purpose was to determine if toxic chemicals such as Tributyl tin(TBT) can be replaced by environmentally friendly enzymes, papain and bromelain to formulate antifouling coatings for marine vessels. I hypothesized that an environmentally friendly antifouling system can be formulated using enzymes,papain and bromelain,instead of toxic chemicals like TBT (Tri Butyl Tin).Procedure: 1L 10%papain or bromelain containing paint was prepared by dispersing 119.996 g enzyme in 900.804g epoxy coating.1L paint with 5%(bromelain+papain) was prepared by mixing 500 ml each of paints containing 10%Papain and

10%bromelain. This paint was mixed with 500 ml epoxy to obtain 2.5%(bromelain + papain) paint.Enzyme paints were incubated at 55°C for 48 hours to test stability. 4 ml hardener and 16 ml enzyme-paint were mixed. One mil film of mixture was applied on glass plate with bird film applicator and cured film was tested for hardness. 3 panels were coated with each enzyme-paint and Trinidad1675 antifouling coating. These panels were immersed at 30 cm depth in lake. Fouling was recorded each month. Each month 3 new panels coated with epoxy#55H027619 were replaced and immersed for fouling census. Analyzed data revealed paint containing 5%(bromelain +papain) was most effective with overall performance 95% , 10%bromelain was 94%, 10%papain was 85% and 2.5% (bromelain+papain) was 81% compared to control Trinidad1675 of 80%.Therefore environmentally friendly natural enzymes were successful in replacing toxic ingredients in marine antifouling systems. I propose to further investigate environmentally friendly endo-exo peptidases derived from Aspergillus oryzae.

Awards won at the 2003 ISEF

Second Award of \$300 and matching grant to winner's school - Bureau of Reclamation/U.S. Department of the Interior
Awards of \$5,000 - Intel Foundation Achievement Awards
Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency
Honorable Mention Award of \$100 - U.S. Coast Guard
Scholarship award of \$8000 for original research in an important Naval-relevant scientific area. - U.S. Navy & Marine Corps
UTC Stock - United Technologies Corporation

2003 - EV040

DAPHNIA DRUGGED? A STUDY OF THE EFFECTS OF PHARMACEUTICAL COMBINATIONS ON DAPHNIA MAGNA

Melissa Ann Barber, DeKalb High School
Waterloo, Indiana, United States

This project was developed to determine whether certain pharmaceutical combinations cause mortality in Daphnia magna after seven days. Six medications were used including atorvastatin, fluoxetine, erythromycin, trimethoprim, acetaminophen, and ibuprofen. The daphnia were exposed to different concentrations of the combinations including 10 ppb, 50 ppb, and 100 ppb.

 Four daphnia were placed in a beaker. For each trial of a combination, there were four beakers. The first was a control. The second was a 10 ppb beaker. The third was a 50 ppb beaker. The last beaker contained 100 ppb concentrations. Daphnia were left in these beakers for seven days and checked every other day.

 A porbit analysis was conducted to find the LC50 values. This shows what concentration will cause 50 percent mortality. All possible combinations were tested once in a preliminary round of tests. Three combinations were chosen to be tested further based on these preliminary results. These combinations all had LC50 values less than 10 ppb. They included erythromycin and fluoxetine, erythromycin and ibuprofen, and trimthoprim and ibuprofen. Three more trials were run with these combinations, so there was a total of four trials for each. Anova statistical tests showed no measurable difference, which leads to the conclusion that the combinations do have an effect on the mortality of the daphnia, but one combination does not effect the mortality more than another.

2003 - EV041

THE EFFECTS OF LEAD ON BIOLOGICAL MODELS: ENZYME ACTIVITY, CELL MEMBRANE PERMEABILITY, AND CELL GROWTH.

Kristen Elaine Fenska
Miami High School, Miami, Oklahoma, USA

Years of mining for heavy metals have resulted in neglected mineshafts and towering chat piles that are major sources of water contamination all over the United States. The Tar Creek Basin in Northeastern Oklahoma and Southeastern Kansas is one of the many areas globally with high lead levels affecting the health of people around it. Research suggests that lead toxicity leads to severe medical problems including brain damage, Alzheimer's, heart disease, and damage to the body's ability to detoxify. The EPA indicates that no level of lead intake is safe. This project focuses on the biomedical effects of low-level lead on biological models. Three systems were tested: enzyme function, cell membrane permeability, and cell growth. It was hypothesized that exposure to low-level lead would inhibit enzyme function, increase cell membrane permeability, and inhibit cell growth. Lead dilutions (1.25, 2.5, 5, 10, and 20 ppb)were used to test for the ability of catalase, a common detoxifying enzyme, to catalyze hydrogen peroxide. The effects of lead dilutions on cell membrane permeability was determined by colorimeter absorbance. Betacyanin, a red beet pigment, diffused into the solution as the cell membrane was compromised. Lumbriculus variegatus, a common mud worm used in ecotoxicity testing, were cut into three sections, exposed to lead dilutions, and observed for cell regeneration. Data indicated that lead levels of 1.25 ppb to 20 ppb, significantly inhibited enzyme function (p=0.0001). Exposure to lead significantly increased the permeability of the cell membrane (p=0.008). There was a significant decrease in the amount of cell regeneration in worms exposed to lead concentrations. The control regenerated an average of 81 body segments while the regeneration was 7.25 segments in the 20 ppb solution(p=0.014). The control group showed a 100% survival rate while the experimental groups were greatly affected by the exposure to lead, with only a 52% survival rate overall in the solutions tested.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency
Third Place Award of \$100 - Society of Environmental Toxicology and Chemistry

2003 - EV042

VEGETATION AND SOIL PROPERTIES OF SPOIL BANKS

Lydie Navratilova
Archbishop Grammar School, Pilarova 3, 767 01 Kromeriz, Czech Republic

The coal mining areas represent significantly changed habitats in comparison with former landscape properties. During the coal-mining period, huge amounts

of coal tailings are extracted and deposited in local areas to form large spoil banks. These spoil banks provide a significantly different and often extreme conditions to plant resettlement.

The following questions were therefore formulated at the beginning of my research. They are:

Has the soil that develops on the tailings any specific feature?

If so, do the features influence the particular species of vegetation?

In order to request them, I analysed samples of some coal spoil banks as Central Europe representatives. It shows significant relationships between soil development and vegetation succession on spoil banks. The extreme soil features determine the structure of the initial species and the specific vegetation development. Plant communities are not important for their composition of rare species, but for their structure and expected ecological roles.

Several attempts to recover the spoil banks took place during restoration of the habitats under investigation. Based on my perception, the natural regeneration was the most successful process. The vegetation of spoil banks can be managed as a recreational forest for visitors from populated adjacent areas.

2003 - EV043

WHAT'S GROWING IN OUR HOME AIR CONDITIONING SYSTEMS? ... IDENTIFICATION AND ELIMINATION OF POTENTIALLY HARMFUL MICROORGANISMS

Jerome Markham Viator
Catholic High School, New Iberia, Louisiana, USA

The purpose of this research was to determine if potentially harmful microorganisms could be found in home air conditioning systems, to identify what types of microorganisms they were, and to find a practical way to eliminate them.

Initially, air samples were collected from air vents in several rooms of three different houses. An incubation period of a week was allowed for growth of mold colonies. Subcultures were then made of the mold colonies, and the subcultures were identified. It was found that there were only three types of molds that grew: Aspergillus, Cladosporium, and Penicillium.

The final step was to test the effectiveness of different cleaners on the molds. Three commonly available household cleaning products were tested as potentially viable mechanisms to eliminate the molds.

The following steps were performed to test the disinfectants on the molds: Transfer the molds to a SAB-DEX Plate, add disc (filter paper) with disinfectant, incubate, and measure zones of inhibition.

It was found that all three household products proved to be effective; however, it was found that the all purpose cleaner worked most effectively.

2003 - EV044

LOSE THE OOZE!! THE EFFECTS OF SELECTED BACTERIA ON THE BIOREMEDIATION OF HEAVY METALS

Sarah Renee' Woods
Miami High School, Miami Oklahoma, United States

There are two main solutions to the problem associated with heavy metal pollution. One is the prevention of further pollution and the other is the recovery of ground water and soil already polluted. Among the most promising new ideas for soil and ground water recovery is bioremediation. Bioremediation refers to the use of microorganisms in the removal of hazardous toxic pollutants, such as the heavy metals zinc and lead, from soil and ground water. The purpose of this experiment is to test the effects of selected bacteria on the concentrations of the heavy metals zinc and lead. It is hypothesized that the selected bacteria will bioremediate a significant amount of the heavy metal concentrations tested. It is further hypothesized that Pseudomonas putida will be the most effective at bioremediating lead and zinc followed by Pseudomonas fluorescens, Bacillus thuringiensis, Thiobacillus thioparus, E. coli K12, and Arthrobacter globiformis. The null hypothesis is that the selected bacteria will not bioremediate the heavy metals zinc and lead. To test this, heavy metal resistant bacteria were isolated and introduced to four different heavy metal concentrations (100, 50, 25, and 12.5 ppm). Then the bacteria were extracted, and a nitric acid digest removed the heavy metal from the bacteria. This heavy metal accumulation was then analyzed using an atomic absorption spectrophotometer. According to the data collected, the hypothesis should be partially accepted and the null hypothesis should be rejected. The selected bacteria were effective at the bioremediation of zinc and lead; however, the order at which the selected bacteria are effective at bioremediating lead and zinc in comparison to one another was not as predicted.

Awards won at the 2003 ISEF

Third Award of \$200 - National Ground Water Association

2003 - EV045

THE DEVELOPMENT OF AN ANALYTICAL METHOD BY WHICH TO MEASURE 1,3,7-TRIMETHYLXANTHINE IN WATER SAMPLES

Katherine Laura Hermann
Boulder High School, Boulder, Colorado

This project examined the use of solid phase extraction and gas chromatography/mass spectrometry to measure concentrations of 1,3,7-Trimethylxanthine, commonly known as caffeine, in laboratory-derived spikes and environmental samples.

For a period of five months, caffeine samples and other water quality data were collected at two sites along Boulder Creek. In addition, total organic carbon measurements were taken at selected effluents in order to examine the effects of run-off from outfalls on a stream system. At the laboratory, spikes of known caffeine concentrations were prepared in order to determine the accuracy of solid phase extraction and gas chromatography/mass spectrometry in measuring caffeine. The environmental samples were then prepared, and the spike and sample data were compared.

Monthly sampling and total organic carbon data showed seasonal trends impacted by extremely low flow levels that were a result of drought conditions. Gas chromatography/mass spectrometry results did not reflect the actual concentrations of caffeine in spikes. Data suggested that caffeine was present in environmental samples, but exact concentrations could not be determined due to the inability to detect the amounts present in the spikes. Currently, the EPA has no restrictions regarding allowable amounts of caffeine in water sources, and little is known about the detection of the compound or its effects in streams. Caffeine is a potential human indicator that might be used to further scientific studies dealing with human impact on a stream system.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV046

ASSESSMENT OF ZOOPLANKTON RESOURCES IN BISCAYNE BAY AND LAGOONAL TROPHIC FLOW MODEL ANALYSIS

Jenna Lyanne Lewis

Cooper City High School, Cooper City FL, United States

This year's zooplankton study provides a more holistic understanding of lagoonal trophic dynamics and of the spatial and temporal structure, composition and abundance of zooplankton communities at the base of Biscayne Bay's food chain, and their environmental interactions. Coupling baseline plankton assessments with the nutrient regime and ecosystem network analysis will assist in the evaluation of CERP strategy and the development of rational management plans for the bay. It was hypothesized that zooplankton communities change in biomass and composition as a function of trophic state, highlighting shifts in trophic structure from a benthic system dependent on primary production by sea grass (and epiphytes) to a pelagic system dependent on planktonic algae production.

 Photosynthetic assimilation numbers for phytoplankton in Biscayne Bay are quite high(10 mcg carbon/mcg chlorophyll-a/hr), indicating it is the low standing stock biomass of phytoplankton that limits planktonic productivity in the bay. Data show the higher planktonic animal biomass in the north correlated with greater input of nutrients in the north, enhancing the production of more animal protoplasm. In the nutrient poor south bay, productivity of sea grass is high because large amounts of nutrient poor cellulose are being produced. Zooplankton biomass was uniformly low in south bay and 2-5 times higher in north bay, where the highest biomass correlated with the highest chlorophyll concentrations. Zooplankton abundance was usually higher in canal mouths than in open water, and very low throughout the bay during summer months, when water temperatures are high.

Awards won at the 2003 ISEF

Awards of \$5,000 - Intel Foundation Achievement Awards

Second Award of \$1,500 - Environmental Sciences - Presented by the Environmental Protection Agency

Scholarship in the amount of \$8,000 - U.S. Navy & Marine Corps

2003 - EV047

PROCESSES REGULATING ZOOXANTHELLAE DENSITY IN CONDYLACTIS GIGANTEA: HALOBIONT EXPOSURE TO IRRADIANCE AND TEMPERATURE GRADIENTS

Carrie Anna Miller

Palm Bay High School,Melbourne, FL, USA

The purpose of this experiment is to identify degradation rates of zooxanthellae when exposed to stress. Cellular breakdown occurs as the hosts are exposed to increasing levels of stress. In this study water temperature is used as the stressor, and the DNA is used to monitor the breakdown and division of the cell. Irradiance will be investigated as a remedy for the stressed zooxanthellae while also producing significant data about the division of the cells. Changes in light(irradiant exposure) producing high irradiance will result in a high zooxanthellae count and a high mitotic index, when Condylactis gigantea are stressed by increasing temperature levels. If it is determined that increased amounts of irradiance can oppose the effects of a stressor, such as temperature fluctuations, it could be used in future studies related to saving coral reefs.

 Coral reefs are being subjected to a phenomenon called "bleaching." This occurs when the endosymbiotic relationship is disturbed and the zooxanthellae(the algae needed for survival) depart. There have been several attempts to reverse the effects of the adverse environment on coral. If irradiance can stimulate growth during a time of stress, it may become a technique to reverse the decline in the world's coral reefs due to bleaching.

 In conclusion, the changes of irradiant exposure and temperature that was applied to the Condylatis gigantea over a period of time, did illustrate an increased zooxanthellae count and an increased mitotic index in all of the experimental runs.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV048

THE EFFECTS OF ANABAENA ON CADMIUM CONTAMINATION IN AN AQUATIC ENVIRONMENT

Derek William Lindskov, PO Box 148 Isabel, SD 57633

PO Box 1000 Timber Lake High School, Timber Lake, SD, 57656

The purpose of my project was to see if the algae, anabaena, could be used to rid aquatic environments of cadmium contamination. I want to determine whether this species of blue-green algae could be a bioassay for cadmium.

 Anabaena algae were grown and then exposed to two different concentrations of cadmium sulfate. They were then filtered and dried after a week's exposure. To determine whether the anabaena were effective as a bioassay for cadmium, a spectrophotometer was used. The amount of cadmium remaining in the growing solutions was also measured and compared to the exposure amount.

 Aanabaena was extremely successful at removing cadmium from this environment. In the high level of contamination over 5000 ppm of cadmium was removed and in the low level, over 600 ppm of Cadmium was removed. The anabaena was able to take up huge amounts of cadmium although how it was able to do so is yet to be determined. In the high concentration samples, about 1/2 of the cadmium present in the algae's environment was removed and in the low levels, about 2/3 of the cadmium was removed.

 Continued research into where the anabaena is storing the cadmium and how they continue to survive in such a toxic environment is next. The mechanism by which anabaena can absorb cadmium would be fascinating to pursue.

2003 - EV049

POLYMER POSSIBILITIES PHASE III - BIODEGRADABLE CELLULOSE FOR WIND EROSION CONTROL

Vincent Tyler Metzger
Cibola High School, Albuquerque NM, USA

The results of previous experimentation indicated that the aqueous application of corn cellulose to soil forms a polymer film (or "crust") that controlled wind erosion, reconstituted when rained upon, and did not interfere with plant germination during controlled tests where naturally occurring conditions were simulated.

 The purpose of this project was to determine whether or not the polymer film formed by the aqueous application of biodegradable plant material to soil is an effective, practical, and economical method of controlling wind erosion.

 This was determined by:

 Discovering whether or not the cellulose mixture must be heated prior to soil application.

 Applying a polymer film to both organic and inorganic soil and comparing how effectively wind erosion was controlled.

 Comparing how effectively the polymer film controls wind erosion on a slope with gravity erosion.

 Testing whether or not vegetation can be established in an area prone to wind erosion through a hydroseeding technique utilizing cellulose, seeds, and water.

 Applying a polymer film to eighty-one square feet of soil and observing the durability and strength of the polymer film in the environment over time.

 Analyzing the soil used in both the controlled tests and the "real-world" experiments in order to determine the vulnerability of the soil to wind erosion.

 The results of this project indicate that the original idea of applying biodegradable cellulose to the surface of soil may provide an effective, practical, economical, and environmentally friendly solution to the extremely harmful effects of wind erosion.

Awards won at the 2003 ISEF

Recognized by AGI on behalf of the Association of Engineering Geologists (AEG) this awardee will receive a subscription to the AEG journal, "Environmental and Engineering Geosciences". - American Geological Institute
Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency
Award of \$3000 in savings bonds, a Certificate of Achievement and a gold medallion. - U.S. Army

2003 - EV050

THE EFFECTS OF PUBERTAL EXPOSURE TO ESTRADIOL ON EPIDIDYMAL SPERM COUNTS

Erica Mariel Burden, Paul D. Schreiber High School
Port Washington NY, USA

Many chemicals released into the environment can mimic hormones of the endocrine system. These endocrine disrupters interrupt feedback loops to the hypothalamus and pituitary gland. The U.S. EPA has begun investigating 87,000 chemicals for properties of endocrine disruption. The test subjects that the EPA is using are the CD strain mice and rats that were previously selected for large litter size and vigor, possibly making them highly resistant to endocrine disruption. The number of sperm per epididymis and the number of sperm per milligram of testis weight were counted for 15 different strains of mice exposed at puberty to 0.0, 2.5, or 40 micrograms of Estradiol(E2). Highly significant (P<.0001) variations were found in the mean numbers of sperm for each strain, particularly the parental and inbred strains. This variation is an indication that there are differences in genetic sensitivity to endocrine disruption and thus a variety of strains of mice should be used to examine the effects of the chemicals on sensitive and resistant genotypes.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV051

AN ALTERNATIVE TO SYNTHETIC NEMATOCIDES: BRASSICA RAPA AS AN ANTAGONISTIC GREEN MANURE AGAINST MELOIDOGYNE ARENARIA

Glenna Matthews Wink
MOISD Math/Science/Technology Center, Big Rapids, Michigan, USA

Nematicides are among the most toxic pesticides in use today. As the Environmental Protection Agency continues to ban nematicides like methyl bromide, alternative options need to be found to treat plant-parasitic nematode infested fields. The purpose of this project was to test the effects of the naturally toxic breakdown chemicals from Brassica rapa (canola) tissue on the prevalent peanut root-knot nematode, Meloidogyne arenaria.

 The effects of the isothiocyanates from the glucosinolates in the plant tissue on the size of the population of the nematodes was determined by a bioassay that rated the population size by the number of galls on the roots of the susceptible host plants "Rutgers" tomatoes. The tomatoes were grown in Meloidogyne arenaria infested soil for thirty-five days before being uprooted. All the roots were gathered and the galls counted for each plant. A t-test of the two data groups resulted in a p-value of 0.044549. The average number of galls on the roots of forty tomato plants grown with the plant tissue soil amendments was 130.825, and the average number without the amendments was 177.875. Therefore, the data supported the hypothesis that the Brassica rapa soil amendments would lower the population of Meloidogyne arenaria. After further research has been done to develop a high glucosinolate, and Meloidogyne arenaria resistant, cultivar of a plant in the Brassicaceae family it can be put to use as an effective alternative to synthetic nematicides in the control of this widespread nematode.

Awards won at the 2003 ISEF

Fourth Award of \$200 - American Phytopathological Society

2003 - EV052

AEROSOLS AND CLIMATIC CHANGE...

Ridhwaan Suliman
Pretoria Boys High School, Pretoria, Gauteng, South Africa

To determine the Aerosol Optical Thickness(AOT) over the Highveld of Southern Africa and to investigate whether these aerosols are causing Global-Cooling.

Using the Hand-Held Haze-Meter I took half-hourly measurements of AOT, for a month. I also ran HYSPLIT trajectory models, got synoptic charts and calculated Angstrom Exponent.

The measurements were sent to NASA and they sent back AOT. The Angstrom Exponent proved that the aerosols occurred from biomass and industrial activity. The trajectories showed that when the wind moved in from industrial areas, the aerosol loading was high, in contrary to when the wind moved in from non-industrial areas. The synoptic charts indicated that when a high-pressure system moved through the Highveld, AOT was high which contrasts with a low-pressure system.

Aerosols are having a cooling effect by: reflecting some solar radiation back into space and interacting with water droplets, causing them to stay in the atmosphere for longer and therefore less solar radiation reaches the Earth's surface.

Biomass and industrial activities account for most of the aerosols over the Highveld. With the aid of trajectory models and synoptic charts, the transport and life span of the aerosols can be seen. High aerosol volumes have the potential to cause Global-Cooling. They also have serious health effects including respiratory diseases. These problems need to be dealt with seriously. One solution might be to implement 'air-quality laws' and monitor the amount of emissions from industrial-stacks. Other solutions might be to use alternative sources of energy: Hydroelectric, Wind, Wave, Nuclear or Solar Power.

Awards won at the 2003 ISEF

Third Award of \$250 - American Meteorological Society

2003 - EV053

BIOSOLIDS IV: THE HEAVY METALS IMPLICATIONS OF AGRICULTURAL LAND APPLICATION

Jennifer Elizabeth Nuest
Kouts High School, Kouts, IN, USA

The purpose of this experiment is to determine whether the heavy metals which were introduced from the prior land application of biosolids remain in the soil or migrate into the drainage ditch, Zea mays indentata tissue, and grain. Zea mays indentata tissue samples were taken at V-5 and postmortem; grain samples were collected during harvest. The grain was weighed, row lengths measured, and yields calculated. Field and ditch bottom soil samples were taken post-harvest. The student prepared and digested soil, tissue, and grain samples and conducted heavy metal analysis for measurable levels of arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

It is 95% certain that there is a significant difference in heavy metal levels between at least two of the field soil samples. While the biosolids plots had higher levels of copper and zinc, the control plots had higher levels of nickel. It is 95% certain that there is a significant difference in the heavy metal levels between at least two of the ditch bottom soil samples. The control sample had the highest levels of lead, nickel & zinc. It is 95% certain that there is no significant difference in heavy metal levels between at least two of the V-5 tissue samples, at least two of the postmortem tissue samples, and at least two of the grain samples.

While there were significant differences between the field soil plots, the biosolids plots had higher levels of beneficial metals, copper and zinc. None of the detected levels were higher than naturally occurring levels for the soils tested. Although there are significant differences in the heavy metal levels of the field and ditch bottom soils, it must be stressed that the controls' levels of these metals reinforce the tenet that heavy metals are naturally occurring, and not migrating. The data from the tissue and grain analysis indicates that the Zea mays indentata plants are capable of using the micronutrients necessary for healthy plant development.

2003 - EV054

RISES AND FALLS OF A GREAT RIVER: AN INTENSIVE BIOASSESSMENT OF THE MISSISSIPPI'S FIRST 382 MILES

Rebecca Jennifer Krystosek
Bagley High School, Bagley, Minnesota USA

As a nonrenewable resource and the basis of life, water must be efficiently managed. The Mississippi and its tributaries comprise the most vital river system in North America. Millions depend upon its numerous functions and resources. Unlike highly variable quantitative water quality parameters, biomonitoring evaluates presence of indicator organisms and overall stability of aquatic ecosystems. Thus, it's an indispensable tool in exposing dynamics that reflect ecological conditions over time.

This study applied Hilsenhoff family-level biotic index (FBI) and other metrics to samples collected on the first 382 miles of the Mississippi. Standardized kick-seine riffle sampling was used to collect macroinvertebrates on 16 occasions at 6 sites (6 Grand Rapids Samples, 2 at other sites) over 4 months.

13,343 individuals from 15 orders and 54 families were collected. Numbers of organisms collected at each site are: Headwaters 3,118; Ottertail 5,910; Pokegama 3,225; Grand Rapids 36; Grand Rapids additional samples 226; Brainerd 206; Little Falls 622. FBIs were calculated and indicate good to excellent water quality at all sites except Grand Rapids, which yielded 5.923, suggesting fairly poor water quality and substantial organic pollution. 300% more Grand Rapids sampling yielded 7.262, indicating very poor water quality and severe organic pollution.

To determine statistical significance of data and evaluate validity of two null hypotheses, Chi-Square analyses were conducted. Using a 0.001 level of significance, both are rejected. It is concluded that the distribution of both macroinvertebrate taxa and pollution tolerances of organisms is dependent upon sampling location. Significant differences exist among sampling sites.

Awards won at the 2003 ISEF

First Award of \$3,000 - Environmental Sciences - Presented by the Environmental Protection Agency
Honorable Mention - North American Benthological Society
All expense-paid trip to attend the U.S. Space Camp in Huntsville, Alabama and a certificate - National Aeronautics and Space Administration
Second Awards of \$1,500 - U.S. Air Force

2003 - EV055

THE REMEDIATION OF ARSENIC CONTAMINATED WATER UTILIZING DATURA STRAMONIUM DRIED PLANT MATERIAL

Brandi Nicole Bahringer, Deming High School

Deming, New Mexico, 88030, United States

The purpose of this experiment is to further assess the possible arsenic remediating effect of the Datura stramonium (Jimson Weed) dry plant material. Arsenic is a naturally occurring element, which can leach into underground drinking water supplies. Possible health risks of ingestion of arsenic contaminated water include cancer, skin lesions, and heart disturbances. Over 93 million people are affected worldwide, with a large percentage being in third world countries. In the United States, the Environmental Protection Agency (EPA) has lowered the arsenic standard for drinking water from 50 ppb (parts per billion), to 10 ppb, taking effect January 22, 2001 and all states must comply by January 23, 2006. In areas with greater than 10 ppb concentration, remediation will be very expensive. Current remediation techniques include activated alumina, reverse osmosis, flocculation with iron compounds, and nanofiltration. D. stramonium seeds were tested in reverse flow column filters, and in batch mixes. Whole seeds were utilized in reverse column flow filters including breakthrough trials to quantify remediating capacities. Batch mixes utilizing D. stramonium were tested with whole seed, and ground seed at pH 6, 7 and 8. All treatments significantly ($p<.001$) reduced the level of arsenic in water below the new standard. This study indicates that D. stramonium has great potential in remediating arsenic contaminated water.

2003 - EV056

WHICH METHOD OF REDUCING FILAMENTOUS AND PLANKTONIC ALGAE IS FASTER AND MORE EFFICIENT?

Emily Anna Putnam

Classen School of Advanced Studies, Oklahoma City, Oklahoma, USA

The purpose of this experiment was to see which method of reducing algae in a controlled environment was faster and more efficient. The hypothesis was that the copper sulfate would have the most devastating effect on both types of algae. The experiment failed to prove the hypothesis, and in effect proved the exact opposite. Chlorine was proven to reduce the tested algae faster and more efficiently. The results of this experiment will highly benefit gardeners, anyone with an outdoor pond or pool, and national wildlife organizations. The experiment required 8 samples of filamentous algae and 8 samples of planktonic algae to be tested. A control group was used with the same amounts. Copper sulfate was added to 4 filamentous samples and 4 planktonic samples. Chlorine was added to the remaining 4 filamentous and the remaining 4 planktonic algae samples. The effects the chemicals had on the algae were closely monitored and recorded on a data chart every 3 days. Other than the chemicals, no substances were added to the samples, and nothing was added to the control group samples. Lids were kept on the samples at all times except when measuring. At the end of the experiment, all samples showed a change in length, width, and depth. If this experiment was to be re-done, a few changes would take place. The pond water used had a high probability of containing other substances besides planktonic algae. Water would have been filtered to eliminate outside factors from influencing the results of the experiment.

2003 - EV057

THE QUANTITATIVE ANALYSIS ON THE RELEASE OF PHTHALATE ESTERS FROM CONSUMER PLASTIC BOTTLES INTO DRINKING WATER

Marian Lynne Cox, Seneca High School

Seneca, MO, USA

Phthalate esters are a class of chemical compounds that are commonly used as softeners, or plasticizers, in a variety of products. A person can be easily exposed to these chemicals by mouth, inhaling it, or absorbing it through the skin. When a person is exposed to high doses for a long period of time, phthalates have been proven to cause serious harm as they accumulate in body tissues. The most commonly used phthalate diethylhexyl phthalate (DEHP) is used as a plasticizer in commercial water bottles. The EPA has set standards for DEHP in drinking water when determining a health risk. This standard is set at 0.006 parts per million. Phthalates have also been shown to migrate outside the plastic above 85 degrees Fahrenheit. In this study, phthalates were extracted from water and plastic in different brands of bottled water. The water and the plastic were tested in two different temperatures, room temperature and heated at 49 degrees Celsius (120 F). Results didn't show a statistical difference between the room temperature and heated groups for water or plastic, but all of the brands far exceeded the EPA standards set for safe drinking water. Levels as high as 4.84 ppm were found in the water of several popular brands of bottled water. Further analysis is being conducted using GC mass spectroscopy.

2003 - EV058

PHYTOREMEDIATION OF METAL CONTAMINATION: ARE THE GROWTH AND SURVIVAL RATES OF MEDICAGO SATIVA AFFECTED BY CU AND ZN POLLUTION?

Jessica Marie McEnaney

Northwestern High School Springfield, OH USA

Phytoremediation is a process that uses plants, trees and other types of vegetation to remove or degrade toxic waste and pollution in the environment. Plants root systems permeate soil and sediment environments with an extensive and active membrane system. Acting as a filter or trap, the plants contain and stabilize pollutants during the process of phytoremediation. In this study, soil metal phytoremediation capabilities of alfalfa (Medicago sativa) was investigated. Alfalfa plants were subjected to four different soil concentrations of Cu and Zn: 1) a control with no metals; 2) treatment 1 with 90 ppm Cu and 240 ppm Zn; 3) treatment 2 with 180 ppm Cu and 480 ppm Zn; and 4) treatment 4 with 270 ppm Cu and 720 ppm Zn. Each treatment was replicated once giving a total of 8 samples. After 6 weeks of growth, alfalfa plants and soil samples were collected and separated. Dried alfalfa leaves were ground, ashed, and digested with 4M HNO3. Soil samples were dried, digested with 4M HNO3 and placed in a centrifuge to aid in separating the metals from soil particles. Finally, both types of samples were filtered and analyzed using flame atomic absorption spectrometry (AAS). The results showed that the plant and soil samples exposed to the highest concentrations of metals possessed the greatest metal concentrations when analyzed. However, the metal concentrations observed were less than expected, suggesting that Medicago sativa is not the best plant for the removal of soil Cu and Zn. Medicago sativa may have a physiological mechanism that keeps these metals out of their tissues. Also, Cu and Zn are essential plant micronutrients, and the plants may be using some of the metals for normal everyday metabolic processes. The bioavailability of the metals may also have been low because of the presence of various types of organic material (wood

chips, perlite, vermiculite, etc.) in the soil. More extensive tests utilizing different plant species should be performed to find better phytoremediators of Cu and Zn contaminated soils.

2003 - EV059

A METHOD FOR REMOVAL OF DISSOLVED TOXIC POLLUTANTS FROM STORM WATER PRIOR TO DISCHARGE INTO WATERS OF THE UNITED STATES

Reagan Munn
Weber High School, North Ogden, Utah, USA

The City of West Jordan, Utah is underlain by alluvial sediments that contain toxic elements such as arsenic, lead, zinc, and other heavy metals. As a treatment for storm water being discharged from West Jordan City's 7800 South Street, the EPA has required that the City experiment with wetland vegetation planted in the basin to extract the toxic elements. Procedures :1.Planting of basin in ten different zones (five each) of two different genera of wetland hydrophytic vegetation.2.Twice-yearly monitoring of the ten zones to determine percentage of surface cover from the two genera and taking photographs in the four cardinal directions of the compass as proof.3.Obtaining four sets of water samples during the first hour storm water run-off from a storm twice per year.4. Delivering samples for analysis of such parameters as pH and BOD, and for content of Arsenic, Lead, Zinc, and total Hydrocarbons.5. Comparison of the results to determine if the plants are effective removal of the elements.Conclusions: Lab analyses of these samples showed that even with only 45%, ground coverage, removal of a slight amount of lead, zinc, and total hydrocarbons has occurred.

2003 - EV060

CELLS: A CONSTANT DAMAGE TO THE ENVIRONMENT

Daniele Uarte de Matos
Fundação Liberato Inconfidentes, 395 , Novo Hamburgo, Rio Grande do Sul, Brasil

This project´s objective is a) to verify the knowledge of the general population about the existence of poisonous chemicals in their cells; b) to verify if the quantity of these pollutants chemicals is according to the CONAMA standards (Brazilian National Environment Council); c) to study the re-use of these polluting materials and d) to verify the community´s understanding on the destination of their cells.The adopted procedures were a research bibliography and a questionnaire that evaluated if the general population knows about the green mark on their cells, that it represents the absence of certain poisonous chemicals, and which brand of batteries is most consumed by the general population.The following steps will be identifying which poisonous chemicals exist in cells and their quantity, and a project promoting awareness at the Fundação Liberato. The questionnaire results showed that most everybody interviewed doesn´t know what the green mark means and that the most consumed brand of batteries is type "A" (which contains a green mark). Another questionnaire will be done to complement these results. Through this project I conclude that a) the population prefers to buy type "A " brand cells, even though most don´t know about the green mark and neither understand its meaning; b) men are more aware about this green mark; and c) the professional occupations, in different of which field, to influence or not the concern with the environmental subject.

2003 - EV061

THE RESTORATION OF AN INLAND BAYOU, YEAR V THE FINAL SOLUTION

Mary Elizabeth Worrel, Mercy Cross High School
Biloxi, MS, USA

The primary focus of the Restoration of an Inland Bayou, Year V, is the effect of oysters on the bacteria levels in the bayou. The experiment involved was designed to prove whether oysters would thrive and pump water in the bayou. I was able to prove in Year IV that oysters filtered and reduced the amounts of fecal coliforms and Enterococcus Faecalis in water. Using this, I was able to infer that if I can identify bacteria in the oysters, I can prove they are filtering. Given the salinity and typical biological factors of the bayou, I believed oysters would in fact thrive and pump in the bayou. I introduced a sack of oysters to an easily accessible area of the bayou. I divided the sack between four bags, tying them to a nearby post. I took initial bacteria tests from the area surrounding the oysters using the micro-filtration technique. Every following Tuesday I sampled the water for bacteria. Every two weeks, I sampled oysters for similar tests. I found that the levels of bacteria in Keegan's Bayou are still at unsafe levels. However, I was able to identify live fecal coliform and Enterococcus faecalis colonies in the oyster meat. This proves that, not only can oysters survive in the bayou, but they are also able to successfully pump water in that environment. This evidence proves that oysters remove bacteria from the water and, if applied on a larger scale, may potentially reduce the levels of bacteria in Keegan's Bayou.

2003 - EV062

CHEMICAL, MICROBIOLOGICAL AND TOXICOLOGICAL ASSESSMENT OF WATER AND SEDIMENT FROM KIANI LAGOON COMPLEX AT THE VIEQUES NATIONAL WILDLIFE REFUGE, PUERTO RICO

Luis F. Zabala-Cardona
Liberata Iraldo Molina Junior High School, HC-03 Box 20461, Río Grande, PR 00745

Sediment contamination in U.S. coastal area is a major environmental issue because of its potential toxic effects on biological resources and indirectly, on human health. In many instances, fish consumption advisories are coincident with severely degraded sediments in coastal water bodies. This investigation pretends to determinate water and sediment quality in the Kiani Lagoon, in Vieques Puerto Rico. Water samples were tested for different physical, chemical, microbiological and toxicological parameters at different stations established along the Kiani Lagoon. Station I, II and III were located at the center of the Lagoon (South, Center and North, respectively). Station IV and V were established on both opposite ends of the Lagoon (West and East, respectively).

Many physical parameters were constant along the Lagoon: recordings were close to an average water depth of 1.01 meters, and vertical transparency of 0.5 meters. Water and air temperature were slightly variable, but air temperature was constantly higher. Toxic ammonia concentration is of great concern, especially on Station I where 0.33 mg/L were recorded on sediment samples. Concentrations as low as 0.003 mg/L of toxic ammonia are considered to be a threat for marine fishes. In general terms it can be established that there is a problem of bioaccumulation in this Lagoon that requires further studies. It is now planned to assess, under the supervision of U.S. Fish and Wildlife the nectofaunal composition of the Lagoon and the presence and concentrations of different environmental contaminants in raw fish tissues.

2003 - EV063
AN ASSESSMENT OF ALDRIDGE CREEK

Sarah Katherine Fisher
Catholic High School, Huntsville, Alabama, United States of America

An Assessment of Aldridge Creek- how clean is it? My hypothesis was that Aldridge Creek was very healthy. I have used three types of testing to find water quality: chemical; biological; and bacteriological. I tested for temperature, pH, dissolved oxygen, total alkalinity, and total hardness. I used "bugs" or benthic macro invertebrates to assess the aquatic life of the water. Finally, I used petri dishes to test for E. coli. These three types of testing are all very useful in determining the health of a stream. Chemicals show high dissolved oxygen levels as well as acceptable pH, hardness, and alkalinity levels. Biological tests reveal that the creek is able to support plenty aquatic life. Bacteriological tests show no traces of E. coli bacteria. All of my results support my hypothesis; the water is in very good condition.

2003 - EV064
THE WIND, A SOURCE OF ENERGY THAT NEVER ENDS

Angel Jonathan Alicea
Colegio Nuestra Senora del Carmen, Hatillo, Puerto Rico

On account of the actual energetic crisis in the world because of the shortage on the non-renewable resources of energy, such as petroleum, carbon, and natural gas, and on account of the actual conflict between countries, it's necessary to investigate about renewable energy resources, specifically the wind. This project demonstrates, through a model of a house and a windmill, the efficacy of the wind as a source of renewable energy and as an alternative to the world energetic crisis. The model consists of a scale house made with white pasteboard and clear plastic thin sheets simulating crystal windows. Electric cables are inserted between the roof and walls of the house, the cables are connected to the light bulbs in the different habitations, the principal cables of the generator are connected to the switchboard and from the switchboard to the house. The gear of the windmill and the generator are joined by a pulley. A fan is used as the wind source to move the windmill vanes. Besides making the model, an investigation was done about this source of energy in government agencies, encyclopedias, and internet. This research took almost four months and the results were positive. With this model it was demonstrated that the wind turbines are technically viable to generate electricity. For future investigations, different places in the world will be investigated to find out if they are adequate for establishing aeolic parks and if there are ways for windmills to work with less wind velocity.

2003 - EV065
COMPARATIVE STUDY OF NOISE POLLUTION BETWEEN URBAN AND RURAL AREAS, AND HOW IT AFFECTS TEACHER'S AND STUDENT'S PERFORMANCE

Luis A. Rivera
Francisco Morales High School, Naranjito, Puerto Rico

Noise pollution refers to noise when it is considered a bothering sound that can result in physiological and psychological effects. The purpose of this research is to find out the effects of noise pollution in teacher's and student's performance in the rural and urban schools of Naranjito county. The hypothesis considered that the performance of teachers and students of the urban schools would be affected by noise pollution. To prove the hypothesis, the noise was measured with a sonometer in a decibel(dB) scale, both in rural and urban areas. A questionnaire was also administered to teachers and students of both areas to obtain the results. The research concluded what was considered by the hypothesis: the performance of teachers and students of the urban school areas was affected by noise pollution. Although it was thought that only urban schools would be affected, it was also proved that both, rural and urban areas, were affected by noise pollution.

2003 - EV066
THE EFFECT OF RECYLCED NEWSPAPER IN AGRICULTURE

Carmen Milagros Acevedo
Ana Roque de Duprey High School, Humacao, Puerto Rico

It is very important to recycle newspaper to reduce the volume of solid wastes in the garbage dumps. This research will demonstrate that milled newspaper applied to a plot of land can be good to maintain the humidity of the soil. To demonstrate this, four (4) one gallon flowerpots with soil and three (3) bean seeds (Phasceollus vulgaris) were prepared. In three (3) of them milled newspaper was deposited at different depths in the pot (¼, ½, ¾ of the pot) In the fourth flowerpot milled newspaper was not deposited. The experiment was also carried out in an open field. For this experiment, two (2) quadrants of one square meter each were prepared, one to be used as a control group and the other one as an experimental group. The growth of the plants was measured daily. It was found that the plants grew bigger and stronger in the pots and in the landfill with milled newspaper. The measurement of humidity in the soil also demonstrated that the milled newspaper helps to maintain the humidity of the soil up to four times more than in the control groups.

2003 - EV067
EFFECTS OF DOMESTIC SEPTIC TANKS IN THE SOUTHERN AQUIFER OF PUERTO RICO

Jose Jose Colon
Stella Marquez High School, Salinas, Puerto Rico

The Aquifer of the South one of the most important sources of water of the island, and the most important in the southern coast is in danger to be polluted. Study done to identify the different sources of contamination showed some different sources. Agricultural activity, especially poultry farms, inadequate disposal of oils and domestic wastes look like the principal sources of contamination.

Another situation in the aquifer is that the excessive amount of water extracted from it increases the concentration of the contaminants and pulls water from the ocean into the aquifer. It seems that the principal source of contaminants to the aquifers is the disposition of wastes into the recharging zone of the aquifer by communities without a sewer system. These communities depend on septic tanks to dispose wastewater and solids but they are established in a zone with well-drained soils or near areas subject to flooding or with high water table.

These septic tanks are not in compliance with Clean Water Act or CFR Part 144 Underground Injection Control Program. This situation is because most of the septic tanks were constructed a long time ago when these environmental factors were not considered.

The hypothesis of this investigation is that the principal sources of contamination of the Southern Aquifer are the septic tanks constructed in the area of the aquifer without the appropriate specifications and management. This study was done evaluating and reviewing environmental documents, laws, and Internet sites and visiting the area for visual inspection.

The study will be continued to evaluate the effects of this pollution in the marine ecosystem.

2003 - EV068
CELL CYTOTOXICITY OF HAA DRINKING H2O DBP'S

Claudia Arteaga
Hubbard High School, Chicago, Illinois, U.S.A

In this study six haloacetic acids (HAA) were analyzed with Chinese hamster ovary (CHO) cells to determine the cytotoxicity of each disinfectant by-product (DBP). The amount of cytotoxicity in the cells was imperative for this experiment to determine the 50% killing of the cells, %C ½. Furthermore the rank order of HAA's cytotoxicity and the relative cytotoxicity potency between the chlorinated and brominated HAAs was to be ascertained in order to distinguish which of the two agents is more toxic than the other.

The cytotoxicity was determined by inserting different amounts of concentrations of the HAA's into the wells. Each HAA intoxicated its own set of microplate of the cells and never were the HAAs mixed together. The HAAs and the cells were kept in an incubator for a period of three days at 37°C with 5% CO2. After three days the HAAs were disposed, the amount of living cells was verified visually utilizing crystal violet and then numerically. The microplates were placed in a BioRad where the absorbency of values of the cells was determined. With the determinations of those values the %C ½ values of the HAAs were figured out.

The %C1/2 values for the HAAs studied were chloracetic acid (CA)847.7 µM, dichloracetic acid (DCA) 7.30 µM, trichloracetic acid (TCA) 2.40 Mm, bromoacetic acid (BA) 9.56 µM, dibromoacetic acid (DBA) 521.3 µM, and tribromoacetic acid (TBA)61.4 µM. The ranking order in decreasing CHO cell cytotoxicity was BA>TBA>DBA>CA>TCA>DCA. Thus, the brominated agents are more toxic than their chlorinated analogs.

2003 - EV069
THE EFFECT OF COMPOST IN SOILS CONTAMINATED WITH THE PESTICIDE ENDOSULFAN 1 & 2

Tania Margarita Okundaye
University Gardens High School, San Juan, Puerto Rico

The purpose of this investigation was to demonstrate if compost is capable of reducing the concentration of the agrochemical Endosulfan, in contaminated soil. The investigation rises due to the lack of mechanisms to reduce the contamination problems of agricultural soils in Puerto Rico.Thirty five post were divided into five groups, named: A(control), B, C, D and E(experimental). Each group was divided in two other subgroups, the first one had two post(without plant) the second group, had five post with Lactuca Sativa L.(lettuce). Group A had only soil. Group B and D had a 0.5% solution of Endosulfan and groups D and E 2%. Compost was added to groups D and E. A sample was taken to the laboratory at the initial and at the end of the investigation to administer the EPA 608 test. The results indiceted that use of compost in soils contaminated by the pesticide Endosulfan was effective in reducing the contaminant. The reduction was greater in soils without plants.It is inferred that the lettuce plant Lactuca Sativa L. interferes with the biodegradation prosses in the samples examined. The soils previously exposed to the pesticide lowered their degradation capacity, after being exposed to new contamination. According to the results it not recommended to continually cultivate contaminated soils because plants seem to lower the degradation process. The results obtained add evodence in favor of the initial hypothesis.Future investigation will control the pH, humidity and organic matter content variables. The use of compost in tropical contaminated soils should be part an integrated bioremediation management program.

2003 - EV070
FROM THE FIELD TO THE FUEL TANK

Aaron Phillip Weyhrich
Delavan High School, Delavan, IL United States of America

The purpose of this project is to test for and compare exhaust gas emissions from a 2.0L Ford engine operating on different blends of gasoline and ethanol. The blends of fuel will increase in ethanol content by 10 percent until 100 percent ethanol is reached. The exhaust gases that will be tested for are carbon monoxide, carbon dioxide, oxygen and hydrocarbons.

The experiment began by the collecting of all necessary materials. The testing equipment and

engine were then set up for use. Next, the engine was started and ran at 2500 RPM on regular unleaded fuel, allowing the engine to reach operating temperature. The engine was then idled for one minute. After one minute, the engine was brought back to 2500 RPM for five minutes. At the five minute mark, exhaust gas readings were taken from the analyzer. The same testing procedure was repeated three times for each fuel.

The testing proved that carbon monoxide and carbon dioxide levels were overall reduced as levels of ethanol increased. Inversely, hydrocarbons increased as more ethanol was used. The oxygen levels did not change during the testing. In conclusion, the increased amounts of ethanol did reduce most emission levels.

2003 - EV071

DETERMINATION OF TRACE METALS IN BIOLOGICAL SAMPLES OF STROMBUS GIGAS BY INDUCTIVELY COUPLED PLASMA-OPTICAL EMISSION SPECTROSCOPY

Rhojonle White Cromwell
Good Hope School, Frederiksted, St. Croix, USVI

Over the past few years, there has been increasing concern about metal contaminants found in shellfish. In 1993, the Environmental Protection Agency identified abnormally high levels of hazardous metals in shellfish nationwide (USFDA, 1993). These findings are alarming because ingestion of toxic metals can result in kidney failure, fatigue, cancer, and in extreme cases, death (The Chemical Basis for Action Report American Chemical Society, 1997).

 The purpose of my study was to examine the presence of arsenic, chromium, and lead in Strombus gigas (queen conch) from the waters off the island of St. Croix, United States Virgin Islands. Seventy-five percent of the island's population consumes queen conch twice weekly (Hansen, 2003). I hypothesized that the majority of samples tested would contain significant levels of arsenic, chromium, and lead.

 I collected fifty specimens of Strombus gigas at each of six locations off the coast of St. Croix for a total of three hundred samples. I analyzed each of these samples for arsenic, chromium, and lead using Inductively Coupled Plasma- Optical Emission Spectroscopy. My results indicate that arsenic (24.52 ug/g in .846 g of wet tissue) and chromium (10.08 ug/g in .5016g of wet tissue) were present in all three hundred samples. Insignificant traces of lead were detected.

 There is currently no standard advisory level for acceptable levels of toxic metals in shellfish. Future studies need to determine if these levels of contaminants pose a threat to consumers. In addition, it is important that the source of these metals is identified so that they can be eliminated in order to prevent associated health hazards.

2003 - EV072

BACTERIAL TOXICITY DETECTORS FOR WATER SAFETY

Ron Neuman
"Ohel Shem" High School, Ramat-Gan, Israel.

Threats to drinking water include both "ordinary" pollution and terrorist assaults. Existing chemical tests require considerable time to identify hazards, while current bioassays are either too slow, insensitive, or poorly reflective of human toxicity to guard against chemical and biological terrorism. This project assesses the possibility of developing a biosensor, using engineered bacteria, to rapidly and accurately determine whether water is safe to drink.

We examined the response of engineered strains of E. coli, containing various promoter gene sequences linked to a reporter sequence producing Green Fluorescent Protein (GFP), in order to evaluate their use for such a biosensor. We evaluated the response of engineered cells employing 96 different promoter sequences to Nalidixic Acid (an antibiotic with low human toxicity but high toxicity to E. coli), Paraquat (an herbicide with pronounced pulmonary toxicity), and Methomyl, (a carbamate insecticide that blocks acetylcholinesterase). This limited set of chemicals addresses a broad range of toxicological mechanisms.

We have shown that certain of the evaluated strains respond to concentrations of these agents that are appropriate for use in assessing water toxicity. They demonstrate a concentration-dependent increase in fluorescence in the presence of the test chemicals.

Our data indicate that a biosensor using a small number of carefully selected engineered cell strains can adequately address a broad range of toxic chemicals in water. When incorporated into a biochip that is currently under development, these cells offer the promise of rapid accurate assessment of water safety.

Awards won at the 2003 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by the Environmental Protection Agency
Honorable Mention Award Certificates for International students and students under the age of 16 - National Aeronautics and Space Administration

2003 - EV073

CARBON EXCHANGE DYNAMICS PHASE III: CARBON DIOXIDE DEPENDENCY OF CARBON AND NITROGEN AVAILABILITY IN A TEMPERATE DECIDUOUS FOREST

Kellen Marie Calinger
Mount de Chantal Visitation Academy Wheeling, WV, United States of America

This research includes a quanification of components of the nitrogen cycle and their responses to CO2. The effects of soil nitrogen availability on C products were investigated. The effects of enhanced atmospheric [CO2] and soil N availability on leaf N content was studied. An instrument was designed that extracted soil gases from the root and below root zones of sugar maple saplings grown in varying CO2 and soil N environments; this instrument was used in studying the effects of elevated [CO2] and soil N levels on [PCO2] of the varying soil rooting zones. The SLA was determined in relation to atmospheric [CO2] and soil N availability.

 The trees grown in increased soil N environments experienced elevated leaf [N]. The leaf [N] of the tree in the increased CO2 environment displayed decreased leaf [N] in the first two testing periods. The leaf [N] spiked in two later fall testing allowing stimulation of decreasing photosynthetic rates. The ambient environment experienced stable leaf nitrogen.

 Increased soil [N] caused an increase in [carbonate] of both rooting zones of the increased soil nitrogen environment and the increased CO2 and nitrogen environment.

 The increased CO2 alone environment experienced elevated soil [carbonate] in the rooting and below rooting zones.

 The [PCO2] followed similar trends to those of the [carbonate] in the rooting and below rooting zones.

 The combined increased CO2 and soil nitrogen environment displayed the highest SLA. The increased CO2 alone and the elevated soil nitrogen environment experienced heightened SLA. The ambient environment experienced the lowest SLA.

2003 - EV074

TO DRINK OR NOT TO DRINK? AN INVESTIGATION OF THE TREATMENT METHODS FOR REMOVAL OF NITRATES IN DRINKING WATER

Marcie Malaj

Grants High School, Grants, New Mexico, USA

Last year's project found that carbon filtration was successful in removing mercury, but not nitrate, from water sources tested.

This project investigated the best method for removing nitrate from water. Methods investigated were filtration: with activated carbon, ion exchange beads (cation and anion), and peat moss. the hypothesis was anion ion exchange beads would remove the most nitrates from water. Peat moss would demonstrate the ability to remove nitrate. The activated carbon filter would show no decrease in the concentration of nitrate. Chemical denitrification would reduce nitrate concentration, but not as much as other methods.

Different filtration columns were made/tested, running 100mL samples of 1000 ppm NaNO3 through each. Before and after water was filtered, nitrate concentration was tested with the PASCO nitrate ion selective electrode. Readings were compared to the developed Nitrate Standard Curve, and the best removal process determined.

Experiments showed the chemical denitrification method removed the most nitrate, ~992 ppm. The anion exchange beads worked well, removing ~990 ppm. Peat moss removed ~985 ppm while carbon filtration removed ~225 ppm. the cation beads did not work, in fact they increased nitrate concentration. The final filter apparatus was a combination of activated carbon, peat moss, sand, and gravel. When tested, it removed ~91 ppm from a 100 ppm nitrate solution. The nitrate removed by this filter brings the nitrate level below the EPA standard of 10 ppm in drinking water.

2003 - EV075

WHERE GOLF BALLS AND BIOTECHNOLOGY MEET-CONTROL OF SCLEROTINIA HOMOEIO- CARPA IN TURFGRASS USING EFFECTIVE MICROORGANISMS

Shannon Elizabeth Ward

Childersburg High School, Childersburg, Alabama, USA

Golf courses in the United States spend tons of millions of dollars each year on fungicides to control a turfgrass disease called Sclerotinia Homoeiocarpa. Control methods often involve the application of chemicals (fungicides) to suppress the growth of these disease-causing organisms. Most of these fungicides are extremely harmful to humans and the environment. The purpose of this experiment is to produce and test a mixture of naturally occurring microorganisms for effectiveness (as a safe, low cost, biological control) against the growth and development of Sclerotinia Homoeiocarpa disease in golfcourse turfgrass. Thus, reducing the input of harmful, chemical pesticides into the environment. I hypothesized that a mixture of compatible, effective, beneficial, non-pathogenic microorganisms (both aerobic and anaerobic) can be combined with molasses, wheat bran, and water to produce an old Japanese compost called "bokashi". And, that this homemade compost can be used to suppress the growth and development of dollar spot (Sclerotinia Homoeiocarpa) in golfcourse turfgrass. A test site was located at a local golfcourse where a sample of diseased turfgrass was taken and identified under the microscope as dollar spot disease. A homemade compost called "bokashi" was made and used to treat the infected area for six weeks. Results suggested that EM bokashi significantly inhibited hyphal growth of Sclerotinia Homoeiocarpa. Increased turf quality was also observed. Further investigations into the beneficial use of bokashi may lead to other biological based technology in environmental systems, shutting out the use of fungicides and pesticides altogether.

2003 - EV076

THE EFFECT OF GLOBAL CHANGE ON DECOMPOSITION: LIGHT AVAILABILITY, STANDING LITTER, AND GROWTH ENVIRONMENT

Grace Hsu

Saratoga High School, Saratoga, California, United States of America

Within the past century, pollution has increased rates of nitrogen deposition and precipitation and caused rising levels of atmospheric carbon dioxide and heat. This study investigated whether these trends affect litter decomposition rates through plant mechanisms such as senescing times, biomass production, and species composition.

 Since 1997, elevated carbon dioxide, heat, precipitation, and nitrogen deposition treatments have been applied to a 150-meter-wide portion of California grassland. For this study, censuses were collected in the fall of 2002 to measure the amount of litter in each treatment plot. Litter differences between ambient plots and elevated treatment plots were examined by correlating senescence, biomass production, and species composition data gathered from the spring of 2002.

 Data showed significantly less fall litter in heated plots than in ambient heat plots. Also, the amount of fall litter in all treatments correlated strongly with the grass population data, a measure of species composition. For example, ambient heat plots displayed both increased litter and larger grass populations than did heated plots. This suggests that grasses may slow decomposition rates since they are physically farther away from the soil, where the fastest decomposition occurs, and since they have a higher carbon-to-nitrogen ratio than the other plants that make up the subject ecosystem.

 The study supports the hypothesis that warming accelerates litter decomposition by altering species composition. Accelerated decomposition could pump more carbon dioxide into the atmosphere, weakening carbon sinks and expediting the warming trend.

Awards won at the 2003 ISEF

Summer internship - Agilent Technologies

First Award of \$1,000 in Environment - American Society of Agronomy

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV077

SEASONAL AVAILABILITY OF MACROINVERTEBRATES AS A FOOD RESOURCE FOR MIGRATORY WATERFOWL ALONG THE MISSISSIPPI FLYWAY

Daniel Boyd Grubaugh

White Station High School, Memphis TN, United States

Aquatic macroinvertebrates are a potentially important food resource for migratory waterfowl; however, little is known about how management practices and seasonal changes affect the availability of macroinvertebrates to waterfowl. During spring of 2002, I sampled macroinvertebrates in differently managed wetland habitats at two wildlife refuges in central Mississippi. Management schemes sampled included: deep water (flooded year-round); millet (drained in summer to plant millet); shorebird (drained to provide food for shorebirds); catfish ponds (permanent aquaculture ponds); and duck potato (drained in spring to plant duck potato). Sampling took place immediately prior to the peaks of waterfowl migration. In the fall, deep management supported significantly higher biomass than other management regimes (ANOVA and Student-Neuman-Keuls, $\alpha = 0.05$). In the spring, millet supported the greatest biomass. No significant differences were seen in richness. In these five managed habitat types, macroinvertebrate biomass ranged from approximately 5 to 30 g/m², which is much greater than estimates normally suggested by waterfowl managers. Thus, these results indicate that each of these management schemes is effective in producing ample macroinvertebrate biomass as a food resource for migratory waterfowl.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency
Honorable Mention - North American Benthological Society

2003 - EV078

PAVING PARADISE: DESIGNING AN ENVIRONMENTALLY FRIENDLY PARKING LOT ON WATERFRONT PROPERTY USING PERVIOUS SURFACES TO REDUCE HARMFUL URBAN RUNOFF

Alice Marie Bagley

Saginaw Arts and Sciences Academy; Saginaw, Michigan

The purpose of this project was to find a parking lot design that best reduces polluted urban runoff on waterfront property without reducing parking capacity or significantly changing the original site design. Urban runoff is one of the largest contributors to poor water quality in urban areas. The principle cause of this pollution source is the large amount of impervious surface area (roads, parking lots, buildings) in urban centers.

This project tested four different designs: (1) a parking lot with two thick filtration islands running parallel to the riverbank (red parking lot), (2) a parking lot with narrow planted swales running parallel to the river and sloping towards shallow retention ponds on either side (yellow parking lot), (3) a normal parking lot (green parking lot), and (4) a parking lot with three thick filtration islands running perpendicular to the river (blue parking lot). Each design was turned into a scale model built in a plastic container. Oil-based clay models of the parking lots represented the impervious surface of the parking lot and soil mixed with activated carbon represented the natural filtering capabilities of soil. Each model included a "river," created by using a piece of mosquito screen to separate the "river" from the land and still allow for passage of runoff. The models were tested three times after administering 12 sets of 44 mL of water with food coloring in it at 30 minute intervals. After each of the three trials, samples were taken from the "river" of each model. The samples contained sediment, which was filtered out before they were tested using a spectrophotometer.

The results from the spectrophotometer showed that the yellow parking lot, despite having the largest impervious surface area, was best at reducing the amount of dye in the runoff. This proves that layout and other design features are more important than the amount of surface area with impervious surfaces.

Awards won at the 2003 ISEF

Fourth Award of \$500 - U.S. Coast Guard

2003 - EV079

THE EFFECT OF MICROBIAL AGENTS IN CLEANING OIL SPILLS

Sophy Hem

Warren Central High School, Bowling Green, Kentucky, U.S. of America

Barren River flows throughout South Central Kentucky in 10 different counties providing the area with parks, resorts, many jobs, and is Bowling Green's main water supply.

This project examines effects of diesel fuel on the bacterial population number.

I postulate that Barren River contains species of bacteria needed to degrade diesel fuel and at proper diesel concentrations, will increase in population.

For a baseline total aerobic heterotrophic bacteria count, a serial dilution was performed on a control Barren River water sample and control diesel fuel sample. Duplicate spread-plate counts were conducted at dilutions of 100-10-5. Three experimental flasks containing 0%, 1%, and 10% diesel fuel with Barren River water were incubated at 150 Celsius for 14 days.

Total aerobic heterotrophic plate counts were then performed to a dilution of 10-7 and incubated as before. (Due to the potential pathogenicity of the bacteria, the supervising scientist handled the plates during counting. Plates were kept closed at all times.)

Gram stained smears, oxidase and catalase tests were performed using a laminar flow hood and proper precautions pertaining to potential pathogens. All isolates were gram negative. 5 characterized as presumptive Pseudomonas: positive catalase and oxidase, and 1 characterized as presumptive acinetobacter: positive catalase and negative oxidase.

Bacterial counts showed 0% diesel had a 1 fold increase, over control plates, a 4 fold increase for 1% diesel, and a 3 fold increase for 10%. The decreased count at 10% could indicate the bacteria were reaching toxicity level.

2003 - EV080

A COMPARATIVE STUDY OF VARIOUS CAFFEINE SOURCES AGAINST THE ACHATINA FULICA

Claire Abigail Young

Leone High School, Pago Pago, American Samoa

The giant African snail (*Achatina fulica*) is considered to be one of the most damaging land snails in the world. Previous study has shown that caffeine solutions

are effective in repelling certain garden pests. The purpose of this study was to prove that various caffeine sources can be used to repel against the *A. fulica*. A series of six trials was conducted, using three caffeine sources: ground coffee, instant coffee and caffeine pill (0.2g). Water served as the control in this study. Caffeine percentage for each of the three caffeine sources was calculated; ground and instant coffee solutions (0.1%)[180mg caffeine/6oz coffee] and the caffeine pill solution with a 2 % caffeine solution. The average activity of the African snails that were treated with the caffeine solutions were compared to the activity of the African snails that were treated with the water (control). Following the first trial, the African snails became lethargic, affecting their feeding behavior. Average activity of the African snails treated with the caffeine solutions was 1; average activity of the snails exposed to the water (control) was 5. Results of this study indicates that the ground coffe solution was most effective in repelling against the *A. fulica*.

2003 - EV081

THE EFFECT OF AN EQIP CATTLE CROSSING ON A STREAM'S WATER QUALITY

Amy Sue Garrison

Onsted High School, Onsted, MI 49265, United States

The purpose of this project was to determine if a cattle crossing developed through the government funded EQIP program had an affect on the pH, turbidity, temperature, flowrate, or number of fecal coliform bacterial colonies in a stream. The hypothesis was if the cattle crossing were installed then the overall quality of the water will increase because there would be less sediment disturbance and fecal waste being directly distributed into the stream. Three locations on the stream were picked before the cattle crossing was activated, one at the crossing, the second five yards downstream, and the third ten yards downstream. Each location was tested once before the cattle crossing was completed, and then twice more after the crossing was activated. Each trial was done three weeks apart. Three water samples were taken at each location then tested for turbidity, pH, and placed in Petri dishes to grow fecal coliform bacteria. It was found that the cattle crossing did have a drastic affect on turbidity, and possibly on the fecal coliform bacteria. The pH changed slightly, it went from in the 6-7 range to the 7-8 range. Flowrate continued to remain the same throughout the entire experiment. Temperature also dropped drastically, as the weather became colder.

The conclusion is that when a cattle crossing is in place not allowing cattle to walk through the stream the turbidity, and amount of fecal coliform bacteria decreased. The pH changed slightly, the flowrate remained constant, and the temperature dropped with the weather.

2003 - EV082

PHYTOREMEDIATION OF EXCESS NITRATES IN GROUNDWATER: COMMON CATTAIL VS. HARD-STEMMED BULRUSH

Kristina Ann Ufer

Bellarmino Preparatory School, Tacoma, WA, USA

Hlgh concentration levels of dissolved nitrogen in groundwater pose a threat to fresh water ecosystems in Washington State. Phytorememdiation using native wetland plants could be the answer to this problem.

The common cattail and hard-stemmed bulrush are co-dominant native species of Washington wetlands. It is predicted that both species will be equally effective in removing the excess nitrogen. An equal amount of cattails and bulrushes are raised in several continuous flow water systems filled with a solution of high nitrogen content. At the end of two months, the plants are analyzed ot determine the effectiveness of each species in the removal of nitrogen.

An analysis of the results show that cattails are more efficient in the uptake of dissolved nitrogen. Future research includes determining the rate that cattails remove dissolved nitrogen and how long it would take to rehavillitate a wetland by using this process.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

First Award of \$500 - National Ground Water Association

2003 - EV083

THE IRON HYPOTHESIS

Moses Ali Hassan

Woodhouse College, London, UK

As early as the 1930's scientists noted the potential role of iron as a limiting factor in phytoplankton productivity because of its extreme insolubility in today's oxygenated oceans. Direct evidence of the role of iron in phytoplankton ecology is difficult to obtain but its potential as a limiting factor is deduced from the fact that in early evolution the lack of oxygen meant increased iron solubility. More recent studies have suggested that iron levels are as low as ten percent of requirements.

 This study sets out to investigate if increasing phytoplankton productivity (by the addition of extra iron) would ultimately lead to increased carbon dioxide uptake. If successful, this model may make a contribution to reversing global warming.

 Under laboratory conditions several marine tanks were set up and inoculated with selected phytoplankton species under standard lighting conditions. Different concentrations of soluble iron were added (in the form of Iron (II & III) Sulphate) to the tanks and the growth and photosynthetic rates of the phytoplankton species were measured at regular time intervals.

 Results from the various treatments show that increasing the levels of soluble iron under laboratory conditions does lead to increased growth rates. However, indications are that there is a threshold level, after which detrimental side effects may occur. As a part of further research, a mathematical model (Initially simplified) will be programmed. Additional experimentation will then provide the necessary data to refine the computerised model, producing an accurate model that can demonstrate the possible consequences of engineering climate on such a large scale.

2003 - EV084

A STUDY OF THE PHYTOREMEDIATIVE PROPERTIES OF THE WATER HYACINTH

Jean Marie Folsom

Yorktown High School, Arlington VA, USA

As water hyacinth become increasingly numerous in environments throughout the United States, the possibility for using these plants to societies' benefit becomes very real. Although plants are occasionally employed to remove toxic metals, it is organic contaminants that pose the greatest threat to aquatic ecosystems.

The purpose of the experiment was to test the phytoremediative potential of the water hyacinth in removing MTBE, atrazine, and diazinon from aquatic ecosystems. It was hypothesized that the water hyacinths would be able to remove the contaminants at a significant rate as well as increase dissolved oxygen. Each contaminant was put into containers with 33L of water at levels of 500ppm, 100ppm, and 1000ppm respectively. Two containers in each of the contaminant groups held plants ("treatments") and one was left as a control. Using a gas chromatograph, levels of the contaminants were tested every three to four days for 31 days and dissolved oxygen was tested using the Winkler titration method. Each treatment group significantly removed its respective contaminant. Almost 99% of both diazinon and atrazine was removed and 81% of MTBE was removed from "treatments". Dissolved oxygen increased over time.

Following the experiment, tissue samples of the root systems were tested for two weeks for each contaminant. By the second week, amounts of the contaminants were undetectable. This study delved into a field of phytoremediation that had previously been primarily uninvestigated - organic contaminants in aquatic ecosystems. The promising results that the study yielded were more impressive than conventional treatments and much less expensive. Future experimentation will include nutrients to increase uptake.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency
Second Award of \$250 - National Ground Water Association

2003 - EV085

PASSIVE REMEDIATION OF ARSENIC AND ZINC USING PERMEABLE REACTIVE BARRIERS

*Douglas Calvin Naftz, Park City High School
Park City, UT, USA*

Drinking-water sources that were sampled in Park City, Utah contain elevated concentrations of arsenic, a known carcinogen. With measured levels as high as 50 ug/L selected water sources are at or just below the current (2003) EPA standard for arsenic in drinking water. Water samples from Silver Creek, also in Park City have zinc concentrations that exceed the aquatic life standard of 388 ug/L. Elevated concentrations of zinc can kill fish by limiting oxygen uptake by the gills.

My laboratory experiment focuses on removing arsenic and zinc using permeable reactive barriers (PRB's). This method is cost effective, environmentally sound, and could help water treatment plants meet the new arsenic standard of 10 ug/L that will be implemented in 2006. Laboratory experiments conducted found a 63% reduction in arsenic concentration after flowing through gravel reactive media (gravel mixed with iron pellets). Based on the laboratory results, PRB's containing iron pellets could be placed in Spiro Tunnel to remove the majority of the arsenic before the water entered the Park City water treatment plant. Removal of arsenic before the water enters the treatment plant could result in less cost to remove arsenic within the plant. PRB's have also proven effective in the remediation of zinc, using the reactive media of calcium carbonate and iron. Ongoing research is in progress concerning the removal of arsenic in drinking water using a cost effective and easy to use device similar to a PRB with the same reactive material for possible use in developing countries.

Awards won at the 2003 ISEF

First Award of \$1,000, a certificate and the book "Origins, the Evolution of Continents, Oceans and Life" by Ron Redfern, inscribed by the AGI Chief Judge - American Geological Institute
Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV086

QUANTITATIVE ANALYSIS OF CUTIN PRODUCTION IN PINUS STROBUS

*Susan M. Pedicini
Revere High School, Revere, MA, USA*

Acid rain destroys plants by penetrating the waxy surface of their leaves, called a cuticle, made of a wax called cutin. Once this coating is gone, the plant is susceptible to diseases, which ultimately kill the plant. A Paraffinic oil solution protects plants from these effects by supplementing their cuticles. While acid rain decreases the thickness of the cuticles, Paraffinic oil increases their thicknesses. I believe that it is possible to stimulate plants to thicken their own cuticle by increasing their cutin production. This may be accomplished by watering plants with coral calcium-infused water. Coral calcium is a form of calcium in which 95% of the calcium can be absorbed, as opposed to the usual 15% maximum. To test this hypothesis, a group of Eastern White Pine tree saplings were taken and sprayed with acid rain for 0, 10, 20, 30 or 40 days, after which I watered them with coral calcium-infused water for 30 days. After the acid rain, the cuticle thicknesses decreased, as was expected. After the treatment, the damaged cuticles increased in thickness, repairing and regenerating the lost parts of the cuticle. The "new" cuticle behaved as a normal cuticle--decreasing at the same rate as the original cuticle when once again exposed to acid rain. As a result, the conclusion was reached that coral calcium will stimulate plants to produce more of their own cutin, thus increasing the thickness of the cuticles naturally, helping the plants repair themselves from acid rain's damages.

2003 - EV087

YEAR TWO: AN EXPANDED AND REVISED TEST OF VARIOUS POLLUTANTS OF THE GROWTH AND REGENERATION OF PLANARIANS (USING LAST YEAR'S MAXIMUM)

*Alison Christine Rice-Swiss
Lexington High School, Lexington Massachusetts, United States*

The purpose of my experiment is to determine the effect that soluble copper, which is currently a widespread pollutant, has on planarians living in environments that differ in the availability of Biotin, an essential growth-promoting vitamin. A significant process during the lives of planaria, a genus of aquatic flatworms, is their ability to regenerate their bodies, which is their main method of reproduction and of repairing lost body parts

 The purpose of Stage 1 was to create simulations of four different environments, varying in their amount of biotin concentration, in order to determine the normal subsistence and regeneration patterns in several natural environments. All procedures that I used in Stage 1 this year were identical to Stage 1 from Year One, except that the naturally occurring biotin concentrations were more precise, based on findings from scientific journals. The purpose of Stage 2 was to determine the maximum amount of copper pollutant that could be imposed on the severed planarians (in environments that were not enhanced with biotin) and still allow the planarians to demonstrate normal regeneration patterns. Additionally, the results from all eight concentrations of copper in Stage 2 were examined for evidence of the effects of the physiological effects that copper pollutants have on normal organism existence. The purpose of Stage 3 was to determine the synergistic effects of a constant concentration of copper pollutant in environments with different concentrations of naturally-occurring biotin. The results demonstrated that indeed there were synergistic effects between the copper pollutant and biotin. This would suggest that the current EPA regulations, which do not account for these synergistic effects, must be developed further.

2003 - EV088
REMOVAL OF ARSENIC RESIDUES FROM DRINKING WATER TREATMENT SLUDGE

Balaji V Sridhar
Cherry Creek High School, Greenwood Village, CO 80111

The source water in many public drinking water systems contains Arsenic(As)at levels above the regulatory limit of 50 parts per billion (ppb). The most common method to reduce As concentration is coprecipitation in ferric hydroxide sludge. The high As levels present in the sludge, make it a toxic waste, requiring special disposal methods. Any process that decreases the volume of sludge would be of environmental benefit. My approach has included the following three paths:

1. Isolating As resistant bacteria from the sludge and measuring their ability to adsorb As: I isolated many As resistant bacteria (aerobic and anaerobic)from a sludge sample containing 300,000 ppb of As. I tested ten of these isolates for As adsorption, plus two additional bacteria not isolated from the sludge. None of the twelve bacteria tested exhibited As adsorption.

2. Selective removal of As from the sludge: I hypothesized that I could elute As from the ferric hydroxide sludge by selective anion competition. Experimental data developed, demonstrated that this hypothesis is true.

3. Use of Sulphate Reducing Bacteria (SRB) to precipitate As: The competitive anion solution eluted from the ferric hydroxide sludge is diluted and used to produce a culture medium to support the anaerobic growth of SRB. The SRB generate sulphide anion, which reacts with the As and other metals to produce insoluble As and other metal sulphides. This is removed by centrifugation, thus greatly reducing the volume and mass of material that requires disposal.

2003 - EV089
CONTROLLED BURNS ON PURPLE LOOSESTRIFE

Jesse Nelson Otis, Mohawk Trail Regional High School
Shelburne Falls, MA, USA

The purpose of this project was to see if a controlled burn would be an effective means of controlling Purple Loosestrife. Purple Loosestrife is an invasive plant, which means that it goes in to places where it is not native and grows rapidly pushing out the other living organisms there. For my procedure I simulated a controlled burn then tested the burned seeds to see if they would germinate.

The results of this project were very decisive. The seeds that were put through the controlled burn simulation did not germinate and would not grow. Also the control group, the seeds that were not burned, germinated at around 80%.

From analyzing these results I concluded that a controlled burn would kill the seeds of Purple Loosestrife. If the seeds were killed then this could help control the Purple Loosestrife population. I could tell that the controlled burn simulation killed the seeds because they did not germinate and the control group did.

2003 - EV090
GRASS FOR BIOMASS

Danielle Marie Wilson
West Central Valley High School, Stuart, IA, Guthrie

In the world today energy sources are becoming hard to find, very expensive to use, and most are nonrenewable. The purpose of this project is to determine which type of biomass will produce the most calories per acre. The types of biomass being explored are: switch grass, prairie grass, brome grass, reed canary grass, and corn stalks.

It was hypothesized that the switch grass will produce the highest yield in grams, the highest calories per gram, and the highest calories per acre. Five different grasses from 15, 1 sq ft areas were collected, weighed, and tested in a bomb calorimeter to measure calories. It was thus able to determine which type of grass would produce the most calories per acre.

The data collected shows that the prairie grass had the most energy per acre with 1.97E+10 calories. It had the highest yield of 115.96 in grams/ sq. ft. The switch grass had the least energy per acre with 6.8E+09 calories. It had the least yield of 40.95 in grams/sq. ft. After performing economic calculations for the operation of each of the grasses it was found that the prairie grass would have the lowest harvesting cost per calorie per acre.

In conclusion, the prairie grass had the most calories per acre and also had the highest yield in grams. My hypothesis was not supported, as the switch grass did not have the highest calories per acre, highest yield in grams, or the highest calories per gram.

2003 - EV091
THE EFFECT OF AGRICULTURAL AND RESIDENTIAL RUNOFF ON THE MICROBIOLOGY OF A HAWAIIAN AHUPUA'A

Kiana Laieikawai Frank

Kamehameha, Kailua, HI, US

The objective of this project was to study the relationship between environmental runoff and the incidence of antibiotic resistant bacteria in freshwater streams. Five water systems were studied along the windward coast of the island of O'ahu. Collection sites along the watercourse included sites upstream of residential or agricultural areas, throughout these areas, and sites of entrance into the sea or bays. It was hypothesized that the incidence of antibiotic resistant microorganisms would increase as the stream was fed by runoff from residential and agricultural areas. The percentage of antibiotic resistant microorganisms did not increase as the stream passed through residential or agricultural areas, contrary to what had been expected. Surprisingly, "pristine" sites well upstream from residential or agricultural areas contained bacteria resistant to at least one antibiotic. Areas most affected by runoff did not show a significant increase in the incidence of antibiotic resistant organisms, thus indicating that the incidence of antibiotic resistance is not correlated with agricultural or residential runoff. The correlation of antibiotic resistance with heavy metal resistance was evaluated because it had been shown by others that antibiotic and heavy metal resistance are each carried on extrachromosomal plasmids. The vast majority of antibiotic resistant microorganisms were also resistant to concentrations of heavy metals reported in the sediments of indicator streams (Waihee, System III) suggesting that an antibiotic resistant bacterium has a high probability of having dual resistance to a heavy metal. A 3.2kb plasmid (pSTAMP) was isolated from a bacterium with dual antibiotic and heavy metal resistance. Further analysis of the plasmid is currently in progress.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

Second Award of \$150 - Patent and Trademark Office / U.S.Department of Commerce / Patent and Trademark Office Society

2003 - EV092

DECOMPOSITION OF NEWSPAPER IN A LANDFILL

Samantha Adriana Conroy

Conroy Learning Center, Export, PA, USA

This project intended to find a way to increase decomposition rate of newspaper inside a landfill. Research was done on three agents, Amylase Enzyme, Yeast with Yeast Energizer, and Campden Tablets. It was found that Campden Tablets contain Potassium Metabisulphite, and kill yeasts and bacteria in winemaking ingredients. Yeast Energizer contains Nitrogen and Potassium. Amylase Enzyme's normal function is to break down starches into sugars. Based on research of enzymes, pH, temperature, and nitrogen, my initial hypothesis was that adding Yeast Energizer and Amylase Enzyme would increase decomposition, while Campden Tablets would decrease decomposition.

 Eight simulated landfills were built, using 4" PVC pipes cut into 2' lengths. The landfills were filled in layers with dirt, biodegradable and non-biodegradable plastic, newspaper, Acrylic and Natural string, batteries, and organic garbage to simulate actual landfill conditions. The three agents were introduced weekly in the form of leachate, and pH and temperature were recorded.

 After two months, the landfills were opened and newspaper samples extracted. A tensile strength tester was built and the tensile strength recorded along with pH and temperature. It was found that Campden Tablets had the greatest effect on tensile strength. However, Amylase Enzyme's and Yeast Energizer's effect was greater than the control's. Future studies are planned to understand this and to further increase degradation rate of lignin, cellulose and hemicellulose which comprise a woody fiber's wall.

2003 - EV093

WASTE NOT, WANT NOT III ENVIRONMENTAL IMPACT OF ENGINEERING CHANGES TO LIQUID LAUNDRY SOAP PACKAGING

Benjamin Allen Huffman

Heritage Christian School, Indianapolis IN, USA

Product packaging overuses materials, making the disposal of waste a major problem. The liquid laundry soap (LLS) industry is an area where this problem can be quantified. LLS waste is manifested in the addition of plastics containing additives like birth defect causing BPA to overflowing landfills, and water systems plagued with uncontrolled surfactants. Past years of research show that modifying the method of LLS delivery results in significant reductions in waste. This year's research indicates that by using water-soluble gelatin capsules filled with LLS gel, further reductions in waste are obtained while retaining high consumer satisfaction levels.

 Atomic Absorption testing was conducted to determine if lead chromates are used in LLS bottles. No published lead testing for HDPE could be found during my research. Energy stored in the packaging required for each LLS delivery method was measured. A market survey was conducted to determine consumer acceptance ratings of different LLS delivery methods.

 Testing showed dissolvable gel caps delivered LLS more accurately and required 50% less plastic. Consumer testing indicated higher consumer satisfaction ratings for gel caps than for bottles. (A larger user test population would be a valuable supplement to this research). Stored energy tests show that the amount of bottles discarded per week potentially contain enough energy for 2916 megawatt hours of electricity. The AA test results indicated the presence of a substance that interfered with the detection of lead. Anodic Stripping Voltammetry(AMV) may be a viable alternative method.

 Overall, dissolvable gel caps were shown to have promise as a method of delivering LLS.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV094

THE BIOHAZARDOUS EFFECTS CIGARETTE FILTERS HAVE ON DAPHNIA MAGNA.

Emily Jane Gubbels

Laurel-Concord, Laurel, Nebraska, USA

Cigarette filters trap carcinogenic chemicals that smokers don't want in their bodies, and these cancer causing agents are introduced into the environment when the cigarette is not disposed of properly. If the filters got into the water it is believed that toxic chemicals would be discarded, and if Daphnia magna were exposed to the polluted water, how would it effect their life? Cigarette filters were added to culture dishes with 1 liter of water and about 50 Daphnia magna. Study 1- Different numbers of smoked cigarette filters were added to the culture dishes. Study 2- Different numbers of clean cigarette filters were added to the culture dishes. Study 3- Smoked cigarette filters were cut up into 1/4, 1/2, & 3/4 and were added to the culture dishes. Study 4- Heart rates of Healthy and Exposed Daphnia magna were compared. Study 5- A "smoking" machine was built to put "smoke" water of one cigarette into the culture dishes. Study 6- Different amounts of "smoke" water from the "smoking" machine was added to the culture dishes. Study 7- Duckweed was added along with the smoked cigarette filters.

CONCLUSIONS: Study 1- All Daphnia magna were effected in less than 24 hours. Study 2- Nothing happened to the Daphnia magna. Study 3- All had different effects. Study 4- Heart beats show to be different. Study 5- 500 ml of "smoke" water killed all Daphnia magna within 17 hours. Study 6- All were effected within 5 days. Study 7- Is still underway.

2003 - EV095

BECAUSE YOU'RE WORTH IT

Haesue Jo

Oak Grove High School, San Jose, CA, U.S.A.

The purpose of this experiment was to show that hair dye is damaging. The experiment was performed in order to demonstrate the weakening powers of dying one's hair. The procedures which were followed include collecting hair samples, dying the hair, and measuring the width and strength of the hair samples. Three types of hair were taken and dyed three times using the same hair dye. Samples of hair after each hair dying session were kept as controls. Using a special microscope connected to a computer, the hairs' widths were measured. To test the strength of the hair, the hair was taped to two ring stands and a paperclip was hung by the hair with the point bending out. Washers of various weights were added to the paperclip until the hair snapped and however many weights the hair could hold showed how strong it was. The hair physically changed width-wise by getting thinner.

Treatment Width (in microns)

Un-dyed 128.3

1st dye 122.6

2nd dye 106.5

3rd dye 102.6

Total change 25.7

In conclusion, the hair did get weaker by getting both thinner and weaker in strength. The thicker your hair is, the more it will be affected. Your hair is most damaged after the second dye because the first dye is just a one time thing and by the third time, the hair is so fried up, there is not really much more damage to be done.

2003 - EV096

REDUCTION OF TEXTILE POLLUTION WITH NATURAL PRODUCTS

Kacee Jo Bootsma

Sunnyside High School, Sunnyside, WA, United States

Objectives: To determine the effectiveness of commercial chitin, raw potatoes and turnips to remove dye from wastewater. To determine which dye creates the best stain.

Methods: 100g of the plant tissue was placed into 50ml of water, boiled for 10 minutes, and then filtered to create the dye. Each solution was measured spectrophotometrically. A 10cm x 10cm piece of fabric was placed into 15ml of that same dye. The fabric remained in the stain for 5 minutes, 30 minutes and 1 hour. The solution was retested for percent transmittance. To determine which natural product removed the most dye, 5ml of the dye solution was first tested for percent transmittance. Then .5g of chitin was added to the solution for 1 hour. The solution was then filtered and retested for percent transmittance. This procedure was done with 1g of chitin, raw potatoes and turnips for 1 hour, 24 hours and 48 hours.

Results: Red synthetic dye, treated with .5g of chitin for 48 hours, had a percent transmission of 64.6%. This means that the chitin absorbed the red dye the most. The chitin was most effective in removing the blackberry. 1g of chitin for 48 hours was the least effective in removing the blue synthetic dye (8.1%).

Conclusion: The chitin was more effective than the potatoes and turnips in removing all natural and synthetic dyes. .5g of chitin for 48 hours removed red synthetic dye the most. The orange squash was the best natural stain and black was the best synthetic stain.

2003 - EV097

BEET 'DE' ICE: ACETIC ACID YIELDS FROM FERMENTED SUGAR BEET TAILINGS

Kurt Martin Dahlstrom

Hillsboro High School, Hillsboro, ND USA 58045

In this third year of study, I tried a variety of fermentation methods to maximize the production of acetic acid, a critical step in determining economic feasibility in the production of CMA. In my procedures I measured out beet tailings and distilled water into jars. Some had yeast added; others had aeration, acidbacter, heat, or were left to ferment unaided. I measured specific gravity at intervals using a hydrometer, converting that to percent of acetic acid and verifying those values with titration.

The beet tailings that were capped and left to ferment unaided produced an 8% strength of acetic acid, measured by specific gravity. Yeast did not speed up the fermentation or increase the strength. Capping the procedure fermented the tailings in the shortest amount of time and better maintained the acid strength.

I can reliably predict that fermenting sugar beet tailings can consistently produce a minimum of 4% acetic acid solutions, which can produce an effective, environmentally safe CMA. using resulting figures, each of the six sugar beet factories in the Red River Valley could potentially produce between 6 and 8 million gallons of a minimum 4% acetic acid product.

The environmental contributions are readily apparent. Producing acetic acid from fermented sugar beet tailings makes use of a renewable resource and is an innovative use for an agricultural by-product, which benefits rural economic development. The acetic acid is an essential ingredient in the currently produced but expensive de-icer and is also used as an organic weed control product.

2003 - EV098

CORAL PROPAGATION 3 THE EFFECTS OF WATER TEMPERATURE ON THE GROWTH OF ACTINODISCUS MUSHROOM ANEMONES

Lindsay Marine Quandt, Algonac High School
Algonac, Michigan, United States

This experiment was conducted to investigate the effects of various water temperatures on Actinodiscus mushroom corals. I chose this particular species because they have a moderate care level, which allows them to adapt to change in tank conditions. The Actinodiscus mushroom corals are commonly referred to as mushroom anemones. They are solitary anemones that are classified in the order Corallimorpharia. These corals display a wide variety of colors, textures, and patterns.

For this experiment, I tested twenty green, stripped mushrooms (Actinodiscus striatus). I grew five mushrooms in each of the four tanks. The recommended tank conditions were 72-75 degrees Fahrenheit. Keeping that in mind, I set the tanks at the temperatures of 70, 75, 80, and 85 degrees Fahrenheit. To determine the change in growth, I decided to measure the weight of the individual mushrooms once a week. This was done using an electronic balance to achieve exact results. I recorded the weights in a table each time.

The mushrooms were measured for eight weeks. During this time period, physical size changes were evident. The mushrooms grown in the 75-degree water temperature had the largest increase in weight, averaging at 1.368 grams. The mushrooms in the 80-degree also increase in weight, however it only averaged at .618 grams. The mushrooms grown in the 70-degree and 85-degree temperatures actually decreased in weight. The ones grown in 70-degree water lost an average of .718 grams. The mushrooms grown in the 85-degree water lost an average of 1.046 grams.

Awards won at the 2003 ISEF

\$10,000 per year scholarships, renewable annually - Florida Institute of Technology

2003 - EV099

THE EFFECTS OF TIME AND THICKNESS ON THE CONCENTRATION OF FORMALDEHYDE EMITTED BY OSB AND THE ABSORPTION OF EMISSIONS BY AN ARTIFICIAL HUMAN LUNG

Katherine Douglas Van Schaik
Spring Valley High School, Columbia, SC, USA

Recently, asthma has increased dramatically among children. Formaldehyde (HCHO), a carcinogen which causes and exacerbates asthma, is found the building material Oriented Strand Board (OSB), which contains a phenol-formaldehyde resin. Studies have shown that HCHO emissions from OSB exceed the USEPA's minimal risk levels (MRLs) for the inhalation of HCHO. The purpose of this research is to determine how much HCHO is emitted from OSB of different thicknesses and time intervals and to determine through a model how much HCHO can be absorbed into the body via the bloodstream. It was hypothesized that HCHO emissions from OSB would be directly proportional to thickness and time, and that greater thickness and time would lead to increased HCHO absorption through the Optima XP Oxygenator (artificial lung used during open heart surgery) into PlasmaLyte-A (blood substitute primer for the Oxygenator). Squares of 3/8 and 11/16 inch thick OSB were placed into airtight paint cans for 5 and 7 days. Air from half of the samples was analyzed for HCHO without exposure to the Oxygenator, and air from the other half was analyzed after exposure through the Oxygenator. The mean HCHO concentrations (no lung exposure) ranged from 5.224 to 7.709 ppm. When analysis was completed with the Oxygenator, it was found that approximately 4.903-6.820 ppm HCHO was absorbed by the lung. This exceeds the USEPA's MRLs for HCHO. A three-way factorial analysis of variance indicated that the Oxygenator ($F_0 = 1988.40$, $F(1,27) = 4.21$, $p < 0.001$), board thickness ($F_0 = 87.02$, $F(1,27) = 4.21$, $p < 0.001$), and the interaction between the lung and board thickness ($F_0 = 27.84$, $F(1,27) = 4.21$, $p < 0.001$) were statistically significant.

Awards won at the 2003 ISEF

Second Award of \$300 and a plaque - American Statistical Association
Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV100

PROVING ARTIFICIAL SELECTION

John Eric Widloski
Maryville High School, Maryville TN, USA

After successfully increasing the concentration of sodium hypochlorite in controlled water, should the population of selected survivors produce offspring more resistant as a whole than the population of their parents who have no been selected?

 The selected subsequent generations of mosquitoes should as populations become increasingly more resistant to 50% lethal concentrations of sodium hypochlorite in controlled water.

 The preliminary procedure consisted of determining the rate of dissipation of sodium hypochlorite in exposed water through repeated experiments at a filtration plant. Once this was determined, the calculated LC50 was checked to reaffirm its value. Following this, mosquito egg rafts were obtained and grown, then separated according to sex. Ten females and 10 males were introduced to each of 4 containers and were fed weekly blood and sugar meal so as to develop proper proteins for mating. The new egg raft would thus be grown in the same conditions so as to prove the artificial selection of the most resistant in the first generation.

 The results of my experiment proved my hypothesis correct: that successive generations exposed to higher doses of sodium hypochlorite would gradually become more resistant. Through exposure to the predetermined LC 50, 3/5 of the first generation died while hardly any of the second generation felt the effects of the chemicals. Due to genetically inherited traits in the offspring, artificial selection ultimately selected the most able population, bred them exclusively, and produced the most resistant population. These results only verify the effects of non-prescribed antibiotics and their ineffectiveness when taken under the Minimum Inhibitory Concentration, thus allowing the bacteria to become too resistant to effectively treat.

2003 - EV101

DROSPHILA VS. ELETROMAGNETIC

Me Rae Enyard
Me'Lisa Enyard, Moberly, Missouri, U.S.A

Problem Statement

Will electromagnetic radiation effect the mutaion in Drosophila?

Hypothesis

Increasing the electromagnetic rediation (EMR)in the Drosophila environment will effect the mutation.

Materials

Microscope Vials Computer

Meter Reader Timer Fly Nap

Tape Drosophila Melanogater

 or the Fruit Fly

Procedure

1. After I received the first two stock of Drosophila Melangaster some were separated by gender.

2. 3 vials were used each of had 7 males and 7 females.

3. The next set of 3 vials had 12 males in each. The next 3 had 12 females in each.

4. The remainder of the flies were returned to the original stock to be used for the control.

5. The meter reader used to indicate the EMR level from the computer

6. The vials were placed on the computer by tape and then timed.

7. The first set were exposed for 2 hours. The next set were exposed for 4 hours and the last set were exposed for 8 hours a day.

8. This process took 8 weeks and each group of vials were checked daily.

9. Then after being exposed for 8 weeks, the flies emerging from the vials were examined and their sex was noted.

Conclusion

My hypothesis, that by increasing the electromagnetic radiation (EMR) in the fruit fly environment may effect the mutation was proved to be correct. The results had showed that the EMR caused some discoloration in a few flies and development.

2003 - EV102
SOMATROPIN'S EFFECT ON CUCURBITA PEPO

Clary M. Gardner
Gaffney High School, Gaffney, SC, USA

My project was designed to determine the effect of Somatropin on curcutiby pepo (summer squash). If watered with distilled water and dissolved Somatropin, plants would yeild more squash than under normal circumstances. I distributed equal amounts of soil in each plant container and put three seeds in each pot. Then I covered the seeds with equal amounts of soil. I then split the pots into a control group (watered with distilled water) and an experimental group (watered with .75% Somatropin enhanced water). I watered (200 mL) the plants every Tuesday and Saturday for 6 weeks. I made observations during the forty-two days. I measured the success of the plants based on the number of blossoms produced. the Somatropin enhanced plants produced an average of 13 to 14 blossoms as opposed to the 7 to 8 blossoms produced with just distilled water. Somatropin could prove a valuable weapon in the fight against world hunger.

2003 - EV103
A COMPARITIVE STUDY OF SOUTHERN INDIANA URBAN AND RURAL TARDIGRADE POPULATION LEVELS DUE TO SEASONAL ENVIRONMENTAL PH CHANGES

Clayton Benjamin Marshall
Eastern High School, Pekin, Indiana, United States of America

A Comparative Study of Southern Indiana Urban and Rural Tardigrade Population Levels Due to Seasonal Environmental pH Changes

 Clayton Marshall, Eastern High School

 Pekin, Indiana, USA

Tardigrades are invertebrates that are used as an environmental bio-indicator. Problems with acid precipitation are occurring across America's Northeast region. Coal burning plants along the Ohio River Valley are a suspected cause of these problems. The purpose of this research project was to determine the effect of environmental pH on tardigrade populations collected from lichen samples on urban and rural limestone monuments in Southern Indiana. It was hypothesized there would be a positive correlation between environmental pH and species populations. Testing sites were selected from six urban and six rural areas in Southern Indiana, and four tests were conducted during each of the four seasons resulting in a total of 96 samples collected. Lichen samples were placed into distilled water, and the tardigrades were counted. The pH was measured and the tardigrades were removed and preserved. Mounted tardigrades were identified as the following species: Milnisium tardigradium, Echiniscus perviridis, Echiniscus viridis, Echiniscus cavagnaroi, and Echiniscus knowltoni. The 12 month urban pH mean was 7.25 with a total tardigrade population of 96. The 12 month rural pH mean was 7.07 with a total tardigrade population of 1292. The deviation of pH from neutral was statistically analyzed using a t-test and was determined to be highly significant at the 4 x 10-6 level. The correlation between pH and tardigrade population density was statistically analyzed using linear regression and was determined to be significant at the 0.01 level. Based on the data collected the hypothesis was supported.

2003 - EV104
ARTIFICIAL REEFS

Mariela E. Lugo
Colegio Radians, Cayey, Puerto Rico

Coral Reefs are living animals belonging to the coelenterate group. Their life is limited to the tropical area where the water and weather are warm most of the year. As a result, corals provide a safe home for other species. Coral reefs also control the level of carbon dioxide in the ocean, and protect the coast from strong currents and waves acting as barriers. Artificial reefs are habitats created by man to promote the growth of organisms that form reefs. To be able to create an artificial reef, we identified an area with easy access to fresh salt water, then a rope was tied to a cement brick (the structure used to allow the growth of reef organisms) and left under observation for a few months. The longer it is under observation the better the results will be, due to the slow growth of these organisms. At the end you will have a small artificial reef that will help increase the number of corals in that area, and in this way increasing habitats for other animals. In conclusion, artificial reefs can be made and can be of use in the future to protect our environment. I intend to keep this project under observation and try to create a program, for other people to participate.

Awards won at the 2003 ISEF
\$10,000 per year scholarships, renewable annually - Florida Institute of Technology

2003 - EV105

PHOSPHOROUS REMOVAL FROM EVERGLADES AGRICULTURAL AREA FARM DRAINAGE WATER: A THIRD YEAR STUDY

Patrick L Geer

Wellington Landings, Wellington, Fl, USA

Before constructing the flowing marsh, aquatic plants were tested to determine

which were best suited for filtration. The following plants were placed in five gallon buckets containing Everglades Agricultural Area farm drainage water: Ceratophyllum demersum, Chara zeylanica, Eichhornia crassipes, Hydrilla verticillata, Hydrocotyle verticillata, Pistia stratiotes, and Typha domingensis. Prior to conducting the experiment, the total phosphorous content of the farm drainage water and plant biomass was tested. The water phosphorous content was tested periodically throughout the experiment. After four weeks, the plants were removed from the buckets, and a final phosphorous analysis was completed: on the water, plant biomass, and the sediment in the bucket. From the seven plants tested, Ceratophyllum demersum, Chara zeylanica, Eichhornia crassipes, Hydrilla verticillata, and Typha domingensis were chosen for use in the flowing filtration marsh due to their filtration performance.

The above plants were placed into two segmented lysimeters, and water was pumped through. It was determined that the filter marsh described, though effective at removing fifty-seven percent of phosphorous content in the water on average, was unable to reduce total phosphorous content to ten parts per billion, only reaching as low as sixteen parts per billion. Through further investigations, the researcher intends to reduce total phosphorous concentrations leaving the filtration marsh to ten parts per billion.

Awards won at the 2003 ISEF

First Award of \$3,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV106

PHASE II: BIOREMEDIATION OF POLYCHLORINATED BIPHENYL POLLUTANTS IN THE SAGINAW RIVER

Yolanda Marie Brooks

Saginaw Arts and Sciences Academy, Saginaw Michigan, USA

Research has been done to genetically produce a strain of bacteria that can degrade PCBs. The transformed bacteria have yet to be implemented in-situ. However, the natural organisms are available to bioremediate their ecosystem of PCBs right now.

I propose that there is a strain of natural bacteria that can degrade PCBs in the Saginaw River. I also propose that the presence of these bacteria are dependent on the amount of PCBs in the sediment.

To test this, inoculation of sediment bacteria in a chlorine-free media was done. For a carbon source, one culture had biphenyl and 2,4dichlorobenzoate (2,4dCBA) and another had only biphenyl. The media was sampled and analyzed with a mass spectrometer and high performance liquid chromatographer for the disappearance of 2,4dCBA and the addition of benzoic acid, a byproduct of the biphenyl metabolic pathway. The results showed that there was a decrease in the concentration of 2,4dCBA and a slight decrease in benzoic acid. Another study was done to measure the amount of PCBs at four sites along the Saginaw River. PCBs were isolated from the sediment using Soxhlet extractions. An attempt was made to analyze the PCB content, but it didn't yield results because of equipment malfunction. Another study was started to identify the type of bacteria that has biphenyl metabolic pathways. At this time, the species of bacteria has not been named.

The results support that there are bacteria that can degrade 2,4dCBA in the Saginaw River sediment. It has not been proven that there are bacteria that can degrade biphenyl into benzoic acid. The results also cannot support the claim that the amount of PCBs dictates the amount of bacteria that can degrade them.

2003 - EV107

THE APPLICATION OF ALTERNANTHERA PHILOXEROIDES INTO ACID MINE DRAINAGE AS AN ECONOMICAL REMEDIATION CONTRIVANCE OF THE FUTURE

Mary Elizabeth Cole

Demopolis High School, Demopolis, Alabama, United States of America

Acid Mine Drainage (AMD), the devastating effect that takes place when pyrite weathers and reacts with oxygen and water to cause high levels of dissolved metals, effects thousands of miles of water sources throughout the United States. This process occurs naturally by processions of conglomerate geo-chemical and microbial reactions, but these reactions are further induced by mining procedures. Last year's experiment dealt with two aquatic plants (Hydrilla verticillata and Elodea canadensis), and a 16-day observation period of AMD effects on the two plants. The continuation of this experiment dealt with the testing of Alternanthera philoxeroides (alligator weed) in the actual ecosystem. First, inductively coupled atomic-emission plasma spectrometry (ICP) tests were ran on the lake for the determination of analytes (Ag, Al, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, SiO2, Sn, Sr, Ti, V, and Zn). The alligator weed was then extracted from a nearby water source and tested using ICP tests. The alligator weed was then harvested for five months. ICP tests were run weekly on AMD, the plant's new growth, and the plant's old growth, and weekly observations of the plant's structure was made. This experiment was proven to be exceedingly successful in contriving an economical remediation contrivance through the usage of a noxious weed. New Acton Coal Mining of Alabama is now maintaining plant growth and is making an attempt to completely decontaminate the abandoned lake.

Awards won at the 2003 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the Environmental Protection Agency

Honorable Mention Awards of \$50 - Society for Mining, Metallurgy, and Exploration, Inc.

2003 - EV108

BIOLUMINESCENCE: THE ROLE OF ATP IN DETECTING BIOCONTAMINATION

Iyen Abdon Acosta

Oxon Hill High School, Oxon Hill MD, USA

Over the past 15 years, diversified methods have evolved in the detection of microbial contaminants. While detection times have been greatly reduced, the process still required a reasonably large quantity of target contaminant to start with, involving considerable levels of skills for the performance of the techniques. Although bioluminescent methods for the detection of biocontaminants have been known for over 20 years and a number of different pathways exist in nature, the firefly system has proven to be one of the most useful routes to adopt. The purification of the heat-stable Luciferin and the labile enzyme, "Luciferase" by McElroy in 1947 paved the way for the bioluminescent determination of ATP with Luciferin/Luciferase system.

 The experiment made use of the bioluminescent reaction: Luciferin + ATP + O₂ + Luciferase + Magnesium ----> Oxyluciferin + AMP + PPI + CO₂ + LIGHT. By diluting the test samples (pond water, ATP Standard Solution, tap water) as sources of ATP and testing for the light emission using the above reaction, we are able to compare the amount of microorganism (bio-contaminants) present in each test sample. Since the light produced by the reaction is dependent on the amount of ATP present in the reaction and ATP is present in all living cells, the amount of light as measured by the Luminometer is directly proportional to the amount of bio-contaminants present in the test sample.

Awards won at the 2003 ISEF

Full-tuition scholarships - Drexel University
Scholarship award of \$7,000 per year for four, five or six years depending upon the degree program - University of the Sciences in Philadelphia
Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV109

UREA TREATMENT OF SOIL CONTAMINATED WITH ESCHERICHIA COLI O157:H7

Terresa Louise Dodge
Hinckley Finlayson High School

"Urea Treatment of Soil Contaminated with Escherichia coli O157:H7" The purpose of this experiment was to determine if urea treatment would kill Escherichia coli O157:H7 in soil. The experimenter's hypothesis for the experiment is that urea treatment will kill Escherichia coli O157:H7 in soil. The experimenter first completed eight preliminary experiments to enable her to design the final experiment. For the final experiment twelve soil containers were made with 1 inch of topsoil (containing E. coli) and 2 to 3 inches of drainage soil. Next, the topsoil was sprayed every other day with a water urea mixture. The topsoil was tested for E. coli every time before it was treated with urea. Last, the results were analyzed. The data supported the hypothesis. The analyzed data showed that the urea increased the rate that the E. coli died and that water decreased the rate in which E. coli died. This experiment was conducted in a designed experimental format. The experiment is in the field of environmental science.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV110

"THE SLICK KILLER"

Kimberly Nichole Trawick
Shades Valley High School/JCIB, Birmingham, Alabama, USA

This project was the result of hearing several stories about water pollution. The idea was to test the effects of boating oil on Elodea densa plants. The experiment introduced different amounts of oil to a plant's environment. The results showed how much oil it would take to begin affecting the plants. This in turn showed that there needs to be a fast response to clean up oil pollution before plants die.

The research conducted on water pollution demonstrated that three to six million tons of oil is spilled every year. This research also showed that cell structures of plants are affected and distorted by the pollution.

An apparatus containing a Gro-Light was built for the experiment. The five fishbowls sat under the Gro-Light for a 12-hour period each day during the experiment. The plants were placed in the fishbowls and allowed to root for a week. The oil was added to the bowls and left for a week to determine the effect of pollution. In less than a day, the plants in the fishbowl with the most oil started dying. By the end of the experiment, the plants in the last two fishbowls were almost completely dead. The ones in the third bowl were dying and the second fishbowl was barely harmed; however, the control group was very healthy. In conclusion, the more oil in the water, the faster the plants died.

2003 - EV111

PROPELLER GUARD MANIPULATION ON THE REDUCTION OF SECONDARY PRESSURE WAVES AND TURBIDITY

Paul Gregory Mueller
Hilton Head High School, Hilton Head Island, SC, USA

Extensive boat traffic has caused problems of increased turbidity in shallow, coastal estuaries and rivers. As the propeller of an outboard boat engine rotates, it produces high frequency pressure waves, which are directed toward the bottom of the riverbed. Pressure waves are responsible for re-suspended sediment and increased turbidity levels, an optical property based on the scattering of light. As turbidity increases, less sunlight reaches the bottom and the photosynthetic rate of aquatic plants on the river floor greatly decreases. Decreasing dissolved oxygen manifests adverse effects on various macro and microorganisms, and increased turbidity is especially damaging to bivalve mollusks such as oysters. Three different modified Hydro-Foil propeller guard apparatuses were designed and engineered with high impact plastic and Plexiglass. It was predicted that these devices would substantially reduce secondary pressure waves while maintaining motor performance integrity. Field-testing was conducted using a 16-ft. boat with a 40 hp outboard engine. Measurements taken were based on direct effects on pressure fluctuation and indirect effects on turbidity levels. A pressure transducer was used in different fixed three-dimensional positions underneath the boat engine to measure pressure difference, and a nephelometer was used to measure turbidity levels. Additionally,

performance tests were conducted with a GPS Trimble unit, which has the ability to accurately measure time, distance, and traveled path. Trials run with two of the engineered devices showed dramatic positive results, confirming original predictions for both decreased pressure waves and turbidity levels, without significant alteration on performance. Data from control testing without any devices showed significantly increased pressure fluctuation and turbidity levels. Continued experimentation with additional modifications of this original device may contribute to improved commercial hydrodynamic designs which can satisfy boat operators while improving environmental conditions in aquatic ecosystems.

Awards won at the 2003 ISEF

Honorable Mention Award of \$100 - U.S. Coast Guard

2003 - EV112

BIOCIDE FREE ANTIFOULING ON SAILBOATS

Andrea Westerdahl

Vasaskolan, Gävle, Sweden

Animals and algae growing on boat hulls is a serious problem for marine vessels. Year 2001 all antifouling containing biocides were prohibited around the Swedish coast in the Baltic sea. The aim which this study is to investigate which of the biocide free coatings, which are available on the market, works best. Different methods were used to come up with a result. One of these was a questionnaire examination. Boat owners that had painted their boats with biocide free coatings answered an inquiry about the growth on their boat. Reference plastic plates were put out in the two main harbors in cove. Temperature and salinity were measured during the summer of 2002. The reference and the inquiry's showed some difference in growth after the summer. There were differences between different types of antifouling, locations and boat types. Hempel mille light, international micron eco and Ilefant SPF were the ones that worked best.

2003 - EV113

THE VORTEX CHAMBER

Destiny Nicole Martin

Jefferson High School, Louisville, Kentucky, United States

The purpose of this experiment was to design a more efficient, and less costly, industrial waste water cooling system. This would lessen the negative impact of industrial waste water by reducing or eliminating the highway hazards that occur from the cloud or plume released from the cooling tower, and by maintaining the desired levels of dissolved oxygen required by the surrounding ecosystem. This can be accomplished by a redesigning of the present waste water cooling systems to be used for future sites, or through the modification of the cooling systems in place today. There are problems with the existing cooling system designs currently being used. These problems can be corrected by the creation of a hybrid waste water cooling and reclamation system that combines the best of the cooling systems in place today, with additional modifications to lessen or eliminate the environmental impact these cooling systems currently have on the ecosystem. The experiment uses a "vortex chamber," attached to a cooling tower, to reclaim the moisture normally lost in its vapor phase. This is accomplished by "drying" and "cooling" the air, thus eliminating and reducing the size of the steam cloud exiting from the system. The "vortex chamber" is also able to reclaim water that is normally had been lost into the atmosphere. During the cooling process, the waste water is continually aerated by the updraft of the air. The waste water is then recycled safely back into the surrounding ecosystem. The result is a more environmentally friendly and safe method for cooling heated equipment.

2003 - EV114

ALL IN THE FAMILY: USING PHYLOGENETIC SYSTEMATICS TO DEVELOP A FAMILY OF ARSENIC HYPERACCUMULATORS

Khaivchandra Ramjeawan

Uniondale High School, Uniondale, New York, U.S.A

Arsenic is one of the most toxic substances in the world. It is extremely dangerous (even at low levels), and is even documented as a human carcinogen. Arsenic in the soil and groundwater has been a problem for many years. Currently, it is plaguing countries like Bangladesh (has over 25 million people at risk of infection). Anecdotal evidence and extensive research has proven that the Chinese Brake fern, *Pteris vittata*, can effectively remove arsenic from the soil. The population of this fern will eventually be stressed because it is the only fern being used as a hyperaccumulator. Therefore, through the use of Phylogenetic Systematics, and the current taxonomic keys, five other *Pteris* ferns were identified and purchased. These included *Pteris cretica* (Roweri, Albolineata, Mayi) and *Pteris ensiformis* (Evergemeiensis). After a great deal of difficulty, *Pteris vittata* was obtained for comparison. In this experiment, these *Pteris* ferns were tested for their ability to remove arsenic from the soil. Arsenic trioxide was mixed in different concentrations with water, and the solution was then inoculated into each plant's soil. The concentrations of arsenic in the plants were monitored to determine if the ferns were successful in removing the arsenic. The results showed that not only were the other ferns able to remove the arsenic from the soil...they did it better than the *Pteris vittata*. Through the use of statistical analysis, I was able to obtain a p-value <.00001. Therefore, this proves that my research was significant. This is important because my research provides a cost effective and promising plan for those that are currently suffering.

Awards won at the 2003 ISEF

Award of \$500 U.S. Savings Bond - Ashtavadhani Vidwan Ambati Subbaraya Chetty (AVASC) Foundation

Second Award of \$1,500 - Environmental Sciences - Presented by the Environmental Protection Agency

2003 - EV301

THE EFFECTS OF VARYING LAND USE ON WATER QUALITY IN THE CENTRAL FLORIDA FRESHWATER ECOSYSTEMS

*Allison Krystle Weili Tjong, Shirin Fatma Khaki, Jennifer Renee Blank
Lake Brantley High School, Altamonte Springs, Florida, United States of America*

Water quality testing was conducted in order to determine if land use around the Wekiva River, Lake Virginia, and Lake Apopka would cause their Water Quality Indexes (WQI) to be excellent, good, and poor respectively. In addition, correlations between the different water quality tests and overall water quality indexes were calculated. Nine tests were performed to determine the overall WQI: nitrates, phosphates, pH, temperature, dissolved oxygen, biological oxygen demand, total solids, fecal coliform, and turbidity. After obtaining values for each test, they were converted to a "Q-Value". Q-Values for each test were weighted differently as components of the WQI. Within the three locations, a total of 14 sites were tested in order to obtain accurate display of the body of water: at Wekiva River and Lake Virginia, five sites were examined, and at Lake Apopka, four sites were examined. Wekiva, unexpectedly, produced only a "good" water quality index of 73.654 despite its isolation from direct human impact. Lake Virginia, as expected, produced a "good" water quality index of 74.112; the best WQI was obtained from the center of the lake. Lake Apopka, as expected due to the many years of agricultural abuse, produced a "poor" WQI of 60.7525. Correlations between fecal coliform and WQI were especially strong; $r=-0.902$. High correlations also existed between total solids, turbidity, and biological oxygen demand with WQI, $r=-0.858$, -0.849 , and -0.728 respectively.

Awards won at the 2003 ISEF
Fourth Award of \$500 - Team Projects - Presented by Science News

2003 - EV302
THE DEVELOPMENT OF A MULTI-STAGE RHIZOFILTRATION SYSTEM

*Anna Ruth Stormer, Ericka Kay Johnson
Benjamin Logan High School, Bellefontaine, Ohio, USA*

There are over 30,000 sites in the United States alone that are contaminated with toxic wastes that prevent life. Phytoremediation is an alternative solution for cleaning toxic soils and waters. This solar powered solution is operated strictly by use of hyperaccumulators. Hyperaccumulators are a specific type of plant specializing in the removal of contaminants from toxic sites. Plants degrading, containing or stabilizing pollutants perform this process by acting as filters or traps. Contaminates remediated in this manner include: heavy metals, solvents, explosives, pesticides and nuclear wastes. Hyperaccumulators are grown and often harvested as a low cost, environmentally friendly, and consumer pleasing remediation method. Phytoremediation can be used alone or in conjunction with mechanical cleanup procedures. Different procedures are used for the remediation of contaminants in various environments. Rhizofiltration is the specific process used for the removal of contaminants within waters into the roots of the hyperaccumulator.

This research involves the construction of a multi-stage rhizofiltration system. Each stage will contain various land or water plants. This rhizofiltration system's function will be to reduce copper concentrations present to below 25 micro grams per liter, therefore meeting Environmental Protection Agency's drinking water standards. Such a system could be upgraded to an industrial size remediation system and will have the potential to be adapted to other contaminants.

Results to date have shown significant accumulation within sunflowers, elodea and duckweed. Continued testing is necessary to reach any conclusions regarding effectiveness of the entire system.

2003 - EV303
WASTEWATER TREATMENT PLANT, SOLUTION OR PROBLEM?

*Claudia Raquel B. Rosado, Susana Patricia P. Pinto, Joana Filipa M. Cunha
Jaime Magalhaes Lima High School, Aveiro, 3804-506, Portugal*

Residual waters of domestic source cannot be directly thrown into the environment. Thus, specific treatment systems, known as Wastewater Treatment Plants (WTPs) are used to solve that problem.

The investigation performed involved two WTPs in our area and had the following main objectives: to study the kinds of treatment used; to compare the advantages/disadvantages of different methods; to discuss the efficiency of some treatments; to know the organic matter decomposer micro organisms in percolators; to analyse some physic-chemical parameters in different WTPs (phosphates; sulphates; nitrates and nitrites; chlorine); to make the community aware of some attitudes and behaviours towards the decrease in the volume of residual domestic waters and contaminant materials into the environment.

For the analyses of the several parameters, a specific "kit" and diverse material and equipment of the laboratories of our school were used, bearing in mind the specific methodologies in each analysis.

A process was studied to decrease the mass concentration of phosphates, responsible for eutrophication, using aluminium sulphate, which caused, besides the phosphate removal, a decrease in turbidity. As to the decantable solids, the study predicts mean values of 66 cubic meter of mud per day, in spite of the solid volume that is not removed in the primary treatment being considerable, which shows the low efficiency of one of the WTPs; this can lead to an excess of organic matter that is not removed. A multiplicity of living organisms was observed in the biological film, namely annelids, bacteria and protozoans.

2003 - EV304
WATER QUALITY IMPACT ON THE MISSISSIPPI RIVER ZEBRA MUSSEL POPULATION

*Noelle Joan Oas, Hillary Joan Oas
Winona Senior High School, Winona MN, USA*

In June of 1988, the Zebra Mussel (*Dreissena polymorpha*) entered Lake St. Clair and has spread throughout the Mississippi River, attaching to hard surfaces and causing damage. Flooding in 2001 caused a major die-off of Zebra Mussels in the Mississippi River. This research studied effects of changes in water quality during

spring flooding on Zebra Mussel growth and population density during 2000, 2001, and 2002. It was hypothesized as the water quality decreased, Zebra Mussel growth and population would also decrease. Dissolved calcium, dissolved oxygen, water temperature, conductivity, total phosphorus, total nitrogen, and turbidity were studied. Three collection sites at river miles 765.5, 766.2, and 767.2 were chosen in Pool 4 of the Mississippi River. Rocks with

attached Zebra Mussels were collected every 10 meters for a total of three samples at each collection site. Water quality data for 2000, 2001, 2002 was obtained from the Minnesota Department of Natural Resources for river mile 764.3A. Statistical analysis indicated turbidity and dissolved calcium to be significantly different during the 2001 flood than during the same period of time in 2000 and 2002.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2003 - EV305

THE DEVELOPMENT OF A SIMPLE MICROBALANCE FOR DETECTION VOLATILE ORGANIC COMPOUNDS IN HIGH SCHOOL'S CHEMISTRY LABORATORY.

Ting-Nien Lin, Ting-Chun Liu

National Taoyuan Senior High School, Taoyuan City, Taiwan, R.O.C.

Many volatile organic compounds accumulate easily in the laboratory and can have adverse impacts on students' health. In this study, a simple microbalance based on a commercial quartz crystal and polyaniline adsorbent was developed to detect volatile organic compounds. The experimental results show that the adsorptivity of the hydrocarbons is in the sequence: organic acids > alcohols > organic oxides > aromatic compounds > aliphatic compounds. The adsorptivity were found to be strongly affected by the chemical and physical properties of volatile organic compounds. In general, the adsorptivity increases with (1) the formation of hydrogen bond between the molecule and the adsorbent; (2) the higher polarity and (3) the higher abundance of pi electrons of the molecule. On the contrary, the adsorptivity decreases with higher steric hindrance because the contact area between molecule and adsorbent decreases. Due to its high polarity, the adsorptivity of acetic acid is the highest among the compounds studied. The utility of this simple device was demonstrated in detecting volatile organic compounds in a high school's chemistry laboratory.

2003 - EV306

A SEARCH FOR RADIOACTIVITY DERIVED MAINLY FROM RADON AND ITS DAUGHTER ISOTOPES

Amy Christine Griffith, Alyssa Lauren Probst

Churchill County High School, Fallon NV, US

In our community there is a Leukemia cluster, and after learning that increased exposure to radiation can increase the incidence of cancer, we became interested in finding out if there was an increased level of radioactivity at our school. Our basic goal was to test different areas of our school and compare the radioactivity readings we obtained to determine if there were increased exposure levels.

We used statically charged helium filled balloons left undisturbed for 45 minutes in various rooms around our campus to collect dust particles and more importantly radioactive particles. Then we taped the deflated balloon to a Geiger counter connected to a computer to obtain the initial levels of radioactivity, as well as a graph of the decay of this collected radioactivity over a period of 10,000 seconds.

We found that there were varying levels of radioactivity around the campus of our school, but none of the levels stood out as being extremely high. We also realized after the initial data collection that the charge on the different balloons might not have been equal so, we corrected this using a magnetic sensor, and were able to collect what we believe to be more accurate results.

It has not been confirmed that exposure to radiation is directly related to the occurrence of Leukemia, but we were interested to investigate this as a possibility. We also learned that eliminating as many variables as possible and maintaining uniform testing conditions is important to ensure accurate data collection and reliable conclusions.

2003 - EV307

A STUDY OF NATIVE GRASS GROWTH IN CONTAMINATED MILLTOWN DAM SEDIMENTS; MISSOULA, MONTANA

Andrew B. Erickson, Graham Meng

Sentinel High School, Missoula, Montana, U.S.

This study investigated the growth of three grasses -Bluebunch Wheatgrass (*Pseudoroegneria spicata*), Idaho Fescue (*Festuca idahoensis*), and Tufted Hairgrass (*Deschampsia caespitosa*)- in the contaminated sediments of Milltown Dam near Missoula, Montana. The study used two groups of experimental soils: test pit soil from the Clark Fork River floodplain in the Milltown Dam reservoir, and stream bank soil from the banks of the Clark Fork on the reservoir. The control soil was from Kelly Island in Missoula, Montana, and was downstream of the dam. The null hypotheses for this study stated that the contaminated soils will have no effect on the germination rate or the growth rates of the grasses. The germination rate for Bluebunch Wheatgrass in test pit soil was 80 percent, and Bluebunch had the highest growth rates in all three soils. The results of this experiment showed that there were no significant difference between the germination rates of the three grasses in the contaminated soil and the Kelly Island control soil, and the growth rates of the plants were not significantly different, therefore, the null hypotheses were not rejected.

Awards won at the 2003 ISEF

Third Award of \$100 - Society for Mining, Metallurgy, and Exploration, Inc.

2003 - EV308

DETERMINATION OF MERCURY LEVELS IN WATER AND SOIL AT SALT PLAINS NATIONAL WILDLIFE REFUGE

Levi John Daniels, Kyle Byrd

Alva High School, Alva, Oklahoma, United States

Mercury, one of only two elements that is liquid in its natural state, is a neurotoxin that can be found in trace amounts in many places. Mercury can pose a

health risk to humans when found in high concentrations. The purpose of this project was to determine whether a significant difference in mercury levels existed between water samples obtained from Salt Plains National Wildlife Refuge and the acceptable EPA standard for mercury concentration in water. In addition, this project was also designed to determine whether a significant difference existed between the mercury concentrations of soil samples from Salt Plains National Wildlife Refuge and the acceptable EPA standard for mercury concentration in soil. Twenty samples of soil and twenty samples of water were collected from the Salt Plains National Wildlife Refuge. The samples were prepared for testing and analyzed by an Atomic Absorption Spectrometer. T-values were calculated from the average sample mercury concentrations and the EPA standards for mercury concentration. The mercury concentrations of the soil and water samples were shown to be significantly higher than the acceptable EPA standards for mercury concentration.

2003 - EV309

A CLEAN ALTERNATIVE

Michael Edward McGuire, Laura Elizabeth McGuire
Lovington High School, Lovington, NM, USA

Reliance on fossil fuels has been an economic basis for more than a century in the United States. Further exploitation of nonrenewable resources will create increasing problems for our economy and environment. The purpose of this project was to determine if an alternative power source could be easily created, relying on renewable fuel sources, while eliminating environmentally unfriendly emissions. Fuel cells are being designed to run cell phones, laptops, cars, houses, and have been used by NASA. We constructed fuel cells using carbon electrodes, Plexiglas, a knife, silicone rubber, and plastic tubing. We tested numerous combinations of fuels, such as methanol, ethanol, and hydrogen, to determine which fuel generated the most power. We utilized a potassium hydroxide catalyst to generate power from the fuels, without combusting them. The reactions only created water vapor as a by-product. In the first trial, methanol and air were utilized, which generated more energy than the other fuel combinations tested. Another fuel cell was built and tested with both air and hydrogen peroxide as the main oxygen source. The hydrogen peroxide was less efficient than air. A third cell utilized hydrogen and oxygen, but a combination of hydrogen and air produced a greater energy output. Although the methanol generated the most power, the use of hydrogen and air provided the most environmentally friendly fuel, since hydrogen and oxygen are easily generated through hydrolysis, while methanol is made from fossil fuels.

2003 - EV310

CLEARING THE AIR: THE EFFECTS OF TROPOSPHERIC OZONE ON LIVE OAK LEAVES FROM VARIOUS LEVELS OF URBANIZATION IN TEXAS

Parker Fennell, Emma Donaldson
John B. Connally High School, Austin, Texas, 78753

The purpose of this experiment was to determine the effects of tropospheric ozone on live oaks leaves in Texas. We predicted that despite the fact that the effects of ozone cannot be isolated, the overall health of leaves will be affected by summertime ozone levels due in part to traffic density of the area. Trips were made to three regions of Texas (San Antonio, Houston, and Austin) to obtain sample leaf populations. Ninety leaves from each site were visually examined and cataloged for amounts and types of damage. Moisture content, average weights and leaf sizes were measured. Ozone levels were determined for each site. After analysis, the leaves at Camp Bullis showed higher signs of health with average leaf percent damage 11% less than leaves at Austin Northwest and 38% less than Houston Westhollow. A strong correlation between percent moisture content and average percent damage of a leaf, suggests an adaptation in stomata in order to protect the leaf from ozone intake through moisture in the air. There was a negative correlation between average maximum ozone and average percent damage, insinuating a defensive response by the leaves to high average ozone levels. Based on the maximum ozone and average percent damage correlation, this mechanism is only good unto a certain undefined area; past that point, leaf damage is inevitable. Traffic density at major intersections regulates the undefined point, as it was responsible for ozone highs. Therefore, leaf damage corresponds to ozone highs, based off of traffic density at major intersections.

Awards won at the 2003 ISEF

Third Award of \$500 - American Phytopathological Society

2003 - EV311

CODE BLUE PHASE III

Kerry Joel Konda, Neal Jerome Konda
Sisseton High School, Sisseton, SD USA

Purpose: Investigate whether a municipal sewer or agricultural land contributed the most nitrate and/or orthophosphate to our surface water. What are the levels, and does temperature and depth affect the levels of nitrate and orthophosphate was also investigated. Hypothesis: The municipal sewer and water directly surrounding the sewer will have a higher level of nitrate compared to the surface water fed by agricultural land. Bodies of water fed by runoff will have a higher level of orthophosphates than the ones fed by the sewer. Levels of nitrate and orthophosphate will increase as the depth and the temperature of the water decreases. Test Site 8 had 41% of its weeks over the limit of 10mg/L. Test Site 5, had only 18% of its weeks over the limit and had average of 6.86mg/L of nitrate for the testing period. Test Site 8 had an average of 7.60mg/L. For orthophosphates Test Sites 7 and 8 had the greatest percentage of weeks over the limit. Only Test Site 11, had an average level below the limit. The sewer was the main contributor. Agricultural runoff is contributing enough orthophosphates to cause the levels rise above the limit. Conclusion: The municipal sewer is the main contributor of nitrates and orthophosphates. That farmer's have a hand in the algae boom and that surface water is on average under the legal limit for nitrates, but not orthophosphates. 17.83% of the time the levels of nitrate are over limit compared to the orthophosphate levels of 50% of the time.

2003 - EV312

THEORY AND PRACTICE ON ECOLOGICAL RESTORATION IN SMALL SHALLOW EUTROPHIC WATERS

Yajia Lu, Yi Zhang, Chen Lin
Wusong High School, Shanghai, P.R. China

NUMEROUS water bodies are suffering from etrophication, which is a major factor of malign algae reproduction, or algal bloom, throughout the world. Most eutrophic small water bodies are unable to conduct self-purification, so the natural balanced state is easily disturbed. It is difficult for them to turn back into a healthy state even if point pollutant sources are controlled.

How to restore the eutrophic aqua-system for a sustainable and healthy development of human civilization is an important and practical problem. We set up a etrophic small shallow water body named Ziqing Creek on campus as our study base. With an idea of water virescence in restoration of eutrophic waters, suitable aquatic macrophytes for nutrient removal was selected by means of constructing seven artificial eco-models (Cerato phylum demersum L., Potamogeton crispus L., Elodea nuttallii, Myriophyllum sp., Eichhornia crassipes, combination, control group) in the lab. Meanwhile, outdoor pilot study of artificial ecosystem designing was also carried out. Results showed that total nitrogen (TN), total phosphorus (TP), biochemical oxygen demand (BOD5) have been reduced by 63.2%, 53.9% and 76.3% respectively, while the transparency and dissolved oxygen (DO) increased.

Statistical analysis indicated that rebuilding a 4D aquatic plan system on the basis of submerged vegetations would be feasible to restore ecosystems of eutrophic waters. The relationship between biomass production and nutrient enrichment rates of aquatic macrophytes was also discussed. In the practice, physico-ecological engineering projects have been designed for the eco-restoration of different small shallow water bodies and an expert system is being developed.

2003 - EV313

"FAKE BAKED WORMS: WHAT ARE THE EFFECTS OF UV RADIATION ON REGENERATION IN BLACK WORMS?"

Kelly Jean Day, Anne Elizabeth Koupal
Mitchell Senior High School, Mitchell, SD 57301

What are the effects of ultraviolet (UV) radiation on the regeneration of blackworms (Lumbriculus variegatus)? In a series of experiments, we separated blackworms into 4 treatment blocks consisting of: control (no exposure), short wave UV light, long wave UV light, and a tanning bed. Before irradiation, the worms were cut in half transversely. The pieces were then exposed for 5, 10, or 15-minutes, then placed in total darkness. Fifteen worms were used for each treatment, 5 for each time interval. At the end of two weeks, the new segments at the cut end were counted. In the first experiment, we did not differentiate the segments as to "head" or "tail" end regeneration. We did in the second and third.

An ANOVA indicates that increased exposure to UV radiation decreased the number of new segments produced and differs with the type of UV used. Head-end regeneration rates were less than tail-end regeneration rates, possibly because the reproductive organs are located in the head. No worms survived the short-wave UV light. The worms exposed to the long wave UV averaged 38.2, 35.4, and 31.6 new segments as exposure time increased. The worms exposed to the tanning bed averaged 55.2, 46.0, and 54.8 new segments. The control worms averaged 57.7 new segments. These pathological effects of short-term UV radiation exposures should concern anyone studying ozone depletion, the effects of a "good tan", and living organisms in general.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2003 - EV314

LIKE WATER OFF A DUCK’S BACK

Gail Miriam Moraru
Georgiana Bruce Kirby Preparatory School, Santa Cruz, California, USA

This year we decided to determine how the crude oil affects birds. We researched how crude oil affects bird feathers and studied the chemistry of detergents and soaps. We compared the effectiveness of two extremes of cleaning agents, a pure castile soap and a household detergent, Dawn. Feathers collected from the beach were paired based on weight and size. One feather from each pair would be cleaned with detergent, while the other would be cleaned with soap. We hypothesized that detergent would be the more effective cleaning agent. We applied the same amount of crude oil to each of the paired feathers, and cleaned each in a series of 5 tubs of water. The second in the line up had a 5% concentration of the cleaning agent, and the fourth had a 1% concentration of the cleaning agent. We compared the original weight of the feathers in each pair to their final weight, as well as the visible affects that we could see, both with the naked eye and underneath a microscope, observing the alignment of the barbs and barbules.

Our results showed that most of the feathers cleaned with the pure soap had gained weight during the experiment, and those that were cleaned with detergent showed a decrease in weight or remained the same. In high concentrations, soap would be able to clean the feathers, but it would leave insoluble salts behind, which might interfere with alignment of the feathers. We concluded that detergents are more effective than soaps.

2003 - EV315

CIGARETTE BUTTS AS TOXICITY INDICATORS?

Tyler W. Smith, & David S. Scoville
American Fork High School, American Fork, UT, USA

This project quantified the toxic effect of inappropriately discarded cigarette butts. Cigarettes are visible in parking lots and roads. These find their way into water resources through storm water systems. The intention of this project was to determine if the quantity of cigarette butts could be used as an indicator of the toxicity of storm water.

 Toxicity was determined using Ceriodaphnia dubia as a test organism. The lethal concentration at which 50% of the organisms died (LC50- in units of Butts per Liter (BPL)) was calculated thorough interpolation on a dose-response curve. Storm water samples collected at area parking lots were tested for toxicity in addition to lab produced dilutions of known cigarette butt concentrations. Additionally, an attempt was made to test toxicity

using osteosarcoma cells in a cancer research lab at a local university. Aspectic techniques were required for the effort. These results were inconclusive.

The LC50 was determined to be approximately 0.13 BPL. The concentration of the storm water samples was estimated using cigarette butt counts, parking lot surface area, and precipitation amount. Cigarette butt concentrations ranged from 0.002 to 0.008 BPL. No storm water samples were found to be toxic.

Based on the results of the experiment, cigarette butts could be used as toxicity indicators. However, it is unlikely that the cigarette butt concentration in parking lots in American Fork, UT will exceed toxic levels.

Awards won at the 2003 ISEF

Second Award \$100 - Showboard, Inc.

2003 - EV316
THE STUDY OF THE ENVIRONMENTAL IMPACT OF ROAD DEICERS ON GLYCINE MAX, DAPHNIA, AND LEMNA

Kaitlin Irene Metzger, Alyssa Kae Walters
Glidden Ralston Community School, Glidden, IA 51443

Deicing chemicals are used on roads throughout the United States and the world to facilitate safe travel during winter conditions. These deicers may be washed away by storm runoff or snowmelt into surface water or into agricultural terrain. The purpose of this project was twofold: first, to determine if there were harmful effects of various road deicing agents on Glycine max (soybeans), Daphnia magna (an aquatic bioindicator), and Lemna (duckweed, a common aquatic plant), and second, to try to determine toxic levels of deicers.

Four different deicers were used: calcium chloride, magnesium chloride, rock salt, and Ice Ban(R). Six soybean plants in sloped containers were used for application of the road salt (30% deicer-70% sand). Four different solutions of deicing agents (calcium chloride, magnesium chloride, rock salt, and Ice Ban(R)) were tested at 10,000 ppm down to 0.01 ppm. Ten daphnia and five duckweed plants were used at each dilution level.

The following conclusions may be drawn:

(1) Solutions of deicers (CaCl₂; MgCl₂; Rock Salt) caused damage in the soybeans. (2) Solutions of deicers (CaCl₂; MgCl₂; Rock Salt) showed acute toxicity to daphnia and duckweed at and above 5 ppm. (3) Ice Ban(R) proved to be environmentally friendly and beneficial to duckweed up to 1000 ppm. (4) Toxic effects of Ice Ban(R) on Daphnia noted at 1ppm.

2003 - EV317
DETECTION OF ESTROGENS IN VARIOUS WATER SOURCES USING A COMPETITIVE ELISA ASSAY

Amy L. Dickson, Nancy R. Rodriguez
Little Rock Hall High School, Little Rock, Arkansas, U.S.A.

Estrogens used as pharmaceuticals are finding their way into the waterways of some states. In Florida and Canada, there have been adverse reproductive effects detected in wildlife exposed to environmental estrogen pollution. Previously, no study has been done to determine if estrogens are in the waters of Arkansas. The purpose of this experiment was to sample local water systems to determine the presence of estrogen. Using standard techniques, water samples were collected from the Cyprus Swamp off of I-430 near Maumelle, Arkansas River above Murray Lock and Dam, Little Maumelle River off Pinnacle Mountain, Butler Park Creek off of Rodney Parham in Little Rock, and a pond in Hensley. An ELISA kit was used to determine the concentration of 17-Beta-Estradiol in each sample. The values for 17-Beta-Estradiol at the tested sites were as follows:

1 Cyprus Swamp 0.1-micrograms per liter

2 Arkansas River 0.1-micrograms per liter

3 Little Maumelle River 0.05-micrograms per liter

4 Butler Park less than 0.05-micrograms per liter

5 Hensley less than 0.05-micrograms per liter

These data indicate that Arkansas waterways have been contaminated with estrogen or estrogen-like compounds. The effect of this on wildlife and humans in our state is not known and warrants further study.

2003 - EV318
THE EFFECTS OF GLYFOSATE ON LEMNA GIBBA

Timothy Steven Szen, Glenn Love, Dell Castillo
Hilton Head High School, Hilton Head South Carolina, United States

This experiment was designed to determine the effects of chemical runoff on our local environment. This has proven to be a relevant project to the local community because the community harbors many golf courses and private homes; these then provide runoff into the large number of ponds and lagoons scattered across the Low Country. In order to test this problem, duckweed was used to represent the environment, and glyphosate was chosen to represent the chemical runoff. Duckweed was an appropriate plant to use because of its great benefits to its environment. Glyphosate was researched to be a common chemical among golf courses and homeowners for managing weeds.

To measure the effects of the chemical, notes were taken describing the condition of the duckweed, and the total surface area of each tub, covered by duckweed, was measured. Eight tubs were used to simulate separate ponds, two for each amount of solution.

The glyphosate had an increasingly deleterious effect on the duckweed as the amount of the solution increased. Those "ponds" receiving the highest amount of solution had the highest fluctuation in the amount of duckweed living, between the first and last day. The contributions of this experiment have proved to be that such chemicals should be used only with good judgement; the effects on the duckweed can be devastating. In an environment such as the Low Country, community members and businesses must be aware of the chemical they are using and its effects on their environment.

2003 - EV319
STUDY OF THE PUBLIC WOODLAND IN A SECTOR OF AZUL CITY, BUENOS AIRES, ARGENTINA

Maria Cristina Dalla Valle, Casiana Lujan Battista
Instituto San Cayetano, Azul, Buenos Aires, Argentina

This work has been motivated by the general lack of knowledge by the City of Azul inhabitants about the trees along the walkways, which generates a sense of

undervaluing.

This study zooms in a public woodland in a sector of Azul City (124 blocks), and the aim is to determine the existence of a vegetation pattern, the type of trees, and the status of such trees. The survey involved measuring the trunks diameter, the effect of tree roots on the walkways and the treetop on the public light wires, as well as the trees’ physical damages and their pathologies.

The analysis of the data showed discouraging results: from a total of 3284 trees belonging to 48 species (only two native), it was found that there is no design of the public woodland, that the sanitary status of several species is questionable (and nothing is being done to fix it), and that the majority of the species are not suitable for the local environment.

This first step in the analysis of the Azul City’s public woodland is an essential input for those who can make decisions on this issue and, on the other hand, is able to generate the necessary knowledge for valuing properly this natural patrimony.

2003 - EV320

BIOREMEDIATION OF INSECTICIDES

Teresa Marie Bryan, Ashley Ann Andrews
Grenada High School, Grenada, MS USA

The goal of this experiment was to determine an effective buffer crop to decrease contamination of major water sources that are commonly used as wildlife habitats as well as for recreation. It was hypothesized that arrowhead, spike rush, rye grass, and sonoma brown mushrooms would remove insecticide contamination from soil. It was further hypothesized that water lilies and bacteria would remove insecticides from water. Also, after researching insecticides, plants, mushrooms, and bacteria, the testing species were chosen and obtained. Plants and mushroom were planted, grown and contaminated. After contamination, species were clipped at surface and foliage was blended and frozen. Bacteria were incubated and contaminated. Samples were then shaken, filtered, and separated from contaminants using dichloromethane. These processes were achieved through the use of an orbital shaker; a vacuum; separatory funnel; a rotovapor; and a n-evap. Each sample solution was then run through the gas chromatograph mass spectrum. Results were obtained and studied. It was found that arrowhead and spike rush exhibited proof of uptake more than the other species. Also chlopyrifos, a contaminant, was taken up more efficiently by the various species than cypermethrin, a contaminant. In conclusion, the selected species of plants and mushrooms are efficient in bioremediation.

2003 - EV321

DEVELOPMENT & WATER QUALITY IMPAIRMENT

Lydia Suzanne Weiskopf, Rachelle Elizabeth Miron
Ecole Secondaire Catholique Algonquin, North Bay, Ontario, Canada

Trout Lake, North Bay, Ontario, is a cold, oligotrophic lake and the water reservoir for 55,000 citizens. Loggers arrived in the 1880's, and today 90% of the shoreline is developed. Development practices have been poor and many lawns extend right to the lake without vegetative buffer strips. Septic systems are the norm and, on what little shoreline is serviced, development is extremely intense. This study reconstructs the water quality history of Four Mile Bay, a 380 hectare arm of Trout Lake by studying chironomid head fossils in sediment strata. Principal components analysis shows that beginning in the late 1980's, almost all chironomid taxa abundances increased substantially, pointing to a recent historical increase in basin productivity. Sedimentation rate increases correlate with deforestation activities associated with lumbering in the late 1800's and increased shoreline development in the 1980's. This correlates well with the citizens' perspective / impression of a recent water quality decline in the basin. The evidence presented in this study adds to the argument that basin eutrophication via watershed development is occurring. This result is important because statistical error in chemical sampling of the basin for over 25 years has thwarted the identification of a water quality trend. Developers are trying to use this result as an argument pointing to no water quality deterioration and therefore the right (implied) to develop yet more shoreline. This study clearly identifies a recent trend towards increased productivity.

Awards won at the 2003 ISEF

Second Award of \$1,500 - Team Projects - Presented by Science News
Award of \$200 - North American Benthological Society

2003 - EV322

MEDICAGO SATIVA, BIOSORBENT FOR THE REMEDIATION OF ARSENIC V CONTAMINATED WATER

Mahlet Kabtamu, Meilea Wertz, Zach Penn.
Deming High School, Deming, New Mexico, USA

The purpose of this experiment is to reduce Arsenic V from Arsenic V contaminated drinking water below the new proposed EPA regulation of 10 ppb. Arsenic is a semi-metallic extremely poisonous element. Arsenic V is the pentavalent form and is commonly found in ground water. Arsenic in air will settle to the ground or be washed out of the air by rain. Studies have shown that inorganic arsenic can increase the risk of lung, skin, and prostate cancer in humans.

 This experiment included running a series of contaminated Arsenic water samples through filters utilizing Medicago sativa (Alfalfa) as the filter medium. Alfalfa was selected for its known affinity for cations and a possible effect on oxyanions. Treatment groups utilized the stems or leaves of the plant in reverse flow column filters and batch mixes. The effect of pH was tested on the batch mixes. It was hypothesized that alfalfa would remediate a significant amount of the Arsenic and that pH will have little effect on the amount of Arsenic removed.

 All treatment groups significantly reduced As V levels, (p< 0.001). Additionally, all treatment groups with the exception of the batch mix utilizing stems, reduced the As V levels below the EPA standard of 10ppb.

 A bench scale model operating at 3 gallons/minute flow rate, successfully remediated As V contaminated water from 6,500 ppb to 40 ppb. The Alfalfa Biosorbent will reduce the projected monthly water bill increase from \$ 90.82 per month, to \$3.72 per month for New Mexico residents.

Awards won at the 2003 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2003 - EV323

KILLER COCKTAILS: A STUDY OF THE LEACHING OF PHARMACEUTICAL DRUGS INTO THE ENVIRONMENT

Courtney Nicole Godwin, Tyler Skelton, Lauren Goodman

West Lauderdale, Collinsville, Mississippi, United States of America

Researchers have discovered that 80% of drugs taken by humans and livestock emerge from the body intact creating mixtures of drugs that are lethal to the environment. The purpose of this project was to experimentally determine whether pharmaceutical drugs such as antibiotics, ibuprofen, hormones, statins, and caffeine pose a greater environmental threat individually or in combination. It was hypothesized that as drugs leach into the environment and combine they potentiate thereby increasing their toxicity. Bioassays using lettuce seed, daphnia, duckweed, planarians, onion root tips, elodea, and radishes were conducted using solutions prepared in ppth, ppm, ppb, pptr. Each species was exposed to both individual solutions and mixtures of solutions. Germination, dissolved oxygen, pH, water hardness, and chromatography tests were performed along with onion root tip squashes. Drug mixtures were lethal to the daphnia at high concentrations. Lettuce seed and planarians failed to thrive in individual and combination solutions. Combination solutions produced decreases in mass and changes in plant pigmentation. Drug combinations increased total water hardness and decreased dissolved oxygen. Combination solutions decreased growth in onion root tip and caused them to become arrested at various stages of mitosis. It can be concluded that as individual drugs enter the environment, they combine with other drugs creating a toxic environment. This is most lethal to those organisms found in an aquatic environment.

2003 - EV324

NITRATE LEVELS IN FANNO CREEK: ARE THERE ELEVATED LEVELS OF NITRATES IN FANNO CREEK WATERSHED FROM GOLF COURSE RUNOFF?

Robert David Davenport, Colin Ackerman

Oregon Episcopal School, Portland, OR, USA

Nitrate levels in watersheds reflect the amount of pollution and the health of the plants and animals that live in or near the water. It is therefore important to measure the levels of nitrates and to know what might affect them. This research project tested the relationship between precipitation and the nitrate levels of the Fanno Creek as it passes through the Portland Golf Club golf course. The nitrate levels of the creek water were tested using an electronic nitrate probe using the Logger Pro software. Water samples were taken three times per week from November 2001 to January 2003 at 3 sites along the creek: entering the golf course grounds, exiting the golf course grounds, and a half mile downstream of the golf course. On average, the nitrate levels exiting the golf course were 44% higher than the levels entering the course. There were two obvious peaks in the nitrate levels exiting the golf course, one from mid-July to early August and one in the first half of September. There was no obvious correlation from the data we gathered between precipitation and the nitrate levels in Fanno Creek. The results showed that the golf course did contribute to elevated levels of nitrates, up to 3 times the legal limit, in Fanno Creek and that irrigation, not precipitation, caused the nitrates to enter the creek.

2003 - EV325

MASS PRODUCTION OF BIODIESEL, HYSEE 1005, WITH USE OF MICROBES

Kyle Anthony Marsland, Wesley Ryan Fuller, and Blair Elisabeth Kowalinski

Hamilton High School 3700 S. Arizona Ave. Chandler, AZ 85248

Within the last century, the world has harnessed petroleum-derived fuels to power their cars and machinery. Furthermore, depletion of petroleum-derived fuels exemplify the necessity for an enviromentally sound alternative fuel. In today's society more and more alternative fuels become accessible, electricity is in demand, solar power is geographically unreliable, and natural gas is nonrenewable. Biodiesel is in fact enviromentally sound and endlessly renewable energy source.

During esterfication of vegetable oil and methanol, a byproduct of glycerol is formed. Manufactuers perform transesterfication on the Biodiesel (Southern States). This process, which does not remove all glycerol content, increases production cost to \$3.00/gallon (Ocean Air). The remaing glycerol causes Biodiesel to cloud at 11.6 degrees Celcius. The clouding makes it necessary for consumers to purchase a \$5000 warming package (University of Idaho).

Last year's project successfully determined that microbes Bacillus thuringienes, Streptomyces albus, and Clostridium butyricum each removed all glycerol traces from manufactured Biodiesel.

This years research consisted of producing own our Biodiesel with used vegetable oil and using microbes to remove glycerol content. After this was produced another glycerol assay was performed showing that no glycerol is present. A cost analysis was figured for mass production and distribution of Biodiesel with use of microbes.

Awards won at the 2003 ISEF

First Award of \$3,000 - Team Projects - Presented by Science News

9th International Youth Science Exhibition ESI 2003 - MILSET -EXPO-Science International

First Award of \$500 - Society of Environmental Toxicology and Chemistry

First Award of \$1000 - Sigma Xi, The Scientific Research Society

Third Award of \$1,000 - U.S. Coast Guard Research and Development

2004 - EV001

THE EFFECTS OF IRON DEFICIENCY AND EXCESS ON ZINC UPTAKE AND TRANSLOCATION BY WATER HYACINTH

Megan Kathleen Bartlett

F. W. Springstead, Spring Hill, Florida, United States

In my project, I induced iron deficiency and excess in an aqueous solution, and measured the effects on zinc uptake and translocation to the leaves of the aqueous plant species water hyacinth. I predicted that the plants grown in iron deficiency would have higher concentrations of zinc in both roots and leaves, but

plants grown in an excess of iron would translocate more zinc to the leaves because iron, which is bound in the root cells before zinc, would occupy the root binding sites. I labelled 8 38L plastic tubs as DEFIC #1-4 and EXCESS #1-4. My metal source, the phosphate by-product phosphogypsum, already has an excess of iron. To induce a deficiency, I treated it twice with the chelate EDTA and rinsed it with rainwater, to chelate and wash away the iron. For each tub, 2.72kg of phosphogypsum, 25L of rainwater, and 8 water hyacinth plants were used. They were allowed to grow for 8 weeks in a greenhouse, then harvested and tested for zinc concentration with an Atomic Absorption Spectrophotometer. My results are:

 Root Leaf Root Leaf

DEFIC#1 73.0 mg/kg 93.0 mg/kg EXCESS#1 37.9 mg/kg 53.2 mg/kg

DEFIC#2 53.8 mg/kg 125 mg/kg EXCESS#2 40.0 mg/kg 53.8 mg/kg

DEFIC#3 48.3 mg/kg 92.3 mg/kg EXCESS#3 66.4 mg/kg 84.6 mg/kg

DEFIC#4 70.7 mg/kg 95.8 mg/kg EXCESS#4 140 mg/kg 77.0 mg/kg

(140mg/kg is an outlier, believed to be due to phosphogypsum residue on tested plant material, but lack of sufficient material prevented re-analysis). As I predicted, the average zinc concentration is higher in the DEFIC plants because there is no competition from iron ions. However, EXCESS plants translocated less zinc because of competition between iron and zinc ions for shoot transport. This helps predict what effects competing cations have on the uptake and transport of a specific cation.

2004 - EV002
AN EFFECTIVE SOLUTION FOR TRICHLOROETHYLENE POLLUTION IN GROUNDWATER SYSTEMS

Hasib Fahin Nasirullah
American Heritage School, Plantation, Florida, United States of America

The purpose of this study was to prove aerobic bioremediation as an effective solution for trichloroethylene pollution in groundwater systems. The study involved using Pseudomonas putida F1 to biodegrade trichloroethylene in the presence of toluene.

 Trichloroethylene is a major pollutant in the United States today, and until recently there was little that could be done to clean it up. Trichloroethylene's uses span all industries, from agricultural to heavy metals, and its runoff is therefore quite significant. Recent studies, such as that done by Rebecca Pareles et. al. 2000, prove that the same enzymes that the microorganism produces in response to the presence of toluene have shown a chemical attraction, or chemotaxis, to trichloroethylene. This has opened the frontier of using bioremediation as a method for cleaning up trichloroethylene. This study explores the ratio between toluene and trichloroethylene in a controlled environment. This ratio is important as toluene is needed to produce the biodegrading enzymes but competes with the trichloroethylene for those enzymes so it can be biodegraded. In the study, environments were set up at different molecular concentration ratios (1:1, 1:5, 1:10, 1:15, and 1:20) to find the optimum ratio at which trichloroethylene could be biodegraded the quickest.

 It was hypothesized that the ratio 1:1 would produce the best results. This hypothesis was correct, with Group 1:1 showing ninety-seven percent of the trichloroethylene biodegraded. This occurred as toluene was in the least concentration in this group, and therefore, trichloroethylene had little competition for the enzymes from P. putida.

2004 - EV003
THE EFFECT OF CERIUM OXIDE NANOPARTICLES ON POLYCHLORINATED BIPHENYL (PCB) TOXICITY IN CULTURED BRAIN CELLS: PHASE II

Andrew Gordon Cook
Lake Highland Preparatory School, Orlando, FL, United States

The use of nanotechnology in biological functions provides the novel opportunity to intervene in biological functions or disease processes. The present research merges the science of nanoscale materials with cell biology to intervene in polychlorinated biphenyl (PCB) neurotoxicity. The stability and pervasiveness of PCBs makes their impact on fragile ecosystems and human health a great concern.

 Live/Dead Assays (Aroclor 1242 & 1254, 1ug/30ug/mL medium for 24 hours) with propidium iodide were used to demonstrate the initial ability of nanoparticles to protect against PCB exposure. Dose response curves increasing up to 5ug/ml and decreasing at 10ug/ml seem to suggest a transition phase for neuronal signaling. This may indicate a toxicological response phase between inhibition and excitotoxicity.

 Examination of neuronal signal transduction with calcium indicator dye, Fura-2, suggested PCBs altered neuronal calcium signaling in a biphasic manner. Dosages of Aroclor at 5ug/ml suggested the beginning of an excitotoxic response. Studies examined the ability of nanoparticles to repair damage to neuronal signaling post-PCB exposure. Additionally, 30ug/mL PCBs and nanoparticles were added simultaneously pointing to the ability of nanoparticles to interact with PCBs not only inside the cell, but outside as well. The current year's research also showed the ability of nanoparticles to both protect and remediate damage as a result of low concentrations of PCBs.

 Brain cell sensitivity to these chemicals after two decades of discontinued use points to the everlasting dangers of PCBs in the environment. Present research indicated potential benefits of nanotechnology in both resisting and repairing damage by this chemical pollutant.

Awards won at the 2004 ISEF
First Award of \$3,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV004
AN ANALYSIS OF PREVENTING STORMWATER POLLUTION BY MEANS OF BOTH A CONTINUOUS DEFLECTIVE SEPARATION (CDS) UNIT AND OZONATION: YEAR 6

Jessica Angelique Caesar
Rockledge High School, Rockledge, FL, USA

The purpose of this experiment is to determine if using Ozonation and a CDS Unit will provide efficiency in removing pathogens, suspended particles, and sedimentation from wastewater in order to prevent stormwater pollution. Pathogens cause diseases and can pose health risks. As sediment and suspended solids enter freshwater, fish respiration, animal habitats, and seagrass are impaired. Turbidity and solid particles in water absorb sunlight penetration from reaching plants. Algae blooms are also formed which upsets aquatic life. Phytoplankton (microscopic algae) can kill both seagrass and fish. Since seagrass traps sediment and provides homes for fish and other organisms, plant productivity indicates good water quality.

Ozone was created using an ozone generator with corona discharge that creates an extra oxygen atom that attacks the peptidoglycan surrounding the cell wall of the pathogen. The ozone was

attached to a demonstrative CDS Unit with ozone resistant tubing and an air stone. Water samples were taken from several different locations. The raw samples ran through the cycle for 24 hours. After treatment, Vallisneria americana (seagrass) were grown in both the treated and untreated water samples by aeration and measured for 14 days. Water samples were analyzed for physical, chemical, and biological parameters.

Results from this study can conclude that the combination of Ozonation and the CDS unit removed the impurities from the stormwater samples (as mentioned above) as well as enhanced plant growth. This system can be the substitution for preventing stormwater pollution.

2004 - EV005

"THE BIG GREEN MONSTER"

Steve Anthony Morgan Jr.
Evergreen Jr. High, Houma, Louisiana, United States of America

The purpose of my experiment is to see how cane field run-off affects H2O quality. I choose it, because, if the cane field run-off is affecting water, it's definitely affecting the fish.

 I think the water quality will decline, because the cane field run-off will increase the phosphates in the water, causing algae to grow, and dissolve oxygen to decrease.

 In my experiment, I tested the following: temperature, pH, total dissolved solids, and phosphates 40ft. above, 150ft. in, and 40ft. below three canals that intersect Bayou Lafourche.

 In my results, I calculated the Water Quality Index Value for each site. I observed that rain cause an increase in phosphates causing a decrease in dissolved oxygen. I also found that at each site the pH was consisting in a neutral range, but was dramatically affected by low dissolve oxygen levels. Total Dissolved Solids was never affected by cane run-off. The temperature never varied.

 I deny my hypothesis, because there is no significant difference in the water quality of Bayou Lafourche after cane canals intersect it. However, the water quality of the canals is affected by the run-off from the cane fields.

2004 - EV006

OIL POLLUTION SOLUTION BIOREMEDIATION

John Harry Heermann
Haxtun High School, Haxtun, CO, USA

There are more than 70 genera of microbes that are

known to degrade crude oil. This project was designed to determine

which of three organisms would be best suited for this job, and if

phosphorous and nitrogen would simulate their growth. It was

thought from the literature that Bacillus brevis would degrade oil

more efficiently then Pseudomonas putida and Arthrobacter

globiformis. A sterile box was constructed to house sterilized jars

for the bacteria and everything was sterilized. Three replications

of the three bacteria, with appropriate controls were placed into

jars. Connecting jars contained KOH to measure amount of carbon

produced. Every six days for 24 days carbon dioxide was measured

using chemical reaction of BaCl2 to precipitate out carbon dioxide.

Results showed that P. putida with nitrogen and phosphorous had

increased carbon dioxide production and also that B. brevis with

nitrogen had increased production. Therefore it was concluded that

P. putida degraded crude oil more effectively than B. brevis, or A.

globiformis and that nitrogen and phosphorous helped increase

metabolism of the crude oil.

2004 - EV007

NITROGEN AND SEDIMENT LOADING TO THE UPPER MISSISSIPPI RIVER: ASSESSMENTS OF 27 WATERSHEDS IN MINNESOTA AND WISCONSIN

Erik Dale Mundahl
Winona Senior High School, Winona, Minnesota

This study was designed to test the hypothesis that Southeastern Minnesota and West Central Wisconsin tributaries are contributing disproportionately more sediments and nutrients to pools 5-8 of the Upper Mississippi River during summer, and that these pools would be retaining sediments and exporting nutrients. Turbidity and nitrates were measured monthly at each of 25 tributaries and Lock and Dams 4-8. Discharges were measured at 21 tributaries, whereas discharges at four tributaries and the Lock and Dams were obtained online. GIS watershed and land use data were used to determine percentage row crops in each watershed, and then compared to sediment and nitrate loads to determine if row crop agriculture increased sediment and nitrate stream loads. Tributary drainages comprised 11.8% of the watershed area upstream of Lock and Dam 8, but contributed 22.1% of sediments and 12.4% of nitrates delivered to Lock and Dam 8. When percentages of row crops per watershed were compared to sediment and nitrate loads, no significant (P>0.40) correlations were found either on a monthly or total summer basis. Pools 5-8 were exporting sediments, with output (107 metric kilotons) exceeding inputs (100 metric kilotons). Nitrates also were exported, with outputs (17.9 metric kilotons) equaling inputs (17.9 metric kilotons). Disproportionate contributions of sediments and nitrates from the Southeastern Minnesota and West Central Wisconsin tributaries to pools 5-8 of the Mississippi River are degrading the river environment by increasing sediment load and contributing additional nutrients to the Gulf of Mexico Dead Zone.

Awards won at the 2004 ISEF

\$10,000 per year scholarship, renewable annually - Florida Institute of Technology

2004 - EV008

DOES BETSCH FEN IMPROVE THE WATER QUALITY OF BLACKWATER CREEK?

Sara K. Sullivan
Unioto High School, Chillicothe, Ohio United States of America

Wetlands, including marshes, bogs, swamps, and fens, are very productive ecosystems. They can regulate water levels within watersheds, reduce flood

damages, control erosion, provide fish and wildlife habitat, and improve water quality. However, wetlands vary in how effective they are at removing pollutants. Their cleansing ability is often seasonal and depends on the wetland size, how water moves through the wetland, the types of native plants, and the length of time the water remains in the wetlands. This project was designed to determine if Betsch Fen was effective in improving the water quality of Blackwater Creek in Ross County, Ohio. It was hypothesized that Betsch Fen would be effective in improving the water quality of Blackwater Creek. Water samples were collected on five different days and at three locations along Blackwater Creek. Sites immediately upstream and immediately downstream of the fen, and near the midpoint of the fen were chosen. Using commercial test kits and a Total Dissolved Solid (TDS) meter, each sample was tested for the following parameters: ammonia, dissolved oxygen (DO), nitrate, phosphorous, pH, and TDS. Readings from the upstream location were used as baseline data. The results of the tests from the downstream location were compared to the baseline data. Moderate to significant improvements in water quality were identified in ammonia, phosphate, nitrate, and TDS levels. The pH improved slightly and the DO change was insignificant. The overall result of the analyses indicated that Betsch Fen was effective in improving the water quality of Blackwater Creek.

2004 - EV009

BIO ACOUSTICS

James Hawken Stegall

Colquitt County High School, Moultrie, GA, United States

The purpose of this experimental research project is to reconstruct an amplifier system that will detect larvae feeding sounds as they chew food.

The experimenter hypothesizes that feeding insect larvae will produce sound that can be detected with an electronic system. Sounds of moving insects can be detected at distances that make the system useful for detecting insect infestations in grain bins.

The amplifier was originally constructed to listen to muscle sounds. It was rebuilt to make it sensitive enough to pick up insect sounds. A Styrofoam was lined with carpet for sound-proofing. Meal worms were fed dog food in a box. The pick up pad was placed in the box connected to the amplifier and the amplifier to an oscilloscope. Tubes of different length were filled with grain and insect noises made at one end. Distances that sound travels in different grains determined.

2004 - EV010

CORRELATION OF MERCURY CONCENTRATIONS IN WOOD, SOIL, WATER, AND LICHENS IN SITES UNDER MERCURY ADVISORIES

Jennifer Nell Becnel

Saint James High School, St. James, LA, USA

To see if a correlation exists between mercury concentrations in air, using lichens as biomonitors, wood from tree cores, water, and soil, samples of each were taken from sites under mercury advisories and analyzed for mercury (Hg) using a Bacharach 50B Mercury Analyzer System employing EPA methods 7471A and 245.1. Wood samples from tree cores were dated using tree ring data and analyzed for periods preceding and following the desired sample dates to determine any variations occurring throughout the cores. Preliminary data indicates a correlation exists between tree core, water, soil, and lichen samples analyzed for the six-month period of summer 2003 to winter 2004 at the advisory sites. A pattern of increasing mercury concentrations while moving eastward across the sites is also indicated by the data. However, more analyses are required to produce validity to the observed trend and are presently being conducted.

2004 - EV011

THE USE OF BARLEY STRAW TO CONTROL ALGAL AND MACROPHYTE GROWTH ON WILD RICE LAKE

Elizabeth Jean Welsh

Proctor High School, Proctor MN, U.S.A.

Wild Rice Lake is a shallow, 2100-acre lake north of Duluth, Minnesota, and the test site for this experiment. Common pondweed covers much of this lake by mid-summer, making fishing and boating difficult. Shallow lakes tend to be more fertile, and often weeds and algae pose a threat (Armstrong, 2003). Macrophytes have not overtaken Wild Rice Lake until recently, and algal levels remain low. The purpose of this experiment was to determine whether barley straw treatments could control macrophyte and possible future algal problems. The hypothesis was that barley straw application will control algal and macrophyte growth. To begin the experiment, twenty 20-gallon limnocorrals were filled with 24 liters of undisturbed lake water. Plastic mesh bags of 240 grams of barley straw were added into two of the four trial buckets for each trial set—five trial sets in all. Fertilizer (0.1%) was then added into two of each set of four trial buckets, one with barley and one without. Thirty Lemna minor and four 14-centimeter lengths of common pondweed were added to two sets of the five, eight buckets in all. Chlorophyll a (Welsh et al), oxygen, pH and L.minor frond number were all measured once a week for ten-weeks. Before and after the ten-weeks phosphate and nitrate levels were measured. The original hypothesis that barley straw would control algal growth was supported. Results show that barley treatment did significantly reduce algal growth (ANOVA p<0.001) and significantly affected frond number, common pondweed growth, pH, oxygen, nitrates and phosphates.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV012

EARTHWORMS: FRIEND OR FOE? (AN ANALYSIS OF EARTHWORM EFFECTS ON SOIL AND LEAF LITTER)

Josiah Alan Johnson

Perham High School, Perham, Minnesota, USA

The purpose of this research is to study the effect earthworms have on different soil types and leaf litter. Phosphorus, nitrate, pH, and humus will be measured. Additionally, the mass of the leaf litter will be analyzed. The hypotheses for this research are that the buckets with 24 worms will have more noticeable results than the buckets with only 6 worms. It is predicted that the pH, nitrate levels, phosphorus levels, and the humus content will increase the most in the buckets with 24 worms. It is also hypothesized that agricultural soil will see the biggest reduction in leaf litter. Initial tests were done on four types of soil for pH, nitrate, phosphorus, and humus. Soil was placed into sixteen buckets and twenty grams of leaves were placed on top of the soil. Soil and leaves were exposed to worms for three weeks. Soil tests were conducted again, leaf litter weighed, and conclusions drawn. The hypotheses for this research were not supported. The worms housed in the yard soil consumed the most leaf litter. Additionally, the results of the various soil testing showed that the buckets with 24 worms did not result in a higher increase in pH, nitrate, phosphorus, and humus levels than the rest of the buckets. Further research needs to be conducted to determine the relationship between earthworms and various soil types.

2004 - EV013

HOW LOCATION AFFECTS ENERGY DENSITY OF AGE-0 WALLEYE POLLOCK (THERAGRA CHALCOGRAMMA) IN ALASKAN WATERS

Ashley Raye Kelly

Juneau-Douglas High School, Juneau, Alaska, United States of America

Bomb calorimetry was used to determine how location affects the energy density of age-0 walleye pollock in Alaskan waters. The pollock used in my experiment were collected as part of the Eastern Bering Sea Coastal Research Project conducted in the Chukchi Sea, Bristol Bay, and the Bering Sea. The samples came from six sites within each location and there were two measurements of energy density from each of those sites. My results supported my initial hypothesis that there would be differences in energy densities of pollock from the three locations. I am confident that the energy densities of pollock in the Bering Sea (mean: 3377 J/g) are statistically different from those of pollock in the Chukchi Sea (mean: 4245 J/g) because the P value was 8.19E-05. I am also confident that the energy densities of pollock located in the Bering Sea are statistically different from those of pollock in Bristol Bay (mean: 4203 J/g) because the P value was 4.31E-05. I am not confident, however, that energy densities of pollock in the Chukchi Sea are statistically different from those of pollock in Bristol Bay because the P value was 0.654. Although energy densities varied from each site, energetic differences may have been influenced by the collection date. Knowing what factors affect the energy density of fish, especially the highly valuable walleye pollock, can help fishers decide when and where to fish for their desired catch. Energy density data can also help scientists who monitor fish populations. My approach could be used to see how the health of age-0 walleye pollock varies by season or by location. My data could also be useful to scientists who study animals that eat pollock, such as sea lions, by showing that the number of calories a sea lion gets from a pollock may depend on when or where it eats the pollock.

2004 - EV014

HOW SOIL AFFECTS THE PERSISTENCE OF THE HERBICIDE ROUNDUP(TM)

Kevin Crossland Heffern

Juneau Douglas High School, Juneau Alaska, U.S.A

To determine how soil affects the persistence of the herbicide Roundup, two soils were tested: a sandy forest soil, and a rocky beach soil. The results support my hypothesis for the following reasons. First, the contaminated water was more toxic then either of the first-rinse leachates, so I am confident that some of the Roundup was trapped by the soils. Second, the forest soil leached toxic amounts of Roundup sooner than beach soil, which shows that there is a difference between the soils in the way they trapped the Roundup. Thirdly, the organic content of the beach soil was lower than the forest soil, and Roundup has been shown to be more persistent in less organic soils. Because of these findings I am confident that the persistence of Roundup in soil depends on the composition of the soil. However, it is not clear what part of the Roundup is acting this way; it could be the glyphosate or the surfactant. Timber companies have been granted permission for the aerial application of Roundup to promote tree growth in Alaska. My data suggests that if Roundup was sprayed near fresh water it could leach into the water, and kill zooplankton, an important part of aquatic food webs. According to my results typical southeast Alaskan soils can leach Roundup for a long period of time, up to 120 hours along with three inches of rain. Timber companies should take the type of soil and the proximity of fresh water into consideration.

Awards won at the 2004 ISEF

Scholarship award of \$9,000 per year for four years - Pacific University

2004 - EV015

THE EFFECT OF DIFFERENCES IN MACROPHYTE APPLICATION ON DISSIMILITIVE DENITRIFICATION IN WETLAND

Winifred Margaret Lo

Upper Arlington HS, Columbus OH, U.S.A.

Eutrophication is a phenomenon that threatens aquatic ecosystems worldwide, ranging from backyard ponds and lakes to the Black Sea and the Gulf of Mexico. In this situation, agricultural run-off containing excess nutrients allows the proliferation of algae, which overtake environmental controls. Such a situation is dangerous to the ecological welfare of habitats, yet there are few solutions. One cost-effective solution is the use of wetlands to filter out nutrients; in this experiment, nitrates were the primary focus. Dissimilatory denitrification was chosen as the mode of nitrate/nitrite removal, since it reduced nitrates to nitrogen gas, a common gas in Earth's atmosphere. Different species of emergent and submergent macrophytes were allowed to decompose and then treated to allow denitrification. Gas samples were collected over the course of a 24-hour sampling period. Cattail, bulrush, arrowhead, pondweed, and duckweed, respectively, had the highest amounts of both N2O production rates and original N2O production 3 hours after beginning experimentation. These performances were used to develop combinations of macrophytes that would have the "better" N2O production rates and produced amounts. In the end, bulrush and arrowhead combinations proved to have the best performance, although it was slightly less than that of the individual macrophyte, cattail. However, it must be noted that cattail, when combined with other macrophytes, had relatively poor performance, making only 10% of what bulrush and arrowhead combinations

produced. Therefore, it was concluded that a combination of bulrush and arrowhead provided the best source of carbon for denitrification.

2004 - EV017

REDUCING SEDIMENTARY RUNOFF: A STUDY OF NATIVE GROUND SURFACES AND THEIR RELATION TO SEDIMENT MOVEMENT

Jason Fredrick Kniss
Southridge High School, Beaverton, Oregon, United States

Sedimentary Runoff is a major dilemma that is commonly overlooked. The movement of sediment causes turbid waters, increases the need for dredging, buries fish breeding grounds, and is a source of Eutrophication / Nutrient Displacement. The goal of this study is to find a surface that will best reduce sedimentary runoff when plants are not accessible, like after a natural disaster, in agricultural regions, and at construction sites.

The study is comprised of four test sequences. The first examines the effectiveness of native materials on a simulated slope. This slope was designed with a ground layer of soil and a water source, simulating storm conditions. Four surfaces were tested including soil, water blockades, river rock, and compost. Water blockades were found to be most effective because they slowed the velocity of the water, which catalyzes sedimentation and reduces scouring.

The second test series assesses what material is best to fill water blockades. The same simulated slope was used from the first test series. Between pine chips, compost, rock, and soil, the pine chips performed the best because they controlled and slowed the downstream water flow. The third and forth test series examines the placement of blockades around point and non-point sources. The pyramid formation was most effective for the point source, while the water ladder formation was more efficient for the non-point source due to its effective channeling capabilities. The effective use of water blockades provides a proactive solution to the sedimentary runoff problem that faces the world today.

Awards won at the 2004 ISEF

Scholarship award - Portland State University
Scholarship award of \$12,000 per year for four years - University of Portland
Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV018

FERTILIZER RUN-OFF AND CROP YIELD EVALUATION

Ashton Bree Wesner
Wilsonville High School, Wilsonville, Oregon, U.S.A.

The experiment simulated and tested two agricultural systems: Conversation Buffers and Precision Agriculture. The hypothesis stated that Conservation Buffer systems provide farmers with healthier crops and are better for the environment than Precision Agriculture systems. It evaluated 'crop' by height and growth speed, measured run-off and tested for fertilizer chemicals, observed erosion and the farm's overall well-being.

These systems were replicated in plastic tubs. The Conservation Buffer was represented by instilling a stretch of stabilized, pre-planted grass. This grass acted like a real conservation strip: permanent vegetation that filters run-off and prevents erosion. Precision Agriculture was imitated by applying fertilizer according to acknowledged variations in soil nutrients. Soil high and low in chemical nutrients was used, and less or more fertilizer was applied in appropriate areas.

Grass growth was measured; water samples derived from daily 400ml of 'rain' were collected and tested for conductivity, phosphorous, and nitrogen.

Results supported the hypothesis, revealing that Conservation Buffer systems are better for the environment and farmers. Grass from the Conservation Buffer system grew taller and faster. Actual run-off from the field was the most obvious factor. 19.61% less water ran off this field: an average amount of 29.63ml compared to 36.86ml. Erosion and soil deposit was less, conductivity level was sometimes lower by 20uS/cm, and a phosphorous test indicated run-off deposited only 1.22mg vs. Precision Agriculture's 1.52mg.

This information is useful for preventing Dead Zones, maintaining clean water sources, and aiding farmers in conservatively producing desirable yield while protecting the environment.

2004 - EV019

ANALYSIS OF HYDROGEN SULPHIDE IN SMOKE AND SEWAGE

Man Sum CHI
Hong Kong Chinese Women's Club College, HKSAR, China

Hydrogen sulphide is a poisonous gas and can cause death in concentrations over 600 ppm. Its concentration in different samples of smoke and wastewater were analyzed and scrubbing solution tested to remove hydrogen sulphide from the wastewater.

The contents of the samples were complex and their concentrations of H2S were very low, so the conventional titrametric and calibration technique were found to be inadequate; hence an ion selective electrode (ISE) Ag/Ag2S electrode was made, a standardized HS- solution was prepared and these, together with Gran plot were used to determine the concentration of HS- in smoke and sewage samples.

It was found that mosquito coils and joss sticks did not produce any H2S. Direct smoke contained more H2S than passive smoke. The H2S level of the smoke from one cigarette was well below the lethal level. Industrial sewage of higher acidity had a higher H2S content than that of domestic sewage.

The self-made Ag/Ag2S electrode is economical and provides a fast and effective means of detecting HS- ions. Very low concentrations of H2S (10-5 to 10-6 M) can be accurately found. Scrubbing solution can remove H2S in wastewater. This is appealing from an environmental perspective, since the reagent iodine can be reused many times.

Investigation into the comparative H2S toxicity levels of different brands of smoking products and the invention of a compact instrument for measuring H2S concentration directly would be of value.

2004 - EV020

ARTIFICIAL WETLANDS CAN CAREX APPRESSA PREVENT EUTROPHICATION IN AUSTRALIAN WATERWAYS?

Andrew James Stewart

Karabar Distance Education Centre, Queanbeyan NSW, Australia

The wetland plant *Carex Appressa* when placed in an ammonium nitrate solution gave a two part graphical relationship for the reduction of total ions. This led to the proposal of tiered artificial wetlands that could improve the efficiency of nitrogen removal by up to five times compared to long term ponding. Data was determined using a resistance method to measure the total ion concentration. Feedback suggested that the shape of the graphs could be a result of the electrical measurement as the plant would have a preference for the ammonium ion.

This study investigated the plants removal of ammonium and nitrate ions from solution by measuring the quantities of the specific ions by using a colorimetric technique. The results show that the plant removes more ammonium than nitrate ions on the first day but this preference changes with time. This imbalance in ion reduction reaches a maximum of approximately ten percent of the uptake rate of total ammonium nitrate. A crossover in this trend occurs around day five where the nitrate reduction exceeds that of the ammonium ion. The time of the crossover corresponds with the inflection point on the total ion curves determined by the resistance method. Both the ammonium and nitrate ion reduction curves show the same two part properties as those determined electrically.

This phase of the research shows that the ammonium and nitrate uptake from solution by *C.Appressa* confirms the suitability of tiered wetlands to improve the efficiency of artificial wetlands.

Awards won at the 2004 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV021

THE EFFECTS OF IONIZING RADIATION ON THE MITOTIC ACTIVITY IN RADISH ROOT TIPS

Kelsey Lee Taylor

Yorktown High School, Arlington, VA, USA

It is a general belief that low doses of ionizing radiation produce detrimental effects proportional to the effects produced by high-level radiation. More recently, though, some pioneer scientists have reported that low-dose ionizing radiation is not only a harmless agent but often has a beneficial or hormetic effect. The experiment was designed to test the hypothesis that if radishes were exposed to ionizing radiation, then their mitotic activity would increase. Radish seeds were irradiated with gamma rays using a Gammacell 3000 Elan, a large blood chamber irradiator, at exposure amounts that ranged from zero rads (the control) to 30,000 rads in increments of 2,500 rads. The seeds were then grown for four days. Afterwards, their root tips were made into mitotic squashes to view the number of cells in the four stages of mitosis: prophase, metaphase, anaphase and telophase. Technically, the research hypothesis was supported by the data, since the total number of cells in mitosis for all thirteen-test groups differed significantly according to the results of a 2-PropZTest statistical test. However, upon breaking down the total number of cells into phases, the data did not support all factors of the hypothesis, as anaphase and telophase saw increasing and decreasing amounts of mitotic activity instead of only increasing activity. Since all phases of mitosis had increasing mitotic activity up until approximately 12,500 to 15,000 rads, the data supported the idea of hormesis. Thus demonstrating that up until a certain point, ionizing radiation can stimulate and provide beneficial results.

2004 - EV022

MINIMIZING ARSENIC LEACHING FROM CCA WOOD

Stephen Goodwin Honan

W.T. Woodson High School, Fairfax, VA USA

This project concerns the reduction of arsenic leaching from Chromium Copper Arsenate (CCA) wood and minimizing its effect on the environment. The need exists to limit the cumulative and carcinogenic effect of arsenic on people and animals. Fifty samples of CCA wood were analyzed. Water samples collected from raw CCA wood and CCA wood with one and two layers of paint or stain were tested. Coating the wood significantly reduced arsenic's potential to leach. Two layers of paint decreased arsenic levels by 98%, from 205 parts per billion (ppb) to 5ppb.

 Toxicity of arsenic in the raw CCA wood, the painted wood (one and two layers) and the stained wood (one and two layers) was determined by isolating and converting the arsenic in the water samples into gas, arsine. Water samples were combined with Tartaric Acid to acidify the samples. Then, an oxidizer was added to prevent the hydrogen sulfide from interfering with results. Finally, zinc was added to convert the arsenic in the water samples into arsine gas. A Mercuric bromide indicator test strip measured the concentration of arsenic through the lids of the bottles. After ten minutes, the strip was removed from each bottle and the reactions on the strip were compared with a color chart to measure arsenic for each sample.

 CCA wood is prevalent in landscaping. Application of this experiment can be used to help improve the environment, health and safety issues involving exposure to inorganic arsenic. Prevention of arsenic-related illnesses would be a great benefit.

Awards won at the 2004 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV023

A CONVENTIONAL WATER TREATMENT PLANT CANNOT EFFECTIVELY REMOVE ENDOCRINE DISRUPTORS

David Day Song

Ballard High School, Louisville, KY, USA

Endocrine-disrupting compounds (EDCs) are chemicals that can modulate the endocrine system. These modulations have been linked to a variety of adverse health effects. EDCs have been detected in water supplies around the world. Most water utilities in the United States still treat water with conventional treatment processes. The purpose of this research is to study how effective the conventional treatment processes are in combating against such organic

pollutants. Jar testing, a scaled-down model of the water treatment processes, was employed in this study. Jar testing has been substantially used in the water treatment industry to simulate full-scale water treatment processes: such as coagulation, flocculation, and sedimentation. In addition, water filtration and disinfection processes were evaluated. Finally, powdered activated carbon (PAC) application was also studied. Water treatment plants apply PAC for spill control and taste and odor removal. The effectiveness in removing atrazine and 17 α -estradiol were studied with common coagulants such as aluminum and ferric products, and lime, a softening chemical, as well as chlorine, a widely used disinfectant. Water samples are taken for analysis with immunoassay testing methods. Preliminary results indicate that conventional treatment plants removed less than 20% of studied EDCs, while PAC addition appears effective in removing 90% of EDCs.

2004 - EV024

ENHANCED PHYTOREMEDIATION INVOLVING SYMBIOTIC RELATIONSHIP BETWEEN A BACTERIUM AND SWEET GUM TREES

Jessica Lynn Erickson

Arkansas School for Mathematics, Sciences, and Arts Hot Springs, Arkansas 71901

Metal pollution has increased hazards to the environment. Ever since the Industrial Revolution, heavy metal toxins have caused much damaged to soil and water pollution. Present remediation technologies are typically complicated, costly, and can be counterproductive to the environment. Phytoremediation is an emerging technology, which uses plants to remediate contaminated soil. Bioremediation is another emerging technique, which uses microorganisms to clean the environment. Remediation of metal contaminated soil confronts a particular challenge. Metals cannot be degraded. Therefore, the removal of toxic metals can be difficult. Sweet Gum trees (*Liquidambar styraciflua*) have been determined as plants that are capable of extracting metals from contaminated soils. However, due to the amount of time it takes phytoremediation to fully clean a contaminated site, there is a need to speed up the process. In this study, bioremediation was tested to see if *Pseudomonas putida* and sucrose would act as a catalyst in the absorption of iron and chromium into Sweet Gum seedlings. In this study, a symbiotic relationship involving phytoremediation and bioremediation was identified. During the experimentation, Sweet seedlings were planted into sterilized soil and a soil containing *Pseudomonas putida*. After the seedlings had been treated with the metal salt solutions and sucrose solution, the seedlings were burned to ash, and tested for the iron and chromium concentrations of the plant's system. It was determined that with *Pseudomonas putida* and sucrose, the Sweet Gum seedlings absorbed a higher concentration than seedlings whose soil did not contain bacteria and sucrose.

2004 - EV025

ECOLOGICAL AND GEOGRAPHICAL PECULIARITIES OF REDFISH INFESTATION BY NEMATODE ANISAKIS SIMPLEX

Maria Yurievna Bakay

School # 27, Murmansk, Russia

The paper is aimed at studying ecological and geographical particularities of *Sebastes mentella* infestation by larval nematode *Anisakis simplex*. Method of incomplete parasitological dissection developed by Professor V. Dogiel (1933) was used. The analysis of evidence available in the literature revealed that this issue had been poorly studied. Specific features of nematode localization and infestation degree for the redfish from different areas in the North Atlantic were identified. The level of infestation by parasite in relation to length (age), sex, area and depth was determined. The possibility of consumption of redfish as food is considered and recommendations are given on specific technology to be used to cut the fish infested by *A. simplex*. The results of ecological and parasitological monitoring in the Irminger, Norwegian and Barents Seas indicates that there exists an equilibrium in the parasite-host system under study. It is suggested that the ecosystems in these areas are relatively healthy and stable, which is indirectly confirmed by the balance of the system studied.

2004 - EV026

DETOXIFICATION OF 1-NAPHTOL N-METHYL CARBAMATE IN SOIL AND WATER BY A STRAIN OF PSEUDOMONAS SP.

Domingo Campos Vargas, Jr.

Claro M. Recto High School, San Miguel, Metro Manila, Philippines

The experiment was conducted to test the ability of *Pseudomonas* sp. to shift to the agricultural pesticide Sevin, the commercially sold carbaryl (85% concentration), as a sole source of carbon and energy. The chemical name of carbaryl is 1-Naphtol N-Methyl carbamate. The rate of degradation of Sevin was investigated using *Pseudomonas* sp., a bacterium isolated from flooded rice soil to confirm if this would be the same as that of other carbaryl brands. *Pseudomonas* sp. maintained as a stock culture in nutrient agar medium was revived in carbaryl enriched minimal medium broths with varying concentrations of Sevin-carbaryl: 0.1, 0.25 and 0.5 g/liter of minimal medium and incubated for 40h in ambient room temperature. Phenol, the toxic blue-colored product of carbaryl degradation was detected by micro thin layer chromatography, which diminished with time and the production of brown colored metabolites after 32h incubation. The brown colored metabolites may be less toxic than carbaryl or non-toxic. Further study should be done to identify this brown product. The results are consistent with previous studies on the degradation of 85% carbaryl and confirm that *Pseudomonas* sp. can be a carbon and energy source shifter given the proper acclimitization.

2004 - EV027

ACID MINE DRAINAGE CONCENTRATIONS OF AS, CD, CR, PB, ZN, AND CU IN WATER AND SEDIMENTS, RELATED TO DISTANCE AND DISCHARGE IN PIKE COUNTY, INDIANA

Aaron M. Ritter

Bedford-North Lawrence High School, Bedford, Indiana USA

Coal-mined areas of southwestern Indiana have disrupted lands and caused acid mine drainage (AMD). Traces of heavy metals are contained in coal and are

released when acids, derived from pyrites, react with the coal. The purpose of this research was to determine the amounts of metals entering selected streams, relate it to distances, compare watersheds, and see if federal standards were being exceeded. Correlation was also made to pH, conductivity, dissolved oxygen, dissolved and suspended solids, streamflow volume, and temperature. This study is important because federal RCRA regulations and EPA water standards set maximum limits in waterways and water bodies that directly affect stream biota and may affect domestic water supplies. The methods used included direct field measurement using anodic stripping voltammetry, conductance and dissolved oxygen by YSI meters, filtration and oven drying, and commercial laboratory analysis. Thirteen sites were used, including two controls. One control site had the highest sediment arsenic, followed by an AMD site. Dissolved arsenic ranged from 2-5 ppb. Cadmium ranged from 9.69 to 14.4 ppb at low flow and decreased at high flow. Dissolved chromium and copper peaked at an acid seep coming from a spoils area. Sediment chromium reached 35000 ppb. Carcinogenic hexavalent chromium was below detection limits. Lead and zinc were present at all sites. Analytes did not necessarily decrease downstream as hypothesized. Tributaries, coal seam, and prevalence of spoils all along most waterways caused rises and falls in concentration. All sites exceeded EPA limits for dissolved cadmium. Seven exceeded chromium limits, and sediment metals reached thousands of times higher than in water. As expected, low pH was prevalent. No sites exceeded RCRA limits. Remediation is still needed to improve water quality, raise pH, and limit exposure of spoils to precipitation.

Awards won at the 2004 ISEF

Scholarship award \$5,000 per year, renewable for four years in any area of natural sciences and mathematics - University of Oregon

2004 - EV028

PRE AND POST STORM EVENT COMPARISONS OF PESTICIDES, ANIONS, AND COLIFORMS IN TWO TYPES OF RURAL WELL WATER

Andrew I Ritter

Bedford-North Lawrence High School, Bedford, Indiana USA

The purpose of this study was to compare pesticides, total coliforms, nitrates, chlorides, sulfates, and phosphates in wells using newer and older technology. This is a very important study, as many people still use wells as their source of drinking water. If pollution exists in these wells there could be some very serious health effects. Many farms in this area use wells, some of which were there when they bought the farms. It was hypothesized that older well types might contain greater amounts of these substances because they are often located near to farm animals and fields. The type of casing, wellhead protection, and technology might be more susceptible to substances getting down to the water supply. Water samples were collected before and after storm events and analyzed in commercial or governmental laboratories that donated the analysis for this research. Five older wells and six newer wells were checked. In older wells, coliforms were high in four locations. Chlorides were below EPA limits and nitrates were found in one well before and in three after rain. One was above limits. Phosphates and pesticides were not detected. In newer wells coliforms were found in three locations, but much lower than older wells. Three newer wells had nitrates pre and post storm, with one as high as 43 mg/L. Chlorides were again detected, but below limits. No phosphates or pesticides were detected. Sulfates were detected in all wells in this project and were expected due to bedrock sulfates. It was concluded that older wells did have a coliform problem, more than newer wells, as expected. Pesticides were a below detection limits in all wells, which is good news. Chlorides were actually higher in newer, but sulfates higher in older wells. Nitrates were found in 60% of older wells and 50% of newer wells. Thus, as measured by coliforms, older wells did have a greater problem, but by anions, it is inconclusive. Studies over a full year's time could show seasonal farming effects.

Awards won at the 2004 ISEF

First Award of \$500 - National Ground Water Association

2004 - EV029

PHARMACEUTICALS IN RIVER WATER: IS IT POSSIBLE?

Jennifer Marjorie Moldan

New Ulm Cathedral High School, New Ulm, Minnesota, United States

The purpose of this project is to find out if pharmaceuticals are present in effluent and river water samples around the towns of New Ulm, Mankato, Saint Cloud, Rochester, Shakopee, and the Twin Cities.

The approach was to gather river water and effluent water samples from six cities located in Minnesota. Samples were gathered where the river flowed into and out of each city. An effluent water sample was gathered for each city except the Twin Cities and Shakopee which shared an effluent water sample. The effluent water samples were tested to see the amount of pharmaceuticals introduced into the river. The river water samples before and after each city were tested to see the affect a city and the effluent introduced by it has on the amount of pharmaceuticals present in the river.

The results of both tests showed that all river water samples were negative and had no pharmaceuticals present. There were variations in the results of the SL Beta-lactam test creating a range from -2807 to -1454. Even though both tests resulted in denying pharmaceuticals presence in the river water I cannot accept it as certainty. The fact that these tests to my knowledge have never been used to test river water and effluent water influences my belief that these tests are fallacious when testing river water. I believe too strongly that there must be a slight presence of pharmaceuticals because of the popularity of their use.

2004 - EV030

THE IMPACT OF SEWAGE TREATMENT PONDS ON THE MINNESOTA RIVER

Hannah Marie Schneider

Belle Plaine High School, Belle Plaine, MN U.S.A

By the time the Minnesota River has reached the Twin Cities it is the state's foulest river and is the largest polluter of the Mississippi River. This projects purpose was to find if the sewage treatment plant near Belle Plaine had an effect on the levels of pollutants such as Fecal Coliform, Nitrates, Total Solids, and Phosphates in the Minnesota River. Testing will show that pollution levels of all the tests will be statistically lower after the sewage treatment plant. Water

samples were collected at two points on the Minnesota River, one 1/2 mile before the sewage treatment plant, and one 1/2 mile after the sewage treatment plant. A 12 ft. pole with a mason jar attached was used to collect the water samples. Water was collected every three days over a period of five weeks from both sites. Fecal Coliform, Nitrate, Phosphate, and Total Solids tests were done according to the proper outlined procedure. The results showed that the majority of the pollution levels were higher before the sewage treatment plant. 67.5% of the tests were lower after the sewage treatment plant. Test results showed that the hypothesis was correct.

2004 - EV031

A PROCESS FOR MAKING USED EXPANDABLE POLYSTYRENE TO REMOVE COPPER IONS FOR WASTE WATER TREATMENT

Yu- Chen Cheng

The Affiliated Senior High School of National Kaohsiung Normal University, Taiwan

Due to the non-biodegradable properties of expandable polystyrene (EPS) wastes, it has become a severe problem for the environment. A novel method was developed to efficiently convert EPS into a cation exchange resin as EPSR (EPS rubber) for the removal of copper ion. Five EPS wastes were selected and converted to EPSR by a standard sulfonated processing. The microstructure of the EPS and EPSR was observed with a polarized microscope revealing a porous and uniform structure. The mode of action was examined with measuring adsorption of copper ions at a fixed temperature indicating that the Langmuir adsorption isotherm was obeyed 50 to 5000 ppm concentration. To explore the mechanism involved in the adsorption of copper ions, an infrared spectrometer was used. The data demonstrate that the -SO3H groups play a crucial role in adsorption. A home-made differential-potential detection device for measuring the copper ion was therefore invented. One of the EPSRs, EPSR-5, with higher content(0.49 mole ratio) of -SO3H groups demonstrated better copper adsorption capacity. More importantly, it showed a good adsorption performance after regenerating with 5% hydrochloric acid. Following the optimization for removing copper ion from waste water, a device containing three sequentially connected EPSR-5 absorption cells was developed. It was able to effectively remove copper with 95% efficiency (51.2 meq/g) within 200 min. Moreover, the resulted brownish EPSR wastes can be solidified as a remarkably attractive decorative-material following the blending with calcium carbonate.

Awards won at the 2004 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV032

AS THE WHEEL TURNS, THE ENERGY CHURNS

Richard Lee Shillington

Michael M. Krop Senior High School, Miami, Florida, United States of America

The purpose of this experiment is to determine the possibility of creating electrical energy by converting the inertia of a moving automobile into clean running power that would otherwise be lost to the ground. This was demonstrated on a small-scale track with two model cars. Two generators were connected to the track. A transformer was attached to the A/V wires and the power level was set to three volts. The CBL probes were connected to the generator outputs and the TI-83 plus calculator. Intervals were set to record the voltage every three seconds. The track was electrified by adding three volts of electricity. The data was collected from the calculator and entered into the computer Graphical Analysis program. The data was then analyzed for efficiency. This experiment was then redone using five, seven and nine volts of electricity. Cars were weighed and along with the track were converted into actual size and weight. The results were generally that the loss was about 35% of the energy produced. Overall, the most reliable voltage was seven volts, which would be comparable on a full-size model to 112 kilometers per hour. The hypothesis was supported by the experiment that this will be the beginning of a new clean source of electrical energy. This experiment can also be used on an aircraft carrier to convert the inertia lost by a landing airplane into electricity. Another use of this experiment is to convert the movement of a train into electrical energy.

2004 - EV033

HOW CONTAMINATED IS THE SOIL?

Elizabeth J. Ruden

West Central Valley Community High School, Stuart, Iowa, Guthrie

Ruden, Elizabeth J. West Central Valley High School 320 NE St. Stuart IA, 50025 West Central Valley High School How Contaminated is the Soil? The purpose of the experiment was to run a lettuce bioassay and a daphnia bioassay on the same soil samples suspected of soil contamination and to compare the results of the two types of assays. Four soil samples from a contaminated site were collected and labeled, East, North, South, West. Spring water and an uncontaminated soil sample were used for controls. For the lettuce bioassay 3 grams of soil was placed in a petri dish , covered with filter paper, 5 ml of spring water added and five lettuce seeds placed on top. Dishes were covered and placed in a dark box for 5 days. Root lengths were measured. For the Daphnia assay, 10 gram of soil was stirred into 100 ml of spring water. From this beaker 10 ml was taken and added to 90ml of water and this dilution continued until a .001% dilution was reached. Five daphnia were added to each of five dilutions. Dead daphnia were recorded after one hour , 24 and 48 hours. The North and West samples showed less than 1 mm of root growth compared to the water control which had an average of 3.53 mm and the soil control with an average of 8.52 mm of growth. This suggested that these two samples were contaminated. An average death response of 100% in the North sample and 60% in the three samples compared to the 0% in the controls, suggested some degree of contamination in all the test samples.

2004 - EV034

DOES FECAL COLIFORM EFFECT OUR LOCAL SURFACE WATER?

Alexis Breann Thrower
Carson High School, Carson City, Nevada, USA

The purpose of this project is to test the quality of local surface waters including, Carson River, Steamboat Springs creek, Washoe Lake, and 2 control locations. In these bodies of water I will test the fecal coliform content at the 4 areas. In three of the four areas I will collect water samples from 3 sites, in the fourth area I will take two samples. The number of sites will total 11, at these 11 sites I will collect three 100mL water samples, making the number of samples 33. All of the sites chosen except for the 2 control locations are located near or downstream from cow pastures. After collecting the water samples I will take the water to the Carson City Water Reclamation Plant to run the tests for Fecal Coliform. I will run the test and incubate the samples for 24 hours. Then I will go back the next day to count the number of colonies that have grown. The number that I get will represent the total number of bacteria that were originally in the sample. My hypothesis is that most of the sites will contain Fecal Coliform. I believe that the Steamboat Springs sites will have more than the other sites because these sites are closer to cow pastures.

2004 - EV035
CARBON MINING: FERTILIZER DRESSED IN BLACK

Dustin George Hughes
Timmins High & Vocational School, Timmins, Ontario, Canada.

My project addresses current global issues such as water, fertilizer and air pollution, the Kyoto Protocol, and the Canadian economic problem of softwood lumber tariffs. I discovered that charcoal blended with household ammonium bicarbonate (ABC), effectively creates a fertilizer that removes 14 moles of CO₂ from the atmosphere per mole of fertilizer produced. Simulation results demonstrate a net 1.27 Gt. of carbon can be removed from the atmosphere annually (carbon, in both the charcoal and gaseous forms, is used to manufacture ABC), saving 81 GJ of energy (ABC requires less energy during manufacture than conventional fertilizers). The porous charcoal texture traps ABC within a matrix during production, providing a slow release mechanism that allows farmers to use less fertilizer on more types of marginal lands. Therefore, the run-off of fertilizers into rivers, lakes and streams is reduced. By using ABC and charcoal to fertilize biomass, the net weight applied can be increased by 30% and the net height can be increased by 37%. This fertilizer, applied to stands of poplar and willow, will increase the yield of tree plantations, and allow the lumber industry to increase profits and to generate power using the yielded wood as a recyclable fuel. The increase in tree plantation yield is cost effective and will provide lumber companies with the money required to account for softwood duties. Finally, through computer simulation analysis spanning over the next century, I discovered that this fertilizer would be effective in bringing the global carbon cycle back into equilibrium.

Awards won at the 2004 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV036
EXAMINATION OF THE LETHAL DOSAGE OF BACILLUS THURINGIENSIS VAR. KURSTAKI ON THE VANESSA CARDUI (PAINTED LADY BUTTERFLY).

Victor Guillermo Castro
William L. Dickinson High School, Jersey City, NJ, United States

The purpose of this experiment is to inoculate the media with Bacillus thuringiensis and determine the toxic effects of Bt on the Painted Lady Butterfly. In addition, to demonstrate if Bt spores can be diluted to an infectivity endpoint, and finally, to determine the range at which Bt solutions lose toxicity in the non-target organism. In part 1, the larvae were placed into identical environments with equal amounts of food. Then Bt was made according to the Bt dilution chart. The highest dosed group followed the lethal dosage and the control had only water. The third part was the administration of the Bt solutions to the different groups. In general, the results showed that as the Bt dosage increased, the lower the average weight of the groups. The trend supported the hypothesis. The higher the Bt dosage among the treatment groups, the higher the mortality rate. The G-test performed proved very significant. It showed that under the same circumstances, there is a 95% chance of repetition among the groups if experiment is repeated. The findings show that the Bt seems to be most effective within the first 36 hours at the lethal dosage range and effective at all levels. It is a high possibility that Bt cannot be diluted to an infectivity endpoint. Although the Bt proved to be more potent than originally thought, the mortality rate and average weight of the larvae seemed to balance out in the middle of the groups in the 3% range.

2004 - EV037
RISK CHARACTERIZATION OF LIMESTONE ROAD DUST AND ITS COMPONENTS ON MONARCH LARVAE GROWTH AND DEVELOPMENT

Rachael Theresa Collier
Mediapolis Community High School, Mediapolis, Iowa, USA

Laboratory tests were conducted to establish the toxicity of limestone road dust and its components on monarch larvae, Danaus plexippus (L.). Monarch larvae were fed milkweed (Asclepias curvassica L.) treated with limestone road dust, silica, calcium carbonate, and magnesium oxide. Bioassays indicated that limestone road dust and its component were toxic to monarch neonates through negatively influencing larval development and respiration.

Awards won at the 2004 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV038

ANALYSIS OF ANTIBIOTIC RESISTANT BACTERIA IN THE WATERSHEDS OF DAIRY BOS TAURUS FEEDING OPERATIONS

Amy Michelle Busch

Patrick Henry High School, Hamler Ohio, United States of America

There is worldwide concern about antibiotic resistant bacteria. The use of antibiotics in animal agriculture has become a topic of discussion. There is concern that antibiotics and antibiotic resistant bacteria will leach into the soil and water were it is able to come in contact with plants, animals, and humans. It was hypothesized that water around a medium dairy Bos taurus Concentrated Animal Feeding Operations (CAFO) will have a higher resistant bacterial percentage count than the water around small dairy Bos taurus Animal Feeding Operations (AFO).

Water samples were first collected in ditches from two CAFO's and two AFO's. The samples were inoculated onto Luria Broth agar plus Ampicillin. This gave the number of resistant bacteria. The samples were inoculated on Luria Broth agar. This gave the total bacteria count. Five resistant bacteria colonies were picked from each farm. The samples were then re-isolated in Luria Broth plus Ampicillin agar: then isolated in Luria Broth plus Ampicillin broth. The Luria Broth plus Ampicillin broth was inoculated onto Mueller Hinton agar plates and the antibiotics Ciprofloxacin, Ampicillin, Streptomycin, Vancomycin, and Tetracycline were used. The Zones of Inhibition were then measured and compared to an inhibition chart. Gram stains were run on the resistant bacteria.

The resistant bacteria count and total bacteria count numbers were divided giving the percentage of resistance. All farms showed less than 0.1% resistant. In the test for multiple resistances, both CAFO's and AFO C-RB5 showed multiple resistances to Ampicillin and Amoxicillin.

2004 - EV039

TROUBLED WATERS: A SIX MONTH LONGITUDINAL WATER QUALITY STUDY OF THE SPANISH FORK RIVER DRAINAGE SYSTEM AND REMEDIATION STRATEGIES

Shannon Lisa Babb

American Fork High School, American Fork, Utah, U.S.A.

This study reports findings of the third phase of a multi-year analysis of the major inlets and outlet of Utah Lake. The focus was to locate water quality problems along the Spanish Fork River drainage system, determine causes and identify remediation strategies.

 Evaluations were conducted at seven sites. Three sites were on the primary tributaries flowing into the Spanish Fork River. Other sites were at the confluence of the tributaries, upstream and downstream from Spanish Fork City (evaluating urbanization impact) and prior to entering Utah Lake (evaluating agricultural impact).

 Each site was tested chemically, physically and biologically using standardized evaluation tools. Chemical testing included dissolved oxygen, phosphorus, pH, nitrate and sulfide. Physical evaluation included turbidity, temperature, cross-section, flow rate and riparian zone surveys. Biological testing for E. coli and surveying of macroinvertebrates, using a validated water quality rating scale, was done.

 Data were collected for six months, May through October, to track spring, summer and fall values, and effects of water diversion for irrigation and other uses.

 Based on state water quality standards for cold water fisheries, results identify a progressively negative impact on the Spanish Fork River drainage system as a result of human activity. Water quality significantly deteriorated following passage through urban and agricultural areas. All seven sites exceeded EPA standards and/or guidelines, either chemically and/or physically, at some point during the six month period.

 Essential remediation plans include public education; rebuilding streambed; repairing riparian zone; and preventing direct runoff from agriculture, roads, railroads and urban areas.

Awards won at the 2004 ISEF

- Honorable Mention Award of \$100 - Association for Women Geoscientists
- First Award of \$500 and matching \$500 grant to winner's school - Bureau of Reclamation/U.S. Department of the Interior
- Second Award of \$1,500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
- Second Award of \$300 - North American Benthological Society
- First Award of \$500 - Society of Environmental Toxicology and Chemistry

2004 - EV040

"THE EFFECTS OF THE TITTABAWASSEE RIVER WATER ON EUCIDARIS TRIBULOIDES"

Quintisha Marie Walker

SASA, Saginaw, MI, USA

In the experiment "The Effects of the Tittabawassee River Water on Eucidaris Tribuloides," sea urchin embryos were being grown in the Tittabawassee River water. I was attempting to determine if the Tittabawassee River was teratogenic, and if so, at what locations near the Midland Dow Chemical Company (upstream or downstream). Also if it was more teratogenic during the Winter or Spring. The river is known to contain PCB's and Dioxins. There have been high concentrations of PCB's found in sport fish. Sea urchins were used because they are ideal for a wide range of developmental studies. Since the embryos were relatively transparent, that allowed me to better analyze their internal components.

 The river samples were collected from four locations; Chippewa River and Emerson Park, which are upstream from Dow, and Immerman Park and Caldwell Boat Launch, which are downstream from Dow. The eggs and the sperm from the sea urchins were placed in a shedding cup of seawater. A sample from each river site was placed in individual petri dishes with a salt water mixture. They were allowed to develop for 24hrs. Temporary slides were made with the embryos stained in Aceto Carmine, fixed in Bouins fluid and preserved in 50% Glycerol. Pictures were then taken of each slide including the control.

 My data supported my hypothesis. The Tittabawassee River is teratogenic. I found that the Tittabawassee River is more teratogenic downstream from the Midland Dow Chemical Company, during the Winter, and it is more teratogenic, in the Spring, at locations upstream from the Midland Dow Chemical Company.

2004 - EV041

THE ROLE OF HORMESIS IN THE TOXICOLOGY OF COPPER IN ROTIFERS

Aakash Kaushik Shah
Academy for Medical Science Technology, Hackensack, NJ, United States

Hormesis is a phenomenon in which exposure to low dosages of toxins is more beneficial to organisms than no exposure at all. The EPA disregards the effects of hormesis when conducting toxicity evaluations partly because its underlying mechanism remains undiscovered. In this study, rotifers were used as a model organism to demonstrate the hormetic effects of copper pollution and to investigate the underlying mechanism of copper hormesis. It was hypothesized that rotifers pretreated with low dosages of copper would have a higher survival rate to heat shock than rotifers unexposed to copper. The results corroborated this; rotifers pretreated with copper between 50 ppb to 5 ppm significantly benefited in comparison to the control, which produced p-values <0.0015 and p-values <0.0005 when analyzed with T-tests and Kolmogorov-Smirnov tests, respectively. The results suggest flaws in the current model for toxicity evaluations, Linear-No-Threshold (LNT). First, LNT assumes the dose-response to low dosages is linear, whereas the data suggests it is nonmonotonic. Second, LNT does not set a threshold, which prevents the discovery of the hormetic benefits. This study has shown that a limit based on an LNT model can be seriously flawed, and could, in fact, deny the ecosystem significant hormetic benefits that may derive from levels of a pollutant that exceed the LNT-derived limit. Therefore the inclusion of hormetic effects could significantly increase the level at which regulation is necessary. Raising the allowable limits has an economic impact because unnecessary purification is expensive. Additionally, an underlying mechanism of copper hormesis is proposed which involves metallothioneins (MTs) and heat shock proteins (HSPs).

Awards won at the 2004 ISEF
Second Award of \$1,500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
First Award of \$3,000 - U.S. Air Force

2004 - EV042
THE EFFECT OF UREA IN THE CONCENTRATION OF PYRODINIUM BAHAMENSE IN JOBOS BAY
Katherine Benn
Guamani Private School, Guayama, Puerto Rico, United States

The coastal development in Mar Negro at Jobos Bay has affected negatively the concentration of Pyrodinium bahamense. Is urea present in this bay? Is urea responsible for the decrease in the concentration of Pyrodinium bahamense? If urea is present in the water of Mar Negro at Jobos Bay then the concentration of Pyrodinium bahamense is decreasing. Two samples of water were taken in Mar Negro with a sterilized bottle. One sample was from an area where there were houses around and the other was from an area where there were no houses around. The samples were taken to the laboratory to find out if there were bacteria present in Mar Negro. The water samples were inoculated in Blood Agar and in Mac Conky culture mediums. The Mac Conky will identify the gram negative bacteria and the Blood Agar will identify the gram positive and negative bacteria. The cultures were incubated for twenty four hours and then the bacteria were identified using a color interpretation chart. The samples taken close to the area where there were houses showed four colonies of E. coli in Blood Agar and in Mac Conky mediums. The samples taken in the area where there were no houses around showed the presence of Protus vulgaris (swarming). The presence of E. coli indicated that there was urea in the water. Since Pyrodinium bahamense is extremely sensitive to the presence of urea this means that it is responsible for the decrease in the concentration of Pyrodinium bahamense.

2004 - EV043
THE WIND, A SOURCE OF ENERGY THAT NEVER ENDS (PHASE II)
Ángel Jonathan Alicea
Colegio Nuestra Señora del Carmen, Hatillo, Puerto Rico

This research intends to create conscience among people about the utilization of windmills as an alternative to the reduction of the burning of fossil fuels to generate electric energy and about the benefits to the environment. Also an enhanced model of a windmill was produced. In this investigation, data was gathered on themes such as how windmills help to reduce the burning of fossil fuels and at the same time help to avoid the greenhouse effect and the global warming, which places in Puerto Rico, United States, and Europe are suitable for the construction of aeolic parks and where actually they are beneficiating from aeolic energy, how economic and efficient windmills are for the consumer at the domestic and industrial levels, and what are the effects of windmills on the fauna and flora in the places where they are installed. There is also an analysis and comparison of data between toxic emissions liberated by the burning of fossil fuels in the traditional electric plants of coal, petroleum, and natural gas to the ones liberated in aeolic parks. A comparison between aeolic parks, hydroelectric plants, and nuclear plants is also included. It is expected that all this data and valuable information help people to gain conscience of the necessity and importance that the wind turbines have, in the production of electric energy, in our ecological development and in our planet. For future experimentations, it is expected to develop a system of vanes that can work with less wind velocity.

2004 - EV044
WATER ANALYSIS OF THE LITTLE MINNESOTA RIVER
Neal Jerome Konda
Sisseton High School, Sisseton South Dakota, United States

Purpose: To determine whether or not the land surrounding the Little Minnesota River will have any affect upon the health of the river. The health will be determined by the levels of nitrates, orthophosphates, dissolved oxygen, dissolved carbon dioxide, and fecal coliform bacteria present. Procedure: Ten test sites were plotted and water samples were collected from them for a period of ten weeks. They were then tested for nitrates, orthophosphates, dissolved carbon dioxide, dissolved oxygen, and fecal coliform. Data: 85% of the time orthophosphates were over the legal limit, 44% of the time nitrates were over the legal limit, and 23% of the time dissolved oxygen levels were stressful to aquatic animals. The dissolved carbon dioxide was moderate and the fecal

coliform levels were very high for a free flowing stream.

Conclusion: The pasturelands had acceptable levels of dissolved carbon dioxide, orthophosphates and E. coli bacteria. Pastureland had the worst levels of dissolved oxygen, nitrates, and coliform bacteria.

Tilled farmland had one high point by having the lowest level of coliform bacteria, but at the same time, it had moderate levels of dissolved carbon dioxide, dissolved oxygen, nitrates, and orthophosphates. Tilled farmland had a low point in the E. coli tests.

Conservation reserve program land had two high points in the dissolved oxygen and nitrates for having the best levels. It was moderate in E. coli and coliform bacteria and raked the lowest in dissolved carbon dioxide and orthophosphates in terms of health of the river.

2004 - EV045

A STUDY ON COALBED METHANE WATER

Hanna Eileen Cunningham
Hysham High School; Hysham, Montana, United States

PURPOSE: This science project was to determine whether or not coalbed methane water from an area south of Decker, Montana, would germinate seeds and support plant growth.

 PROCEDURE: Two water samples were taken. The control sample consisted of purified river water and the test sample was taken from a coalbed methane water well near Decker, Montana. Four test were performed. Each included a control box/plant as well as a test box/plant.

 TESTS

~ Damp paper towel with grass, radish, turnip, and corn seeds

~ Potting soil with grass, radish, turnip, and corn seeds

~ Twenty-one day old house plants

~ One year only house plants

 CONCLUSION: It was concluded that coalbed methane water from a well south of Decker, Montana, worked well to germinate and support plant life; however, this experiment was performed on a short term basis only. The long term effects were not determined.

2004 - EV046

FILTERING THE DANGEROUS EFFECTS OF ROAD SALT

Laura Kathleen Jones
University School of Milwaukee

Salting is commonly used in northern areas to de-ice roadways, but there is concern that the salt might have damaging effects on the environment. An experiment was devised to compare two typical roadside fill materials, gravel and topsoil, to see which provides the greatest salt retention/absorption. This was done by conducting two similar experiments on different scales. The first experiment was on a large scale, and was done by replicating a concrete roadway within a closed structure, spreading it with salt, and measuring specific amounts of sprinkled water over the test area. The second experiment was on a smaller scale, and was done by mixing a salt solution and measuring the filtration of the dissolved salt and the two types of fill.

The test sequences were carried out, and the consequent runoff was then collected and tested for salinity, using a conductivity sensor and data analysis software (Logger Pro). I hypothesized that the topsoil would be better at mitigating salt runoff, since it contains both inorganic material (pebbles, sand, silt, clay) and a variety of organic matter which I thought should absorb more salt. The results confirmed my hypothesis.However, my hypothesis about the salinity slowly getting higher was wrong. Even though salt was being dissolved, more water was diluting it, causing the salinity to slowly drop. In the smaller scale, the results showed that the topsoil was a better filter, but pea gravel had a faster rate of decline for salinity, agreeing with my hypothesis.

I am now adding plants to my experiment, testing which substance promotes the best plant growth and which substance provides optimal salinity for growth. Additional research and testing is also being done to determine if there is a material that could be placed by the sides of roads that would react with the salt, neutralize it, and take away its harmful effects.

Awards won at the 2004 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV047

PHYTOREMEDIATION: ECOLOGIC SOLUTION FOR VIEQUES' BEACHES

Jovied Cáliz
Josefa Vélez Bauzá High School, Peñuelas, Puerto Rico

In this research project phytoremediation was performed. It is a process in which the plants clean the environment (water or soil) from heavy metals, oil and bacteria. In view of this, this investigation was done with the principal purpose to find out if the phytoremediation process may help to reduce the level of contamination by metals in Vieques' beaches. Can the plants reduce the level of metals in the ground by the phytoremediation process? If the ground of Vieques' beaches are exposed to phytoremediation using the plants Bryophyllum x serratifolium, then the level of metals in the ground will be reduced.

To confirm this, the investigator visited Vieques Island and took water and ground samples from the beach of Puerto Esperanza. One of the ground samples became the control group and the other one the experimental group, which received the phytoremediation treatment for two weeks. Then some plants of Bryophyllum x serratifolium were planted in two flowerpots to begin the phytoremediation process. After two weeks, the samples were analyzed and tests for metals content were performed.

The analysis of the water sample demonstrated that there was no considerable amount of metals. The control group showed a considerable amount of lead (2.134 mg/kg), but the experimental group revealed less amount of lead (1.095 mg/kg), making the hypothesis true. In view of these results, phytoremediation is an effective ecologic solution that helps to reduce the level of metal contamination in Vieques' beaches.

2004 - EV048

SALT CEDAR MOVEMENT DO SEEDS DISPERSED BY SALT CEDAR PLANTS FOLLOW PREVAILING WIND PATTERNS?

Reid Michael Buckley

Roundup Jr./Sr. High School, Roundup, MT, U.S.A.

A saltcedar patch with many established, mature plants was mapped using a Trimble GPS mapping system to globally locate random plants throughout the patch. The GPS information was loaded into a program called GPS Pathfinder. After differentially correcting the data, the information was loaded into another program called Arcview, which enabled changing the appearance of the maps. The large maps were printed on a plotting machine. The rest of the information was organized appropriately, and analyzed as a whole, concluding that the hypothesis that the saltcedar is moving north/northeast was incorrect. The saltcedar is moving south, against prevailing winds and drainage patterns. Some follow-up research to find a cause for the movement of the saltcedar determined the only alternative to be the animals that live on the river bottoms.

2004 - EV049
GASSY WEEDS

Chris John Strand
Mitchell Sr. High School, Mitchell, SD, USA

The goal was to find a plant besides corn that could be used to make ethanol. Increased ethanol production would reduce the current need for non-renewable energy sources as well as aid in the production of cleaner burning fuels.

 Activated yeast (*Saccharomyces cerevisiae*) was added to a solution of dried plant material and distilled water (to extract soluble carbohydrates) and incubated at 37 degree C for ten minutes. Respiration rate (ppm CO2/min) over a five-minute period was analyzed using a Vernier carbon dioxide sensor. A portion of the solution was also centrifuged to remove particulate matter. The supernatant was analyzed by gas chromatography for relative ethanol content as compared to a standard 9.5% ethanol solution.

 Data were analyzed for the average height of each plant's ethanol peak and the change of carbon dioxide in the chamber over five minutes. Results for carbon dioxide production had *Nepta cataris* (catnip), *Chenoposium album* (Lambsquarters), and *Tagetes* spp. (Marigold) outperforming *Zea mays* (red and yellow varieties) in ethanol production. Analysis of ethanol production by anaerobic respiration also had *Nepta cataria* L. on top with *Artemisia absinthium* L., *Solidago canadensis* L., and *Ambrosia artemisiifolia* L. showing no significant ethanol production.

 It is therefore concluded that there are several plant species that could be used for an ethanol production source. Of most interest was the common "weed" *Nepta cataria* L. (catnip). It is a "weed" that grows well under adverse conditions and is a perennial (coming back every year)!

2004 - EV050
ECONOMICAL REMOVAL OF BACTERIA FROM STORM WATER

Reagan Laura Munn
Weber High School, North Ogden Utah, USA

EPA publicly has recognized stormwater as being one of the worst polluters of the Nation's water supplies, thereby requiring its cleanup before discharging into "Waters of the U.S.". However, "cleanup" of contained fecal bacteria is not included in this order. Because of "non-mention", to this date, virtually no research has been devoted to this problem. This Project is one of the first studies ever attempted to find a method for such removal.

This project used wetland vegetation in a one-acre, constructed earthen basin to remove *Esterichia coli* bacteria from stormwater. Study procedures included "spiking" of a known number of an *E. coli* strain (one not found in stormwater) into incoming waters to basin and counting of numbers outgoing. This strain became identifiable and countable by inclusion of an antibiotic in the petrie plate agar to which the "spiked" strain is immune, but by which all other organisms are eradicated.

Results showed that in warm Seasons with vegetation thriving, approximately 96.8 % of the "spiked" strain dropped out of the water column before exiting the basin. Because all *E. coli* strains approximately are of same size and mass, all other strains in the water are assumed to have dropped out in similar percentages.

Further testing showed that in cold Seasons with vegetation dormant, 0% of the "spiked" strain dropped out of the water column before exiting the basin. But, that exiting showed grouping together of the bacteria in a "swarm", with movement suggesting intelligent organization and communication, both individually and collectively.

Awards won at the 2004 ISEF
Scholarship award of \$5,000 per year for four years - Oregon State University
Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV051
FUNGAL SAMPLING IN INDOOR AND OUTDOOR ENVIRONMENTS: IDENTIFICATION AND DIFFERENTIATION.

Cortney Ann Timmons
Byng High School, Ada, Oklahoma, U.S.A.

No EPA standards currently exist for indoor airborne mold that can cause health and building problems. The project objectives were: 1) to find an optimal sampling time for indoor and outdoor mold using APDA settling plates; 2) to identify and compare airborne mold at different times of the year; and 3) to identify common fungal genera and variation within genera. On thirteen days over six months, replicate plate sets were placed indoors and outdoors and exposed for either ten, twenty, thirty, forty, or sixty minutes. Temperature and humidity were recorded. Total fungal colonies were counted, as were *Aspergillus*, *Penicillium*, *Epicooccum*, and *Cladosporium* colonies. Esterases, stained after polyacrylimide gel electrophoresis of proteins from isolates of two genera, identified putative genetic differences among outdoor *Cladosporium* and *Epicooccum* populations collected on different dates.

 Comparing indoor and outdoor total colony counts, t-Tests showed significant differences ($p < .05$), except on two days, and indicated optimal sampling time of sixty minutes. A strong positive correlation existed between mold and temperature, especially in sixty-minute samples (.81). *Cladosporium* and *Epicooccum* colonies were the most common on the agar plates, and electrophoresis gels showed genetic variation within the two genera.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
Second Awards of \$1,500 - U.S. Air Force

2004 - EV052

THE CONSTRUCTION AND ENERGY-EFFICIENCY OF WINDOWS

Kathryn Lee King

McNary High School, Keizer, Oregon, United States

Windows are a key element in keeping heat and air conditioning costs at a reasonable price. It is crucial that engineering and construction of the window are sound. One concept is for the window to act as a temperature control by automatically opening and closing based on the temperature difference between the exterior and interior of the building. However, it is first important to identify which materials used to construct the components of windows (window frame, glass, spacer, gas-fill) are most energy-efficient. The materials that each window is constructed from determine how well the window insulates the building. To determine the most energy-efficient combination of materials for the construction of a window, I identified commonly used materials by consulting window manufacturers and window installers. In order to narrow down the material options to the best fit, I engineered a testing box to compare the rate of heat transfer for each material. By testing these products, I can collect data that can answer questions such as, is vinyl or fiberglass a better window frame material for creating the most energy-efficient window? Does krypton have enough benefits over argon as a gas insulator that its increased cost is worth it? Does aluminum allow enough heat transfer that it should not even be used any more? For a stable, energy-efficient window to be designed these questions must be answered.

Awards won at the 2004 ISEF

Scholarship award of \$5,000 per year for four years - Oregon State University
Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV053

DETERMINATION OF THE PRESENCE OF ANTIBIOTIC RESISTANT BACTERIA DUE TO IMPROPER DISPOSAL OF ANTIBIOTICS THROUGH THE SEWAGE SYSTEM

Jennifer Ann Taylor

Henry A. Bradshaw High School, Florence, AL, United States

In recent years, there has been increasing concern about the threat of antibiotic resistant bacteria. An often-overlooked aspect of this problem is proper disposal of prescription medications. The presence of low levels of antibiotics both in the sewage and river water due to disposal through the sewer system provides ideal conditions to promote the development of antibiotic resistant bacteria. The goal of this project is to determine the presence of antibiotic resistant bacteria in sewage and in the Tennessee River that are potentially caused by the improper disposal of antibiotics. Three sets of samples of raw and treated sewage were taken in addition to samples upstream and downstream from the release point of the treated water. Bacteria in the samples were isolated and identified by using six sets of selective/differential media per sample and gram stained slides. A control group of the media set was also included. Isolated bacteria were then grown on slants, and were used to inoculate antimicrobial disc diffusion susceptibility testing plates. Many bacteria with multiple resistances were found, suggesting the presence of low levels of antibiotics in the sewage, which are then released into the Tennessee River. A higher proportion of resistances in the treated sewage than the raw sewage was found, indicating the severity of this problem.

Awards won at the 2004 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV054

GROUND WATER QUALITY AND MICROBIAL SEQUESTRATION OF COPPER

Elizabeth Anne Markus

Carroll High School, Dayton, Ohio, United States of America

The purpose of this project was to determine which soil environment, either wetland, grassland, cornfield, or deciduous forest produces the most favorable microbial colonies for the removal of the heavy metal copper. Since wetland soil appeared to have the most organic matter, it was thought that if these environments produce microbes which can remove copper ion from their environment, then the wetland's soil would produce the most favorable colonies. Soil samples were extracted from each environment. The wet weight was calculated by drying the soils. Media was made, and soil microorganisms were placed in flasks aseptically. Baseline copper content was tested for, and an equal amount of copper ion was added to each flask. The flasks were placed on rotary shakers, and were tested for copper content at 0, 72, and 144 hours. This test involved testing for free as well as total copper. To test for copper removed by microorganisms, the media was centrifuged, and the pellet obtained was assayed for free and total copper. In determining the amount of copper retrieved in the centrifuged pellets, the highest concentrations were the wetland and grassland total samples. Lesser amounts were found in the corn field and forest samples, which implies that the microorganisms in those soil types were less efficient in extracting copper from their environment. Therefore, one can conclude that microorganisms may be used in the removal of copper from the environment. The results suggest that there is greater microorganism diversity or organisms with more affinity for copper in the wetland and grassland environments.

2004 - EV055

MAIN FEATURES OF CLIMAT (ENVIRONMENTAL) CHANGES OF THE SOUTH-WEST YAKUTIA IN THE XXTH CENTURY (THE REGION OF

OLEKMINSK CASE)

Katerina Veniaminovna Zakharova
Secondary school #2, Olekminsk, Republic Sakha (Yakutia), Russia

The objectives of the work: to detect specific features of climate changes process in South-West Yakutia in the XX-th century.

The main tasks included:

-To form on the basis of literary data permanent set of climate characteristics (years1882-2003).

-To determine the list of parameters, showing the climate change process and its impact on ecosystems.

-To carry out statistic data handling, to detect characteristic value, to do comparative analysis per period.

-To determine tendencies in climate change characteristics.

-To discover changes in ecosystems of South Yakutia taiga as a result of climate changes.

Hypothesis:

1.In case climate changes are typical for South-West Yakutia it will develop certain climatic characteristics for a certain period.

2.In case climatic characteristics exceed ecosystem adaptation abilities biota changes occur.

Novelty and practical significance. For the first time for boreal forest area in South Yakutia evaluation of climate changes during the period of 1884 – 2003 was done, tendencies in climate change characteristics were determined, permanent set of climate characteristics were determined, changes in ecosystems of South Yakutia taiga under the influence of climate changes were discovered, optimal terms for farming were determined. The data obtained can be used for making out territory climatic passport, climate changes forecast, prognosis ecosystem state, crop yield.

2004 - EV056
THERMO INVERSION: NATURAL PHENOMENA AGRAVATED BY THE LACK OF AMBIENTAL CONSCIENCE. WHAT IS THE ROLE OF METROLOGY IN THE REDUCTION OF ITS IMPACTS?

Rodrigo Souza Barreto Mathias
CEFET - Unidade do Rio de Janeiro, Rio de Janeiro, RJ, Brazil

The objective of this research is to diminish the effects of launching pollution in the atmosphere, by showing a new approach to the environment and clarifying the natural phenomena known as thermo inversion, and the problems it could cause when it occurs in polluted environments.

This project was based on scientific knowledge related to atmospheric sciences, as well as other Earth Science knowledge. The objective of the initial part of this research was to learn about the thermo inversion phenomena. A simple and easy description is presented, and then follows an explanation of the main cause and effects of the Thermo Inversion, reiterating that this is a natural phenomenon, and the negative aspects are due to men’s influence on it.

It’s made very clear that Meteorology has access to very precise data through satellite images, synoptic letters, computerized numbering models, atmospheric pumps, which are all used to build the meteorological alerts. The daily bulletins are distributed from local weather forecast centers to the appropriate government channels and businesses and the region’s pollution sources. The alert is received by the government implying the need to be Environmentally Responsible. If no actions are made after the initial inquiry and the pollution percentage in the low atmosphere has not changed, strong legal action will be applied.

We also conducted a case study of a thermo inversion episode, several pictures are shown and meteorological patterns that favored the happening are examined, then we compare with theoretical concepts, and results obtained by the tools used.

2004 - EV057
THE EFFECTS OF ANABAENA ON CADMIUM CONTAMINATION IN AN AQUATIC ENVIRONMENT PHASE TWO: THE MECHANISM

Derek William Lindskov
Timber Lake High School, Timber Lake SD, U.S.A.

The Purpose of my research was to see by what mechanism anabaena is absorbing cadmium ions. I believe that anabaena is binding cadmium in its cell walls. I cultured anbaena and divided it into 3 groups with one control group and exposed the groups to cadmium sulfate. The algae was filtered and media samples were collected. The algae was washed off the filter paper and put into centrifuge tubes. The tubes were spun down and the remaining liquid in the tubes was descanted off. Each pellet was put into a separate tube and spun down again. The remaining liquid was descanted off again and each tube was weighed. A solution of .05 M tris/HCl buffer was made and a 1mM dtt was added to it. 50mL of buffer was added to each sample and ran through a cell grinder. Each sample was then spun down and a sample of the liquid was diluted and tested with a spectrophotometer. Samples of the algae were dried and digested. 5mL of 0.2 HCl was added to each sample and then vortexed briefly and serial dilutions were made. .5mL of the original stock solution was also diluted. Each dilution was read by the spectrophotometer. The anabaena algae stored 96% of the cadmium in the cytosol and as much as 57,000 micrograms/g dry weight of algae. Anabaena could be introduced to a polluted small lake or river during a bloom. After absorbing heavy metal ions, the algae could then be filtered out using small pumps and dried and then smelted down thus cleaning the contaminated waterway.

2004 - EV058
TESTING AND DEVELOPMENT OF A TREATMENT CELL TO REMOVE ARSENIC FROM DRINKING WATER

Douglas Calvin Naftz
Park City High School, Park City Utah, USA

Elevated levels of arsenic were detected in drinking water in Park City, and determined to be similar in other parts of the world. Adverse health effects can be cause by arsenic ingestion. Less developed countries lack infrastructure to remove arsenic from water. Tests were conducted to determine if arsenic could be removed using a passive treatment cell.

 Four materials were hypothesized to remove arsenic. Tests included column, shaker, rate, and full-scale prototype experiments. Initial column experiments indicated Granular Ferric Hydroxide and BayoxideE33 lowered arsenic concentrations to less than two micrograms per liter (98%-100% arsenic removal). A third material, zero-valent iron, removed 97% of the arsenic from the water. The fourth material, iron sand, removed 70% of the arsenic. BayoxideE33 performed the best during the shaker test experiments, possibly due to its nano-cut surface. Results from the column experiments combined with a calculated porosity of 75% indicate that a 4-liter volume of BayoxideE33 material could treat over 6,600 liters of arsenic contaminated water before failure. Treatment rates using a production-scale treatment cell containing BayoxideE33 averaged 0.40 L/min. Combined results of

column, shaker, rate, and prototype experiments indicated that high concentrations (> 100 ug/L) of arsenic could be removed to levels below 2ug/L for greater than one year using a single treatment cell. Treatment volumes are sufficient to supply clean drinking water for a family of four for at least 412 days. Computer modeling experiments are currently underway to determine how varying water chemistry may impact arsenic removal efficiencies using iron-containing material.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
Second Award of \$250 - National Ground Water Association
Student membership in SETAC - Society of Environmental Toxicology and Chemistry

2004 - EV059
PRICE CANYON FIRE SOIL EROSION AND VEGETATION RESPONSE

Kelly Broadbear
Mont Harmon Junior High, Price, Utah, U.S.A.

My Science Fair project is an investigation of the Price Canyon Fire that occurred during the summer of 2002. I wanted to find out if the Price Canyon Fire caused soil erosion and/or soil deposition. If so, which areas of the burn received the most and least soil erosion? What types of vegetation re-sprouted after being burned by the fire?

I hypothesized that areas that burned with different intensities would experience variable amounts of soil erosion/deposition. I hypothesized that the moderate burn area would experience the most soil erosion, the high burn area moderate erosion, and the low burn area the least soil erosion. The oakbrush thickets and aspen trees would show slight signs of re-sprouting due to the drought. However, the sagebrush and Utah Juniper trees would show no signs of re-sprouting.

In the Spring I created soil erosion plots and photographed the vegetation in the three burn intensity areas. Six months later I returned and collected data from the plots and examined the vegetation once more.

I concluded through my observations and data collection, that the Price Canyon Fire did contribute to soil erosion and deposition throughout the burn areas. The moderate burn area experienced the most soil erosion and deposition despite measures taken by the BLM to reduce erosion. The low burn area showed variable soil movement. The high burn area showed very little soil erosion due to extremely rocky soils. The oakbrush thickets and aspen trees showed obvious signs of re-sprouting. The sagebrush and Utah Junipers were still completely burned, and did not show any signs of re-growth.

2004 - EV060
A COMPARISON OF HERBS AND BTI AS LARVICIDES ON CULEX PIPPIENS AND THEIR EFFECT ON DAPHNIA MAGNA

Abigail Marie Hines
Orchard Day School, Fort Wayne, Indiana, USA

Mosquito larvicides used today can be toxic to wildlife, especially aquatic organisms. One natural larvicide in use is Bacillus thuringiensis israelensis (Bti). Yet Bti is not without problems, causing effects on the food web.

 My purpose was to find another natural substance as effective as or better than Bti. Four herbal oils: neem, peppermint, marigold, and catnip were tested as larvicides. Are they as effective as Bti and environmentally safe? My hypothesis was that the herbs and Bti would act as larvicides, the most effective being peppermint, without being harmful to Daphnia magna.

 Using serial dilutions of the oils with an emulsifier, thirty Culex pipiens larvae were tested at time intervals: 15min to 96hrs. Catnip and Peppermint oil concentrations were 3.125-50ppm. Neem and Marigold concentrations were 1ppm-8ppm. LC50 was calculated at 24&48hrs. Marigold was most toxic with LC5024h=3ppm and LC5048h=2ppm. Order of toxicity of oils for LC50 at 24-48hrs was Marigold>Catnip>Peppermint. Neem oil's LC50 was above 8ppm and not calculated. My hypothesis that peppermint would be most effective was wrong. In comparison, Bti (.17gm) killed all larvae in 24hrs.

 Bioassays with thirty Daphnia were done in same oil concentrations and Bti for 48hrs. Oil solutions were more toxic to Daphnia than Bti.

 The emulsifier alone had no effect on larvae, but in 50ppm all Daphnia died after 24hrs. Further research with this emulsifier is needed on aquatic species. The oils were toxic to larvae, but more toxic to Daphnia. Bti worked better. Need still exists for more environmentally safe larvicides.

2004 - EV061
THE INFLUENCE OF CHLORIDE SODIUM AND BROMIDE SODIUM SALTING ON THE BARLEY SEEDLINGS

Roman Y. Artsiomau
School N1, city of Dzerzhinsk, Minsk region, Belarus

The problem of salting soils takes the character of the most significant environmental problems nowadays.

The purpose of the project is to investigate the effects of Sodium Chloride and Sodium Bromide on growth barley seedlings.

The carried out experiments with 7-day barley seedlings of the grade "Burshtyn" showed some peculiarities of the influence of chloride and bromide of sodium on germinating power of barley seedlings. I have found out, that sodium salting makes sharply negative influence on the initial phases of the plant ontogenesis. I have established that there is a precise correlation between some morphological parameters and the quantity of salts in nutritious solution: the higher the concentration of the researched salts in the incubatory solution is – the suppressed are the vegetative processes of growth and development.

It was found out, that the processes of germinating power of the seedlings are braked at the concentration of salts more then 0, 01 mole. It was established, that bromide of sodium makes a more negative influence, then chloride of sodium.

I have also determinate, that at low concentrations of salts even some strengthening of seedlings growth is observed, but at the further increase of the concentration there are signs of oppression of all the growing processes.

So, I have established that ions of chloride and bromide of sodium have an important value for functioning of root system and a plant as a whole.

Many farms in Belarus use the results of my work when planting barley.

2004 - EV062

ESTIMATION OF CARBONYL SULFIDE (COS) FROM BIOMASS BURNING

Luis René Aponte

Colegio Radians, Cayey, Puerto Rico

Biomass burning is considered to be a major source of atmospheric gases and particulates. Recent studies (G. Pitari et al., 2002) show that 43% of the stratospheric aerosols are formed by carbonyl sulfide (COS). Calculations of the amount of COS resulting from global biomass burning using satellite fire maps and emission factors from various field studies were conducted. Geographical Information Systems (GIS) software was used to execute these estimates. Fire activity shows dependence on seasonal and global distribution. The estimates indicate that biomass burning is a significant source of COS (539 Tg of COS yr⁻¹). Tropical biomass burning is the largest ecosystem source of COS from burning (82%).

2004 - EV063

THE EFFECTIVENESS OF PAM FOR WASTEWATER TREATMENT IN SWINE RUN-OFF

Derrick Austin Helton

Tuscumbia High School, Tuscumbia, Missouri, United States

Polyacrylamides (PAM's) are white, odorless, crystalline solids made from the compound acrylamide. Currently, they are being used to enhance irrigation systems. Some research suggests that anionic polyacrylamides could be used to treat animal wastewater. The purpose of this study was to determine if an anionic polyacrylamide could be used to remove E. coli and heavy metals from swine wastewater. The heavy metals tested were zinc and copper. Additives to the PAM to act as additional independent variables included calcium oxide and aluminum sulfate. Treatment columns were designed and built to determine the effectiveness of the PAM and the additives. Five different treatment groups were created:
1. sand only, to act as a control
2. sand/polyacrylamide
3. sand /polyacrylamide/aluminum sulfate
4. sand/polyacrylamide/calcium oxide
5. sand/polyacrylamide/aluminum sulfate/calcium oxide.
Based on this study, the following conclusion may be drawn: The PAM with aluminum sulfate was successful in reducing the amounts of E.coli in swine wastewater. Also, the PAM with aluminum sulfate and calcium oxide reduced the amount of zinc in the swine wastewater.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV064

EFFECTS OF PAPER SLUDGE ON RECLAIMED SURFACE MINE SITES

Jared Benjamin Steed

Buckeye Valley High School, Delaware, OH, USA

Paper sludge is a by-product mixture of paper fibers and calcium carbonate from the Kraft manufacturing process. One southern Ohio paper-producer produces three hundred wet tons a day. Surface mining is the removal of overburden to reveal a seam of coal. The Surface Mining Control and Reclamation Act requires that bonds be posted to the state redeemable five years after a strip mine has been reclaimed and with live vegetation. Southern Ohio's pyrite rich soil oxides when disturbed and forms iron hydroxides and sulfuric acid. Recalimed strip mines leach surfacic acid to the surface years after reclamation. Yearly liming is required to sustain vegetation.
"Surface" soil from a surface mine site and paper sludge were tested for pH, moisture, organic matter and electrical conductivity (EC). Eight replicates of 0, 150, 300 and 450 tons per acre (T/A) paper sludge were mixed and placed in a controlled environment. Each pot was watered twice a week. Leachate was collected and water adsorption, pH and EC were recorded. Weekly, saturated pastes from 1/2" cores were tested for EC and pH. Initial and ending water holding capacity (WHC) was determined. Samples at one, three and five weeks were seeded with *Lycopersicon esculentum* 'Rutgers Select'. Germination and stamina were recorded. Sludge addition increased pH, EC, neutralization potential and WHC. Sludge addition delayed and lowered germination rates. The 300 and 450 T/A treatments significantly increased WHC and neutralization potential over the soil and 150 T/A sludge without adversely affecting the soil pH or EC.

2004 - EV065

RAPID PROTEOMIC IDENTIFICATION OF A DIOXIN-DEGRADING BACTERIUM SPHINGOMONAS WITTICHII STRAIN RW1

Anna Kalmykov

Baltimore Polytechnic Institute

Chlorinated dibenzo-p-dioxins and dibenzofurans (DF) are among the most toxic and abundant pollutants in the environment. Environmental cleanup of contaminated soils is most effectively achieved by the introduction of specialized microorganisms for removing contaminants. *Sphingomonas wittichii* RW1 is the only known bacterial strain capable of using dioxins as a sole carbon source. This study explores the use of proteomics and mass spectrometry tools for monitoring of RW1 by targeting its characteristic dioxin dioxygenase (DDase) as a biomarker. Cells grown on selective media were harvested, partially purified, and digested using trypsin. Different concentrations of the bacterial proteome or fractions thereof were analyzed by matrix assisted laser desorption/ionization time-of-flight mass spectrometry. Submission of detected ions to on-line databases (e.g., Mascot) facilitated the identification (DDase) from a very complex mixture of proteins. The influence of growth conditions upon the expression of DDase was explored through the use of non-selective media. The DDase was identified in the cultures grown in the presence of DF, but was lacking in those grown on non-selective media. This study represents the first successful rapid and direct detection of bioremediation agents using contaminant-transforming catabolic enzymes as targets of mass spectrometry.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV066

THE CONCEPTION OF DOUBLE SAFETY FERTILIZER AND ITS EXPERIMENTS

*Xiaofeng Liu, Fuzhou No.1 Middle School
Fuzhou, Fujian, China*

Chemical fertilizers cause a serious problem of the environmental pollution and human health endangerment. For example, on producing super-phosphate, the by products (hydrogen fluoride, arsenic and residual acid, etc.) are very harmful. Using large amount of chemical nitrogen fertilizer causes accumulation of nitrate and nitrite in crops especially in vegetables, and nitrite is one of the dangerous factors for inducing cancer. Chemical nitrogen and phosphorus application also bring water pollution seriously. Hence it is necessary to invent a new kind of fertilizer, which reserves the efficiency of fertilizer, but without pollution to environment and jeopardy to human health. It is called Double Safety Fertilizer (DSF), or New Fertilizer Chain (NFC) Fertilizer. In order to get the Double Safety goal, rock phosphate is ground into extra fine powder (1-10 micron) to substitute super-phosphate, and mixed with dry powder of Azolla Plant which has strong nitrogen fixing capacity, and also some potassium chloride to form granular fertilizer (DSF). To evaluate the efficiency of DSF, experiments including six groups of crops: three of hollow greens, one of rice, one of Chinese cabbage and one of peanuts applied with DSF were compared with chemical nitrogen, phosphorus and potassium at the same rate. The yields were calculated, and the analysis of nitrogen, phosphorus and nitrite content in crops were also conducted. Results showed that DSF can substitute chemical nitrogen, phosphorus and potassium at the same rate. It also significantly reduces the accumulation of nitrite in vegetables (more than 80%). So it attains the goal of Double Safety. Furthermore it has also a great possibility for industrial production, which will be further investigated.

Awards won at the 2004 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
DuPont's Center for Collaborative Research and Education, Office of Education recognizes individual and team winners in the categories that best exemplify DuPont's business-related interests: Biology, Chemistry, Engineering/Physics, Earth/Environmental Science and/or Computer Science. Each project is recognized with a Primary Award of \$1,000. - National Aeronautics and Space Administration

2004 - EV067

EUTROPHICATION IN LAKE LORAMIE WATERSHED IS PHOSPHORUS A CONCERN?

*Mark Alan Flock
Lehman Catholic High School, Sidney, Ohio, USA*

Eutrophication has been identified as the main cause of impaired surface waters in the United States. Phosphorus is a key component in the acceleration of eutrophication. Thirty-two locations were sampled in the Lake Loramie Watershed to determine if Phosphorus is a concern. Sediment samples were taken from tributaries and the lake itself. Bioavailable Phosphorus (BAP), Mehlich III Soil Test Phosphorus (STP), and soil pH tests were performed on each sample. The iron oxide impregnated strip P test was performed to measure BAP. The BAP levels in tributaries ranged from 9-64 ppm. BAP levels in lake sediments were all very similar, and ranged from 24-38 ppm. Mean BAP levels in this study were similar to those found in other watershed studies. The high BAP levels, above 35 ppm, found in many tributaries pose a concern to Lake Loramie. Phosphorus is a water quality concern that should be monitored in the future for eutrophication in Lake Loramie. The mean BAP of the lake sediments was 31 ppm, which is slightly above the 20-30 ppm safe BAP level. Thus, at this time, it appears that Phosphorus is not a critical problem for eutrophication at Lake Loramie. Future testing should be performed to monitor Phosphorus levels in this watershed.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV068

EFFECT OF ENVIRONMENTAL STRESS ON PLANT SYMMETRY

*Caitlin Christin Grothaus
Notre Dame Academy, Kentucky, United States*

This experiment investigates the effect of environmental stress on plant symmetry. Pinto beans were germinated and then transplanted into a planter with a mixture of potting soil and vermiculite. Plants were watered through a wicking system, and grew for one week before being subjected to stress. At that point, two planters were designated as controls, the wicking system for one planter was disabled, and the water in the fourth planter was replaced with a 1% NaCl solution. The plants were then allowed to grow for an additional week. Leaves from the main stem were removed and imaged using a microvideocamera interfaced to a computer. Image analysis features of NIH Image were used to measure the length of the central vein and then determine the quarter, half, and three-fourths points on the vein. Then widths to the side of the central vein were measured at these positions on both the left and right sides. The area and perimeter to each side of the central vein were also measured. These were next normalized to the leaf size. The absolute values of the differences of the respective lengths, perimeters, and areas were determined for each leaf under the salt stress, water stress, and control conditions. An F-test was conducted for each data set to determine whether the distribution of right-left differences was significantly different from the control. For the droughted plants, most differences were statically significant, indicating that the drought had influenced the symmetry. This was not the case for the salt-treated plants.

2004 - EV069

A COMPARISON OF CARBON DIOXIDE CONCENTRATIONS IN CLASSROOM AIR

Casey Renee Chatfield
Byng High School, Ada Oklahoma, USA

Classroom carbon dioxide concentrations that exceed the recommended indoor air quality standard of 1000 PPM may adversely affect students' learning. The purpose of this project was to measure and compare CO₂ at different locations within classrooms, on different days, with varying ventilation at three grade level sites. CO₂ was measured in three rooms per site on six days--near the door, in the middle, and at the back of each classroom, before class in the morning and in late afternoon, three days with the doors open and three days with the doors closed. Also, testing at the end of each class period was done for one day in one room per site, and a room with an exhaust fan was similarly monitored for three days. Outdoor CO₂ levels and temperatures, room dimensions, and occupancy were recorded each day. Maximum one-day CO₂ levels ranged from 923 PPM in the elementary to 3679 PPM in the high school. Mean CO₂ peaks in all rooms exceeded 1000 PPM, with high school levels more than twice the recommended standard. A Split-Split-Plot ANOVA showed significant differences in CO₂ levels between grade level sites ($p<.01$), locations in room ($p<.001$), locations in room and site interaction ($p<.05$), and locations in room and doors open or closed interaction ($p<.005$). Variation in occupancy during the day correlated with CO₂ variation, and differences in building ventilation systems may have affected peak levels. Results of the exhaust fan trial indicate a method for lowering classroom CO₂ levels. Smaller class sizes would also remedy the problem.

2004 - EV070
BIOPROCESSING OF BOOT AND SHOE LEATHER SCRAPS TO VALUE-ADDED PRODUCTS

Amanda Delyn Forbis
O'Donnell High School, O'Donnell, TX 79351

Boot and shoe leather scraps are the most complex and challenging raw materials for recycling studied, to date. The finishing chemicals can interfere with this process. Can the conversion of waste finished leather scraps from boot and street shoe production be demonstrated with an alkaline protease system to produce an organic fertilizer and pigment mixtures? The alkaline protease system can produce an organic fertilizer and pigment mixtures. A commercial, powdered enzyme preparation from *Bacillus subtilis* sp. (Amano Enzymes – Japan) was utilized to release collagen peptides from the tanned protein complexes in finished leather scraps. The finishing chemicals (pigments, fats, oils, and waxes) must be segregated from the enzyme to prevent interference and/or destruction of catalytic action. This was accomplished by a combination of pre-extraction and basic hydrolysis. Bench scale experiments demonstrate the viability of this approach to finished leather recycling. Further chemical optimization and pilot scale experiments are being designed. The products of the enzymatic bioprocessing are an organic nitrogen fertilizer liquid and a pigment-rich inorganic sludge. This research will provide more options for leather manufacturers in developing countries to minimize industrial waste while providing valuable by-products using earth-friendly processes.

2004 - EV071
CARBON EXCHANGE DYNAMICS PHASE IV: EFFECTS OF ELEVATED CO₂ ON THE PRODUCTIONS OF RIBULOSE-1,5- BISPHOSPHATE CARBOXYLASE/OXYGENASE AND CHLOROPHYLL COMPOUNDS IN C₃ AND C₄ PLANTS

Kellen Marie Calinger
Mount de Chantal Visitation Academy, Wheeling, WV, U.S.A.

This year's research is a field and in-lab study of the effects of elevated atmospheric [CO₂] and soil nitrogen on soil [PCO₂], soil CO₂ emissions, specific leaf area, and chlorophyll a, chlorophyll b, xanthophylls, Beta-carotene, and [Rubisco] and their effects on carbon sequestration. The [carbonate] of enriched environments increased. In the field component, the increased CO₂/soil N environment experienced the highest [carbonate] followed by the elevated CO₂, the increased soil N and ambient environments. The soil PCO₂ and soil gas emissions followed similar patterns; seasonal patterns existed. The highest readings occurred in the summer, decreasing throughout the fall and winter. The increased CO₂ environment and the elevated CO₂/soil N environment experienced heightened SLA. The combined elevated CO₂/soil N environment's SLA was higher than the elevated CO₂ environment. The elevated soil N environment experienced a slight SLA increase.

 Because of similar results between field and laboratory carbonate testing, it can be said that an in-lab phase that modeled effects of varying [CO₂] was designed. The two elevated CO₂ microcosms experienced higher [carbonate] than other environments; decreased CO₂ environments experienced the lowest [carbonate].

 Enhanced environments experienced pigment increases; depending on the environment and the pigment, variations occurred; other enriched environments experienced increases.

 The in-lab [carbonate] and [leaf nitrates] were similar to the field phase. The [xanthophyll], [Beta-carotene], and [chlorophyll a] followed similar patterns. The decreased CO₂ environments displayed lessened levels. The ambient environment and the decreased CO₂ environment had similar [chlorophyll b]; the increased CO₂ environment had decreased concentrations.

Awards won at the 2004 ISEF
Tuition scholarship of \$5,000 per year for 4 years for a total value of \$20,000 - Indiana University
Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV072
ENERGY RECOVERY FROM AGRICULTURAL WASTE: METHANE PRODUCTION FROM COW MANURE

Tara Ellen Gloyna
Temple High School, Temple, Texas, USA

With over 94.9 million head of cattle in the U.S. alone, there is a growing need to research environmentally friendly ways to dispose of their manure. The anaerobic activity present in this waste can be used to produce methane gas, a potentially valuable fuel source. The purpose of the project was to study if a diet of pasture or grain feed made a difference in the amount of methane produced by anaerobic activity. The method used to conduct this experiment was the addition of manure to anaerobic sludge and the measurement of the total gas volume produced every 24 hours. An experimental apparatus was composed of

three chambers: a digester, a gas collector, and a salt water collector. The digester housed the chemical reactions of the anaerobic bacteria. The gas collector was filled with salt water and the amount of displaced saltwater determined the volume of gas produced. The experiment was maintained at a temperature of 35 C and a neutral pH for optimal bacterial growth. The total amount of gas produced by the grain fed cow was greater than that of the pasture fed animals. The pasture fed cow produced 49% of the total amount of gas volume produced by the grain fed cow. This information can be useful in determining the diet of feed lot cattle. In order to minimize the amount of methane and other gases from large herds of congregated animals, it might be advantageous to consider the amount of grain fed to the animals.

2004 - EV073

THE ROLE OF PHOSPHORUS IN CONTROLLING THE DISTRIBUTION OF SAV IN PARKERS CREEK

Sarah Charlotte Brownlee

Calvert High School, Prince Frederick, Maryland, USA

Submerged aquatic vegetation (SAV), an important part of fresh and saline aquatic habitats providing shelter for many Bay biota, has declined dramatically in the Chesapeake Bay over the last 40 years, primarily in response to human-induced nutrient and sediment increases. In Parkers Creek, SAV are heavily fouled with epiphytes at their downstream limit, while relatively free of epiphytes upstream. Phosphorus concentrations are higher downstream while nitrogen concentrations are higher upstream. It is hypothesized that phosphorus, released from sediments downstream, stimulates epiphyte growth and inhibits SAV growth. The purpose of the current study was to determine if phosphorus release is elevated in downstream sediments. At three sites with different SAV densities and epibiont fouling, phosphorus concentration and flux were measured over time in waters above incubated sediment cores and sediment dry weight, ash-free dry weight and percentage organic matter were determined. Phosphorous concentrations and percent organic matter were significantly higher at the downstream site. Phosphorus flux was not significantly different between the three stations but did show significant differences over the time. Flux was into the sediments at 0-2 and 4-6 hr but out during the 2-4 hr period. The expected elevated flux downstream was not observed. Downstream phosphorus could be provided from sediments further downstream, the Chesapeake Bay, episodic releases during sediment re-suspension, or in quiescent periods when high biological activity in the sediments drives the sediment anoxic. This study should be repeated with additional stations further downstream over the growth cycle of the SAV and under varying weather conditions.

2004 - EV074

ANALYSIS OF GLASS POLISHING WASTEWATER PHASE II

Kelly Lavian Kinzer

Lakeview High School, Columbus, NE, USA

To reduce the amount of copper in potable water, industrial wastewater, and municipal water supplies, a series of experiments were designed. In previous years experiments plants were used to lower the copper ion concentration, but it was discovered that the glass containers worked better then the plants. Last year glass tubes were dues to remove copper ions from the water. This looked promising, but was not filly explored. This year a tap filter made of crushed glass was used to reduce the copper ion concentration in potable water. A Brita and Pur water filter were tested to see how much they reduced the copper ion concentration in comparison to the glass filter. The crushed glass was first tested to see how many liters could pass through before it was unable to remove any more copper, and would need to be acid rinsed. Soda-lead glass was also tested, to see if it worked better then borosilicate glass. Conclusions drawn show that about 20 liters of water can be run through the crushed borosilicate glass before it needs to be acid washed, and an average of 38% of the copper ions were removed. The Brita filter removed 58% of the copper, and the Pur filter removed 74% of the copper. The glass filter removed more copper ions then just the crushed glass; it removed an average of 42% of the copper ions. The soda-lime glass only removed 22% of the copper ions; therefore the borosilicate glass was used for the filter.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV075

COLD-VAPOR ATOMIC ABSORPTION ANALYSIS OF MERCURY CONCENTRATIONS IN ALBACORE TUNA AND OTHER COMMON CANNED FISH

Shannon Marie Morey

Imlay City High School, Imlay City, MI, United States

There are many different reports stating the concentration of mercury in cans of fish. I want to know if cans of jack mackerel, red salmon, chunk light tuna, and albacore tuna contain mercury. If they do contain mercury, how much? How do these levels compare to each other and to standards set by government agencies? I believe all of the cans of fish will contain mercury. I also think albacore tuna will contain the most mercury, jack mackerel the second most, chunk light tuna the third most, and red salmon the least. A cold-vapor atomic absorption procedure is used to test for the mercury. A digestion procedure is performed on the samples before the cold-vapor atomic absorption procedure is executed. All of the cans of albacore tuna have a higher mercury concentration than any other type of fish tested. None of the cans are above the Food and Drug Administration's (FDA) standard of 1 ppm concentration. Using the Environment Protection Agency's (EPA) standards, there are mercury concentrations that could be dangerous to people if they eat a certain amount. This experiment shows the large difference between mercury concentrations in albacore tuna and other common canned fish. Mercury concentrations are shown to be safe by the FDA standards, but using the EPA standards the concentrations are potentially dangerous.

2004 - EV076

RATIOS OF PLASTIC-TO-PAPER EATING MICROBES, BACILLUS STEAROTHERMOPHILUS AND RUMINOCOCCUS ALBUS IN VARYING LANDFILL

ENVIRONMENTS

Blair Elisabeth Kowalinski
Hamilton High School, Chandler AZ, USA

Each day Americans throw away 150,000 tons of trash. Most of trash is deposited into incinerators, recycled or dumped into landfills. Seven percent of all typical waste thrown out by Americans is plastic and thirty-six percent is paper and cardboard, however these numbers are rapidly increasing (Hilger, 2000). In Arizona all landfills are inland and about 519,755 tons of solid waste are collected annually. An inland landfill contains both aerobic and anaerobic microorganisms. Aerobic organisms need oxygen to survive and breakdown products faster while anaerobic organisms are selective eaters that do not consume oxygen, therefore decomposing garbage very slowly. A microbe *Bacillus Stearothermophilus* grows in warm temperature and causes rapid breakdown of compost piles. Microbe *Ruminococcus albus*, survives only in warm climates and decomposes trash very slowly (Sevenning, 2003). With global warming becoming more and more of a public concern making any type of recovery on the world's pollution would be highly beneficial.

My project will focus on a ratio of plastic-to-paper eating microbes. I will be using various amounts of *Bacillus Stearothermophilus* and *Ruminococcus albus* and varying the environments with oil and cornstarch. I will use different types of liners; plastic, clay, and composite. Through this I will then be able to measure pH, monitor temperature, and measure the size of each plastic and paper sample. A total of thirty-six, four quart containers, will be representing a mock landfills. This will hopefully heighten the degradation of compost piles using oil and cornstarch additives and different microbe ratios.

2004 - EV077
OPTIMAL PH FOR SMZ DECONTAMINATION OF SOIL

Melinda Mariko Medlock
Lexington High School, Lexington, MA, USA

Decontamination of soil and water can be challenging since contaminants can vary in their physical and chemical properties. One economical method is electro-osmosis which works well for removing dissolved ions from samples. The method, however is not applicable to insoluble or non-polar molecular species. A viable alternative is the use of zeolite, an inexpensive, naturally occurring mineral with a high cation exchange capacity. When the zeolite is impregnated with a surfactant, such as the hexadecyltrimethylammonium (HDTMA), which is positively charged with a hydrophobic tail, this surfactant-modified zeolite (SMZ) is able to bind to both positive and negative ions as well as insoluble molecules.

 This project tested the effect of soil acidity on the decontamination abilities of SMZ. It was determined that at pH 1-3 SMZ is an ineffective anion filtrate. This may be because the hydrogen ions from the ionized acid bond with the anions to form a stable acid. SMZ is an effective anion filtrate at pH 4-6 however, because there are fewer hydrogen ions and less competition to bind to the surfactant. Since cations are attracted only to the zeolite surface, SMZ is an effective cation filtrate at pH 1-6. Because the nature of the contaminants often determines the pH of the soil, these results suggest which method of soil decontamination to use at a particular site.

2004 - EV078
WILDFIRE AFFECTED SOILS AND RHIZOSPHERE RECOVERY: YEAR TWO

Michael Richard Olson
Gold Beach High School, Gold Beach Oregon, USA

Sprouting evergreen hardwoods, such as tanoak, have been shown to be reservoirs of soil biological activity in areas disturbed by timber harvest and slash burning in southwestern Oregon. The purpose of this project was to determine if they have a similar role in the rhizosphere recovery of burned soils.

 Study sites with three levels of soil burn severity (low, moderate and severe) were selected on soils with similar parent materials. Three five-point transects were established on each site. The center sample point of each transect was a sprouting tanoak. Two sample points were located at the dripline of the tanoak canopy, and the remaining two points were located 1 meter away from the dripline to sample areas unaffected by tanoak. Tests for all 45 sample points included: soil pH, soil organic matter by ignition, soil macroinvertebrates, water-holding capacity and percolation rate. In addition to these tests, a bioassay with Douglas-fir seedlings was done with soil from one transect per burn intensity and the effects on root growth and mycorrhizae development were assessed after one month. None of the properties tested varied by transect location, and soil macroinvertebrates appeared to be the most sensitive indicator of soil rhizosphere recovery. Of the 11 groups of soil macroinvertebrates, 10 were found on the low burn, 5-6 on the moderate burn and 6-9 were found on the severe burn. Moderately and severely burned soils had similar soil organic matter levels, but total numbers of soil invertebrates indicated a higher degree of recovery in the medium intensity burned soil vs the severely burned soil. The wildfire appears to have consumed large amounts of carbon that must be restored before a full soil invertebrate community can be supported on moderately and severely burned sites.

Awards won at the 2004 ISEF
Scholarship award of \$5,000 per year for four years - Oregon State University
Scholarship award of up to \$5,000 per year for four years - Southern Oregon University

2004 - EV079
ELIMINATION OF ARSENIC FROM SOIL AND WATER: THE USE OF HYPERACCUMULATORS TO PHYTOREMEDIATE ARSENIC SALTS.

Khaivchandra Ramjeawan
Uniondale High School, Uniondale, New York, U.S.A

Arsenic (As) is one of the most toxic substances in the world. Currently, it is plaguing the water and soil of countries like Bangladesh (over 25 million people at risk for infection) and regions of the United States such as central Florida.

This year, my research focused mainly on the hyperaccumulation of potassium and sodium arsenate from the soil and drinking water. This was done through the development of a filtration system. Known absorbents like activated carbon, and cerium (IV) oxide were combined with dried fern material to make a super adsorbent. The other phase of this project was to identify and

develop the first ever thiol for arsenic hyperaccumulation.

GIS (Geographical Information System) analysis was done to identify the dispersion of arsenic in Bangladesh and the United States of America. The information gained from this technology was used to develop an Educational Plan for the areas that could become harmed by arsenic in the soil and water.

My results impact the area of arsenic remediation because my project provides an environmentally friendly and a cost effective way to save lives through the remediation of arsenic from BOTH the soil and water. It also serves to educate many people about the effects of arsenic and its distribution. Through the use of statistical analysis, I was able to obtain a p – value <. 00001. This proves that my research is statistically significant.

Awards won at the 2004 ISEF

First Award of \$3,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

Award of \$3,000 in savings bonds, a certificate of achievement and a gold medallion - U.S. Army

Scholarship in the amount of \$8,000 - Office of Naval Research on behalf of the U.S. Navy and Marine Corps.

2004 - EV080

THE EFFECTS OF IN-SITU BIOREMEDIATION ON GASOLINE CONTAMINATED SOIL

Gracia Maria Aguilar

John Ehret High School 4300 Patriot Rd. Marrero, La , United States

This project was meant to determine the effectiveness of in-situ bioremediation on gasoline. This was determined by making three reactors. All reactors had local soil scaled to 40 feet and spiked with gasoline. One reactor was used as a control, air and nutrients were added to a second reactor, and pure oxygen and nutrients were added to a third reactor. Tests were ran every day for two months to monitor the health of the reactors including pH, Nitrogen, and temperature. Chemical oxygen demand (COD) was tested weekly to track gasoline contamination levels. Bacteria was allowed to acclimate for two weeks before gasoline was added into the reactors. The addition of air and oxygen along with nutrients did increase the rate of gasoline hydrocarbon removal in the reactors. The reactor that did not receive air or pure oxygen did not have successful contaminant removal. However, the use of oxygen did not significantly increase the rate of contamination removal over the reactor with air injection.

2004 - EV081

DECREASING NUTRIENT LEVELS IN EUTROPHIC PONDS

Arianna Rachel Sundick

Harrison High School, Farmington Hills, Mi, US

Pond owners are often confronted with the problem of excessive weed and algae growth due to high organic matter. The object of this project is to look at the effectiveness of a marketed bacterial mixture to reduce nutrient levels, plant growth, and sediment levels (Microbe-Lift; Ecological Labs, NY). The company claims that this assortment of bacteria breaks down organic matter, decreases nutrient levels, and reduces plant growth. To test the effectiveness of this product I set up containers simulating ponds, which had a one to two ratio of sediment to pond water. Aeration was provided to some replicates to examine the interaction between aeration and bacteria on organic nutrients. In another experiment bacteria were used at two different concentrations. Nitrite levels, ammonia levels, and plant growth were monitored. The results show that though bacteria do decrease nutrient levels, the results obtained from aeration are not significantly different. And though the bacteria are said to decrease plant growth, plant growth was induced in containers with higher concentrations of bacteria, than those with no bacteria added.

2004 - EV082

SMART MULCH

Maren Marie Sand

Ellendale Public School, Ellendale North Dakota, USA

Which mulch works the best as a weed suppressent and as a natural additive to the soil and how will the mulch affect the soil over a year and what is the difference between Hackberry and Colorado Blue Spruce? How will each mulch affect the fertility and temperature of the soil?

The carpet will have the best results of all the mulches.

The materials needed for this project are carpet, soybean mulch, straw, water, Hackberry trees, spade, bucket, test kit, and a tiller.

The procedure begins with tilling the ground to be planted. Place the tree in the hole and cover with dirt. Do not cover any branches with dirt. Water the tree with 2-3 gallons once a week or as needed. Photograph before and after mulching. Select trees to be mulched with carpet. Select trees to be mulched with soybean mulch then use the same steps to mulch with straw as well. Make a layer of mulch 10-15 cm thick. It should cover evenly around the base covering no branches. Test the trees comparing the results of the Colorado Blue Spruce with the previous year and the Colorado Blue Spruce of this year with the Hackberry trees.

The carpet kept the soil the warmest while the pH, potassium, nitrogen, and phosphorus levels changed in all the mulches. The soybean mulch kept the soil the coolest while the straw and carpet were the warmest.

The hypothesis proved correct, that the best weed suppressing mulch was the carpet. The soil under the mulches did not show great change over a years worth of time. The pH level was always high and did not change much. The nitrogen levels either stayed the same or dropped in all types of mulch. The phosphorus and potassium levels were always very close to the desired level and did not change much in any of the types of mulches. These results were similar over a year. If the main goal is to suppress weeds the carpet works the best.

2004 - EV083

ARSENIC MOBILITY IN FRESHWATER MICROCOSMS

Brian M. Rurik

Bellarmino Preparatory School, Tacoma, Washington, U.S.A.

Arsenic is a toxic element found in American Lake. It is important to know how and when arsenic is released from the sediments into the water. Through the use of microcosms, arsenic chemistry and its relationship to iron, sulfur, and phosphorus was studied. The concentrations of all of the chemicals were tested using probes and spectrophotometers. The data shows that as sulfur and iron increase in concentration, arsenic concentration in the water decreases. Chemical modeling shows that as a lake becomes anoxic, reducing conditions occur. In its initial reduced state, arsenic is released into the water. As reducing conditions persist, sulfur is reduced and binds to the arsenic which then precipitates out of the water.

2004 - EV084

BIOFILTRATION OF ENVIRONMENTAL POLLUTANTS

Megan Beth Cornelius

Sunnyside High School, Sunnyside, WA, USA

To determine the effectiveness of natural products to filter biological stains, oil, chemicals, and biological organisms.

Trickle filters were built with one, two, or three bags of the natural filter materials: corn husks, sand, cheat grass, charcoal, and sawdust, which were all sewn into chiffon bags. Contaminates Bismark Brown, KNO3, FeCl3, CuSO4, oil, and phytoplankton were poured into separate filters of each type. The contaminated water was filtered for 30 minutes. Filters were tested two more times for longevity. Amount of filtrate was measured for each test. Bismark Brown was measured spectrophotometrically, chemicals were analyzed using test strips, oil was tested for specific gravity, and phytoplankton was tested for using a hemacytometer.

Filtering out the highest percentage of each contaminate were: Sand with three pillows used the third time and sawdust with three pillows used the third time filtered 100% of the Bismark Brown. Sawdust with two pillows used the third time and three pillows used the third time filtered 100% of Chlorine. Nitrates could not be filtered. Charcoal with three pillows used the third time could filter out 86% of Iron. Cheat grass with 3 pillows used the third time filtered 96.4% of oil.

I partially accept and reject my hypothesis. I predicted sand and charcoal would filter chemicals most effectively and they did but sawdust was also very effective. I predicted sawdust would filter biological stains most effectively, but sand did. I predicted cheat grass would filter out the most oil and it did.

Awards won at the 2004 ISEF

Student membership in SETAC - Society of Environmental Toxicology and Chemistry

2004 - EV085

PHYTOREMEDIATION OF LEAD USING BRASSICA NIGRA: A SOLUTION FOR THE FORT ORD CLEAN-UP?

Smita Mascharak

Santa Cruz High School, Santa Cruz, CA, USA

The purpose of this experiment was to find out if lead in soil could be phyto remediated using Brassica nigra (black mustard) and if the addition of EDTA sped up this process. I hypothesized that the plants would accumulate a substantial amount of lead and that the addition of EDTA would increase the total amount of lead collected by the plants. 100 azalea pots were set up and labeled as follows: A, B1, B2, C1, and C2. Three weeks later, 16 planters from each category were selected. Those in the A category received no lead. The plants in the B category each received 400ppm of lead per planter. The plants marked C each received 2000ppm of lead per plant. The lead source was lead nitrate (Pb(NO3)2). A week later, EDTA was added to the B2 and C2 planters. Every month from this point on, 3 plants were collected from each category, dried and ground. Aliquots of this powder were digested with 1:1 HCL: HNO3, diluted and analyzed for lead using Atomic Absorption Spectroscopy. My results strongly supported my hypothesis: not only did all the plants accumulate considerably high amounts of lead, but also EDTA greatly facilitated this process. In conclusion, this experiment has demonstrated the feasibility of economically feasible as well as effective in large-scale remediation sites, such as the shooting ranges of Fort Ord where high levels of lead contamination have resulted from paint and spent bullets).

Awards won at the 2004 ISEF

Paid Summer Internship - Agilent Technologies

2004 - EV086

DIETOTAXIC RELATIONSHIP OF SLIME MOLD TO SOIL DWELLING CREATURES AS SPRINGTAILS AND ORIBATID MITE IN FOREST ECOSYSTEMS

Takanori Yano

Kumon Kokusai Senior High School, Yokohama City, Kanagawa Prefecture, JAPAN

The slime molds that inhabit the forest are well known for their unique and interesting lifecycles, however their ecological niche within the forest ecosystem has not been clarified. Here, movement towards food, which I termed "dietotaxis", of soil dwelling creatures, such as white springtails Onychiuridae and oribated mites, towards slime molds was analyzed. When the red fruit bodies of the slime mold Arcyria denudata were placed with white springtails, about 20% of the white springtails' abdominal regions turned red after several days. This result indicated that white springtails consumed the slime mold. The springtails were dissected in order to confirm whether the slime molds were actually ingested, and the presence of the spores and capillitium of slime molds was confirmed. In addition, the dietary preferences of white springtails were examined using slime molds and mushroom species, which mainly comprise the diet of white springtails in nature. In this experiment, the white springtails preferred mushrooms, but a minority did consume the slime mold.

2004 - EV087

THE EFFECT OF SULFUR-FEEDING TO SULFUR-DEPRIVATION INTERVAL RATIOS IN CHLAMYDOMONAS REINHARDTII (GREEN ALGAE) ON

TOTAL HYDROGEN GAS PHOTOPRODUCTION

Ioana Lupascu
Spring Valley High School, Columbia SC, USA

The prospective use of natural renewable sources of energy could be a fundamental solution to the problems encountered in resource efficiency and allocation. Certain algae, when deprived of sulfur, photoproduce hydrogen gas. The purpose of this study was to ultimately find a way to make the unicellular green algae, Chlamydomonas reinhardtii, release large enough amounts of hydrogen gas to use commercially, as a replacement source of energy to the nonrenewable resources currently employed. This was done by determining which sulfur-feeding to sulfur-deprivation time interval ratios drove the algae to emit the greatest amounts of hydrogen gas. It was hypothesized that the amount of hydrogen released would be significantly higher when the ratio of feeding to starvation days is 2:5, than at any other interval ratio. The algae were placed in controlled nutrient solutions (containing sulfur) for a varied number of days, upon which the nutrient solutions were extracted and replaced with sulfur-free solutions. Hydrogen gas was collected by means of water displacement and measured indirectly by way of dissolved oxygen concentration and total pressure of collected gas. An ANOVA test revealed a significant difference in the different sulfur feeding/starving interval ratios at the 99% confidence level ($p=0.000$), with maximum hydrogen gas photoproduction at the 4:3 day sulfur feeding to starving ratio. A regression analysis was performed on the two variables to identify and model the relationship between them. The best fit was found to follow the quadratic equation: $(\text{mmol H}_2) = -0.424 + 0.261 \times (\text{ratio}) - 0.0833 \times (\text{ratio})^2$, where $R^2 = 79.5\%$. Further models were also analyzed.

2004 - EV088
EFFECT OF NOSTOC FLAGELLIFORME ON THE STRUCTURAL STABILITY AND WATER CONTENT OF ARID SOIL

Zixuan Hu
Wuchang Experimental High School, Wuhan City, Hubei Province, P.R.China

The present form is the results of experimentations on the role of Nostoc flagelliforme in arid soil. The effect of algal crust on the structural stability and crude algal polysaccharides on water content were investigated. N.flagelliforme was helpful to the structural stability and water-holding capacity of arid soil.
Algal cells were inoculated in sterilized soil and cultured under 25 \pm 0.5 \circ C, 45 μ mol m⁻² s⁻¹, 16:8 L/D with 5mL distilled water everyday, algal crusts formed after 120d culture. Micro-morphology was investigated by SEM. Soil particles were bound and entrapped in the intricate network of cells and polymer secretions. The stability was investigated by testing aggregate breakdown under fast-wetting, slow-wetting and mechanical breakdown. The fragment size and the mean weight diameter (MWD) revealed the great stability of aggregates from soil inoculated with alga (MWD 0.885 to 1.005) compared to that from soil devoid of alga cover (MWD 0.281 to 0.631). The crude polysaccharides were extracted from algal cells. It retarded water evaporation and infiltration, the two parameters decreased as the increase of the concentration of polysaccharide in soil. The saturated water-content increased consistent with the increase of the polysaccharides concentration. The contributions of this project are twofold. First, N.flagelliforme was important to arid soil on structural stability and water-holding capacity. Secondly, the benefits of cyanobacterial inoculation as a biotechnological means of promoting microbiotic crust formation, preventing the sandstorms, enhancing structural stability and increasing water content in arid soil was demonstrated.

Awards won at the 2004 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV089
DOES INLET RELOCATION IMPROVE TIDAL FLUSHING IN ADJACENT TIDAL CREEKS? A CASE STUDY OF MASON INLET

Meredith Alana Parr
Laney High School, Wilmington, North Carolina, United States of America

PROBLEM: Mason Inlet in Wilmington, North Carolina was relocated in an effort to save Shell Island Resort. During funding appropriations, proponents argued that relocating the inlet would not only save Shell Island Resort but would also contribute to better estuarine water quality. Although it was argued that open inlets result in better tidal flushing and better water quality in adjacent tidal creeks, no scientific data was presented supporting this claim.
PROCEDURE: Two hundred seventy six water samples were collected from adjacent marine waters. The samples were analyzed for salinity before and after dredging using a saline refractometer. The samples were collected over 31 sample days. Data was analyzed for statistical significance using the Student T test.
RESULTS: The salinity in the majority of adjacent waters did not change after dredging. The average salinity for Howe Creek, however, was significantly (0.006) lower after dredging. Although high tide salinity did not change, low tide salinity showed a significant drop (0.01). In addition the high tide/low tide salinity difference was significantly increased (0.03).
CONCLUSION: It appears that relocating Mason Inlet and dredging Mason Creek did improve tidal flushing in Howe Creek by allowing better tidal outflow at low tide. Tidal flushing in more distant marine waters, greater than 1.5 miles away, was not affected. Based on the results of this study, it appears that inlet relocation may improve tidal flushing in salt water creeks that are nearby and have preexisting poor tidal flushing. If tidal creeks are located farther than 1.5 miles away or already have good tidal flushing, no effect on tidal flushing would be expected with similar projects.

Awards won at the 2004 ISEF
\$10,000 per year scholarship, renewable annually - Florida Institute of Technology
Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV090
BIOELECTRICITY:THE MICROBIAL FUEL CELL: PRODUCTION OF ELECTRICITY USING YEAST AND ANAEROBIC SLUDGE AS ELECTRON MEDIATORS IN A CMFC AND MFC BUILT WITH RECYCLABLE MATERIALS
Kartik Madiraju

Centennial Regional High School, Greenfield Park, Quebec, CANADA

In the light of humankind's increasing need for energy, it is vital that an effective, environmentally safe, energy-producing technique be developed. It has been described that microbial respiration can be exploited to generate electricity. The objective of this project was to construct a microbial fuel cell (MFC) that produces electricity in a cost-effective manner. In addition, the designed MFC was tested for its ability to act as a wastewater treatment system. In this project, an MFC was built using household and recyclable materials. Experiments determining optimal voltage production were conducted using three substrates—glucose, molasses and jaggery— and two microbes, baker's yeast and E.coli. Effectiveness of the RMFC was compared with that of a conventional MFC (CMFC). Results indicate that glucose yielded the highest voltage (434 mV), using yeast in the CMFC; however, jaggery (247 mV) is a more cost-effective substrate and has higher organic content, based on its COD value. Yeast produced higher voltages than E.coli, using glucose. Running on nutrient solution and anaerobic sludge, the RMFC generated voltage comparable with that produced by the CMFC running on anaerobic sludge and glucose. The COD results for the RMFC suggest that this model is an efficient wastewater treatment system, as it was able to oxidize ~25% of the nutrient solution's organic matter. This study led to the discovery of a low-cost substrate jaggery. The novel design of the RMFC constructed in this project provides a more cost-effective and an environmentally safe MFC model that combines electricity production with wastewater treatment.

Awards won at the 2004 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
Honorable Mention Award Certificates for International students and students under the age of 16 - National Aeronautics and Space Administration

2004 - EV091
ENVIRONMENTAL EFFECT OF FARM RUNOFF

Alicia Esther Hall
Valley High School, Hoople ND, USA

The purpose of this project was to find which farming method GMO, conventional or organic had the safest runoff in water and soil. Soil from an unsprayed area was collected. Pots were made out of PVC piping with a water collection pot at the bottom and were planted at depths of 12 and 22 cm with GMO, conventional and organic soybean seed or kept barren. All tests were replicated six times. The pots were treated with chemicals recommended for each farming method, and runoff was collected. Thirty daphnia were placed in each runoff solution for 60 minutes, fed phosphorescent sugar and allowed to feed for 15 minutes, then observed under a UV light to see how many were fluorescing, or alive. Heartbeat and observations were also taken. Daphnia were placed in the chemicals used (Raptor, Reflex, Rezult, Sonalan, Glyphosate, 20 percent acetic acid) for 60 minutes. Observations were taken every ten minutes, and heartbeat and observations were taken at the end of the 60 minute period. The conclusions of this project are that soil and water pH were in the neutral range. Organic farming method had the least fluorescent daphnia. GMO farming method had the least effect and organic farming method had the most effect on daphnia in the Chemical Microscope observations. Glyphosate and Rezult had the least effect on daphnia and were the only chemicals in which there were live daphnia after 60 minutes. Twenty percent acetic acid had the most harmful effect on daphnia in all chemical tests.

2004 - EV092
IMPACTS OF KENTUCKY BLUEGRASS ON NATIVE MIXED-GRASS PRAIRIE

Jared Mayer Peterson
Lakota High School, Lakota North Dakota, USA

The purpose of the project was to determine the impacts of varying levels of Kentucky bluegrass on the native plant community within a mixed-grass prairie. The null hypothesis of this project was that Kentucky bluegrass will have no effect on the plant community. Ten blocks were selected using five different treatments, on a visual estimate of Kentucky bluegrass invasion, with two replicates of each treatment. A fifty meter transect was placed across each block, and a ten-pin point frame, with data recorded every meter, was used to determine graminoid species density and frequency, as well as bare ground and litter. Along the same transect, graminoid diversity and shrub and forb density were estimated using a 0.25 meter squared frame, recorded every two meters. Data by treatment was analyzed to determine the mean diversity of each treatment, as well as the levels of various species within each treatment. As Kentucky bluegrass invasion increased, plant community diversity increased at the 40-50% invasion. However, after that, diversity declined. Essentially, native plant species were displaced.

2004 - EV093
ECOLOGICAL TIME BOMB: ACID MINE DRAINAGE-A STUDY, NEW DESIGN TECHNOLOGY, AND APPLICATION FOR CLEANING UP ACID MINE DRAINAGE

SHANNON ELIZABETH WARD
CHILDERSBURG HIGH SCHOOL, CHILDERSBURG, ALABAMA, USA

Acid mine drainage is a major environmental hazard that affects and pollutes aquatic ecosystems around the world. Control methods are often complicated, expensive, and are designed to treat the problem after it has already been exposed to the environment. This experiment addresses the design of a dual filtration system used to combat acid mine drainage at the source of the problem. I hypothesized that water samples collected at a mine site would show the presence of acid mine drainage and low organism diversity. Furthermore, that a new filtration system for cleaning up acid mine drainage can be developed using limestone gravel, em bokashi (microorganisms) and activated carbon and that a combination of all three materials would yield more effective results than using each material separately. Em bokashi was made and three different filters were constructed. A test site was located and samples from the mine site, a nearby creek, and an adjacent stream were collected. Samples were tested for pH, iron, sulfate, carbon dioxide, dissolved oxygen, alkalinity, and plankton diversity. A model of a subsurface mine was constructed and used to test the new filter design with acid mine water. The filtered samples were then retested for iron, pH,

sulfate, carbon dioxide, dissolved oxygen, and alkalinity. Results suggested that the combination filter worked the best, and proved that this efficient, easy, inexpensive filtration system could be used to combat acid mine drainage at the source of the problem.

Awards won at the 2004 ISEF

Scholarship award - Portland State University

2004 - EV094

LICHENS AND BIOMONITORING: COMPARING HUMAN POPULATION DENSITY

Drew Elijah Kamper

Kingston High School, Cadet MO, UNITED STATES

Lichens are a major component of biological diversity. The association between the high diversity of lichens and pristine habitats is so clear that scientists use lichens as indicators of ecosystem continuity—to help identify areas that should be under protection. That is what a bioindicator does. Lichens are like little sponges that soak up everything that comes their way including air pollution. When lichens disappear; they give early warning signals of harmful conditions.

In this study I compared different areas with different population density to the growth of lichens. I designated seven areas to collect data by using a land-use-classification chart that I developed. My hypothesis was supported that lichens were decreasing or disappearing as I moved farther away from natural environments.

I also designated three lichen indicator species in order to stabilize my findings. Flavoparmelia Caperata is very pollution in-tolerant so it should disappear in heavily populated areas. Physcia milligrana is very pollution tolerant so it should be equally present no matter what amount of human population is surrounding it. Punctellia reducta is right between Flavoparmelia Caperata and Physcia milligrana so it should vary in presence and be present in more natural areas. In my study I calculated what percent of the total lichens on a tree were these three lichens. My results supported my hypothesis that Physcia milligrana would be most prevalent, Punctellia reducta would be second most prevalent, and Flavoparmelia Caperata would be least prevalent.

2004 - EV095

THE EFFECT OF RESIDENTIAL AND AGRICULTURAL RUNOFF ON THE MICROBIOLOGY OF A HAWAIIAN AHUPUA'A PHASE III: MOLECULAR MICROBIAL ECOLOGY OF WATER SYSTEMS

Kiana Laieikawai Frank

Kamehameha High School, Honolulu, HI, USA

The goal of this project is to assess microbial diversity in freshwater systems more accurately and time-efficiently using molecular techniques. Other studies have shown traditional culture medias to be representative of only 1-2% of bacterial population present in freshwater systems. With the results of initial experimentation, an alternative method of fluorescence microscopy showed greater diversity of microbial populations than did traditional culture techniques. The disadvantage to both the standard Luria-Bertani based culturing and fluorescent staining is that the point to which speciation is accomplished is tedious, inaccurate and time consuming. DNA of high purity was extracted directly from the water samples using a modified protocol to eliminate the selectivity of traditional culture media for use in molecular techniques. The presence of bacteria was confirmed using two primers, which amplify highly conserved regions of DNA specific to bacteria. The presence of coliform bacteria was identified using DNA extracted directly from water sample using a primer, which amplified a region of a lacZ gene. Another primer illustrated the presence of methanotrophs at certain sites. Other primers used focused on the molecular identification of antibiotic and/or heavy metal resistance genes present in the environment. Primer SHV, which amplifies a region of the b-lactamase gene, amplified DNA extracted from environmental ampicillin resistant microorganisms. Heavy metal primers specific to genes regulating efflux systems also showed varieties of positives from DNA extracted from environmental ampicillin and heavy metal resistant microorganisms. Correlation between heavy metal resistance genes and antibiotic genes are also currently being evaluated using molecular primers.

Awards won at the 2004 ISEF

Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
Student membership in SETAC - Society of Environmental Toxicology and Chemistry

2004 - EV096

FOOD FOR TROUT PHASE V: CAN A NATURAL ENVIRONMENT BE SIMULATED AND USED TO STUDY COPPER BIOACCUMULATION FROM WATER TO AUFWUCHS TO SNAILS (GASTROPODA PULMONATA)?

Emily Sarah Munday

Butte High School, Butte MT, 59701, USA

Silver Bow Creek (SBC) watershed is contaminated by a century of mining and smelting and is now being cleaned up because of Superfund law. Metals such as copper (Cu) continue to impair water quality, stream habitat, and life in SBC.

To study copper bioaccumulation (accumulation up food chains), I simulated SBC in aquaria. I also simulated different pollution scenarios/events.

I hypothesized there would be correlation between water, Aufwuchs (periphyton), and snails (Pulmonata Lymnaeidae & Physidae, genus? Sp?), Snails of Pulmonata are ideal because they are metals tolerant, graze on Aufwuchs, and naturally occur in the SBC watershed.

Blacktail Creek, a relatively unpolluted tributary of SBC, provided snails and water needed. Rocks with Aufwuchs were collected from SBC. A solution of CuSO4 was the simulated copper source.

Four aquaria were used: control, LD-50, storm event (large flush of Cu) and chronic (constant Cu). Water Cu concentrations were monitored with a portable colorimeter. I took snail, water and Aufwuchs samples and used Atomic Absorption Spectrophotometry to analyze.

LD-50 results provided lethal dosage and critical body burden of copper in snails. The storm aquarium showed snails shed copper very rapidly. In contrast, snails with chronic copper sources don't shed, but accumulate copper. The control snails were healthy and unaffected.

Data demonstrates copper loading in chronic and storm events result in rapid transfer of copper from water to

Aufwuchs, to snails. Copper concentration in water is limited, so transfer through food webs is the primary factor in bioaccumulation.

2004 - EV097

HEAVY METAL CONCENTRATIONS IN STREAM SEDIMENTS ADJACENT TO THE GREENFIELD SANITARY LANDFILL, DADE COUNTY, MISSOURI. STUDY 2

Keenan Thomas Rose
Glendale Highschool, Springfield, Missouri, USA

A study conducted in May 1999 showed that the stream sediment in the Wetzel Branch had been contaminated with high levels of heavy metals from the Greenfield sanitary landfill. The purpose of this study was to conclude if over the span of four years these levels have significantly altered. Former sites with high levels of heavy metals had samples recollected. These samples were then prepared for chemical analysis in an Induced Coupled Plasma Spectrophotometer. A t-test showed that six of the eight metals had significantly increased with at least a 95% confidence level.

2004 - EV098

THE ENVIRONMENTAL IMPACT OF CRUDE OIL ON SEA URCHINS

Kimberly Nichole Trawick
Jefferson County International Baccalaureate, Irondale, Alabama, USA

This project stemmed from a long time fascination with the effects of oil on different types of organisms. The purpose of this experiment was to test the effect of the water-soluble fraction of crude oil on sea urchin embryos. Research showed that some components of crude oil dissolve into the water after an oil spill. This is known as the water-soluble fraction of oil. The WSF (as it is commonly called) was believed to be just as harmful as the coating of the oil on organisms. Research also showed that sea urchin embryos are susceptible to damage from pollution, and are easy to observe because of their clear membranes, quick development, and easy visibility under microscopes.

 For this experiment, sea urchins were spawned to create embryos, which were grown in vitro. The embryos were then exposed to different concentrations of the crude oil, ranging from 1% to 20%, for 48 hours. The different concentrations were observed during each stage of development. The rate of development and ratio of normal embryos to abnormal embryos were recorded for each concentration. The results of the experiment showed a delay in development of the 2 highest concentrations when the complex structure of embryos began to form. It also showed a seemingly dose dependent reaction in the ratio of abnormalities.

2004 - EV099

LETTUCE SEED BIOASSAY OF RIVER POLLUTION

Jacob Ryan Whatley
Glynn Academy, Brunswick Georgia, United States

 How does the freshwater of the Altamaha River compare with the freshwater of the Satilla River?

 The Hypothesis is that the Altamaha River has more harmful chemical pollutants than the Satilla River

 This project is to prove or see how the Altamaha and Satilla Rivers compare. Collected water samples from the Altamaha and the Satilla Rivers. Buttercrunch lettuce seeds were places on Whatman paper filter in petri dishes--twelve dishes per sample with a control for water samples. After preparation four seeds were placed on hte filter paper in 36 petri dishes. Six ml of undilute water sample was placed in each sample dish and six mi of six ml of distilled water was placed in each control dish. Seed were incubated at room temperature for five days. Distilled water was used to prevent the filters of drying out. Seeds were measured on a daily basis.

 The hypothesis was correct. In the comparison with the control samples, the Altamaha samples had a 44% less end root growth, while the Satilla samples had only a 10% less end root growth. The Altamaha samples had 15% less sprout change. Daily root end growth of the control averaged 8.24 mm, while the Satilla averaged 7.87 mm and the Altamaha averaged 5.41 mm. Towards the end of the experiment ab unknown yellow substance was growing on all of the Altamaha samples.

2004 - EV100

ANALYSIS OF THE OIL CONTAINED IN THE FRENCH FRIES.

Katiuska Briones Elmes
Jucitic - Instituto San Lorenzo, Rancagua, Chile

The present work shows to measure experimentally the contained oil in the french fries and its quality.

To carry out the investigation I proceeded to compare some commercial marks such as: Evercrisp, Mom's and Primor. Besides, I compared them with french fries made at home and with other made of a local supermarket. I measured three times the mass of each type of french fries; then I extracted the greater quantity of oil that I could, I distilled, I calculated the contained mass in each sample and afterwards I did a espectrofotométrico study of the oils.

According to the results I could conclude that: the contained oil in each studied mark contains another's components to the original oil. According to the UV spectra there are aromatic substances in solution. Besides, appear Saturated Hydrocarbons, which are detected for be present in solid form in the obtained sample. Also it informs in written form to the population about the french fries' components.

2004 - EV101

SHEEP WOOL NATURAL DYEING: A FORGOTTEN HANDICRAFT IN LA COCHA - TUCUMÁN - ARGENTINA

Julián Abel Herrera
Escuela Secundaria Técnica La Cocha - La Cocha - Tucumán - Argentina

Sheep wool natural coloring using vegetables, practiced long ago by the inhabitants of La Cocha, Tucumán, Argentina, was part of the community cultural identity.

Nowadays, tints production techniques, sheep wool coloring and afterwards dyeing are not practiced, even when they represent an ecological alternative and run the risk of disappearing, because of the presence of industrial anilines. The present investigation recovered from the artisans and old experts memory, techniques and procedures for tint manufacturing, mordents, hank preparation, conventional dyeing, covering with ashes and dyeing again.

Bibliographical investigations, surveys, interviews to professionals, and field exploration made it possible: observation, location, release and responsible use of vegetable biological material potentially qualified.

Techniques of chopping, tearing, mincing, maceration, repose and filtration of 0,300 kg.of Eucaliptus globulus labell - Acacia caven - Anadenanthera colubrine - Urtica dioica - Tillandsia aëranthos - Taraxacum officinale - Schinus polygamus - Salis sp – Aspidosperma - Bulnesia sarmienti - Allium cepa - Zea mays - Beta vulgaris y Brassica oleracea boiled separately in 10 liters of water each time, allowed to dye sheep wool hanks of 0,100 kg previously treated with Allenrolfea vaginata ashes as mordant .

Three tonalities were obtained in the ocher range, four of brown, three derived greens, one gray, two sand tonalities and three yellow degradeé sepia.

Besides, it was detected trees and plants disappearance from which red and blue were obtained.

The Micro enterprise: "Handmade dyeing of practical use elements elaborated with sheep wool, allowed the transference of acquired knowledge to the community to preserve our identity.

2004 - EV102
BIOSORPTION OF LEAD BY CHLORELLA

Crystal Daisy Wong
Burkburnett High School, Burkburnett, TX, USA

The purpose of this project is to determine at what pH Chlorella algae absorbs the most lead from solution. Water in older and more industrialized cities may have lead contaminated waters. By testing the lead absorptions by Chlorella, our waters could become less contaminated by using Chlorella as an alternative in removing toxic metals from our waters. As indicated in research, I hypothesized that Chlorella would absorb the most lead in the pH range of 1.0-3.1.

Lead absorption was detected by atomic absorption spectroscopy (AAS). A lead standard was made and adjusted to pH ranges from 1.0-4.0 in increments of 0.5 and Chlorella was added. Each solution was then magnetically stirred. As the solutions became more acidic, the smell of Chlorella grew stronger and the color gradually became darker green. All mixed solutions were then filtered to separate the algae. AAS was then used to detect the amount of lead left in each solution. In order to compare lead residuals, the standards with no Chlorella added were analyzed.

Results showed the pH of 3.3 was most effective in absorbing lead removing 97.51 +/- 0.74%. Lower pHs had an increase in lead residuals. Chlorella was no longer as effective in absorbing lead from solution. My initial hypothesis was incorrect, at a higher pH, Chlorella was able to absorb the most amount of lead. From the pH range of 1.0-4.0, the pH of 3.3 was the most effective in absorbing lead and the range of 3.3-4.0 was also effective.

2004 - EV103
WHAT LIES BENEATH. . .

Karen Elizabeth Brown
Hilton Head Preparatory School, Hilton Head Island, South Carolina, USA

This experiment deals with the discovery of mold growth on EIFS stucco (Exterior Insulation and Finishing System). The purpose was to determine the types of toxins that may be present in this mold growth. The methods utilized were (1) exposing Nutrient Agar to the home air circulation system for one hour, and (2) taking sterile swab swipes across the stucco surface as well as at the bottom of a five-centimeter hole. The hole had been drilled through the stucco down to the wood before swiping. Sterile bacteriological techniques were used throughout the collection process. Each exposed dish was accompanied by an identical unexposed control.

After an incubation period, the samples were identified by comparing them to known photographs in order to determine the different types of toxins present in the molds. In addition, samples were sent to a professional mold analysis company for further confirmation.

Species of Aspergillus, Cladosporium, Penicillium, Mucor, and Fusarium were found on Petri dishes of both air collected samples and swab samples. Botrytis cinerea, Alternaria, and Candida were predominantly found in visual samples, but were found in small amounts on the air samples. Species of Stahybotrys were found in significant amounts on the air samples, but were found in small amounts on the swab samples. The swab samples confirmed mold growth in the walls, while the air samples showed that rooms bordering the synthetic stucco contained molds that could potentially cause more harmful diseases than the rooms not bordering stucco.

During the installation of EIFS stucco, foam in the walls was placed on the inside of the wood rather than the outside where it should have been. This application created an environment conducive to the growth of toxic molds.

2004 - EV104
WILL USING ACOUSTIC VIBRATION ENHANCE THE ABSORPTION OF NON-TOXIC CHEMICALS IN WOOD?

Emily Elaine Woolsey
Oxford High School, Oxford, MS, USA

The purpose of this project is to find a cost effective method to enhance the penetration of a proven non-toxic preservative chemical into wood. The chemical used in this study was developed as an environmentally safe alternative to CCA. The desired effect is to absorb the chemical as quickly and uniformly as possible in order to increase the durability of the wood. If the life of the preserved wood can be extended, then less wood will be required for future replacement. This would result in the conservation of forests and an overall cost savings. Experiments were conducted that exposed wood to different conditions to determine which process would be most effective in enhancing the absorption of the chemicals into the wood. The hydraulic pulse chamber driven mechanically by a reciprocating diaphragm effectively treated the contained wood by breaking down surface tension and opening up the pore spaces during the negative (vacuum) down-stroke and forcing the chemical into the open pores during the positive (pressure) up-stroke. Vibration alone in the pneumatic vibration chamber did not make a significant difference, but pulling a vacuum and then adding vibration did significantly enhance the penetration of the non-toxic chemical into the wood. The addition of acoustic vibration to current methods will enhance the penetration of preservatives into wood.

2004 - EV105

THE REMEDIATION OF CHROMIUM (VI)

Katrina Esther Korhonen

The Kinkaid School, Houston Texas, USA

Chromium (VI), a carcinogen, is used as a pigment in paints, leather tanning, and chrome plating. After corporations use chromium (VI), the waste is often dumped into the environment. If it enters the body, chromium (VI) can easily enter cells and convert itself into chromium (III), which then alters DNA, blocking replication. The difference in the dangers of chromium (VI) and chromium (III) lie in the fact that chromium (III) cannot easily enter body cells like chromium (VI), although it is chromium (III) that does the damage to cells.

Using ethylene glycol (antifreeze), chromium (VI) can be turned into chromium (III). The remaining ethylene glycol then breaks down into carbon dioxide and water. All that remains is a highly acidic mixture of chromium (III) and the leftover hydronium ions necessary for the reaction to work (supplied with HCl). This solution can then be mixed with NaOH to neutralize the acid and precipitate chromium hydroxide (Cr(OH)3). Chromium hydroxide, a substance green in color and used to color lotions and soaps, can then be sold.

I have designed a continuous flow system that monitors samples of "dirty" chromium (VI). When they reach a certain voltage reading, they would activate a pump that then pumps out the newly formed chromium (III). I hope to replace the battery that is currently being used with a solar cell. Another topic of interest to be pursued in the future is the idea of using "spent" antifreeze in the system.

Awards won at the 2004 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV106

WHAT ARE THE EFFECTS OF ANTIHISTAMINES ON AVOIDANCE BEHAVIOR IN RED SWAMP CRAYFISH (PROCAMBARUS CLARKII)

William Patrick Jagoe

A.R. Johnson Health Sciences and Engineering High School, Augusta GA USA

There is increasing concern about potential effects of pharmaceuticals (both prescription and non-prescription drugs) as environmental pollutants. Pharmaceuticals enter wastewater when they are excreted from the human body, or when unneeded drugs are discarded. By their nature, pharmaceutical agents are designed to produce biological effects at relatively low concentrations, and may pose a threat to animals living in waters that receive waste water from sewage treatment plants. Pharmaceuticals include antihistamines, which may adversely affect arthropods because arthropods use histamine as a neurotransmitters for certain neurons, including photo receptors and touch receptors. This suggests that antihistamine exposure could affect crayfish behavior. I tested effects of two types of antihistamines (H1 and H2 antagonists) on a well-characterized behavior: the avoidance of light and the seeking of cover or shelter. In some experiments, antihistamine exposure altered the time-to-shelter response. There was evidence for decreased learning ability as well. This could increase susceptibility to predation or have other negative consequences in the environment.

Awards won at the 2004 ISEF

Honorable Mention Award - American Psychological Association

REMOVE FROM AWARD SCRIPT>>> Honorable Mention - American Statistical Association

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV107

SKEETER BEATERS? THE EFFECT OF AESCULUS GLABRA ON CULEX PAPIENS- YEAR II TESTING THE SAFETY OF A BUCKEYE PESTICIDE ON THE ENVIRONMENT

Sky Breeden Vanderburg

Moberly High School, Moberly, Missouri, USA

The purpose of this experiment is to determine the effect of a buckeye derivative on Daphnia magna and Lemna minor and continue the tests on Culex pipiens that were started with last year's research.

Based on previous research, the LC50 for Culex pipiens will be approximately 6.25% and the LC50 for Daphnia magna will be between 6.25% and 12.5%. The TC50 for Lemna minor will be between 50% and 100%.

To verify the hypothesis, a derivative of buckeye with distilled water was made. Three cultures per concentration of 6.25%, 12.5%, 25%, 50%, and 100% buckeye derivative and a pond water control were made. Concentrations were made with the derivative and pond water. Each container received 10 individuals of one type of test organism. Life was assessed at different intervals for different species of organisms. Also, pH and dissolved oxygen tests were done to detect any deviation from normal levels.

It was found that the buckeye was detrimental to Daphnia magna with an LC50 between 0% and 6.25%. The buckeye was moderately detrimental to Lemna minor with a TC50 of 6.25% to 12.5%. The LC50 for Culex pipiens was 6.25%.

I thought that the buckeye would prove to be a safe pesticide, but it was proved too strong for Daphnia magna and Lemna minor. My hypothesis was partially correct, although more experimentation must be done before buckeye is ruled unsafe. With these results, more control can be exercised over buckeye as a completely natural pesticide targeting mosquitoes.

2004 - EV108

A TALE OF THREE RIVERS: MEASURING THE WATER QUALITY OF THE ANACOSTIA, OCCOQUAN AND POTOMAC

Catherine St. John Carter

Georgetown Visitation Preparatory School, Washington, D.C., USA

This project is the result of observation of the water quality of the Anacostia, Potomac, and Occoquan rivers. The purpose is to determine the cleanliness of all

three rivers and discover which river is the healthiest according to current standards of the Environmental Protection Agency. The hypothesis is that the Occoquan is the most compatible with current EPA standards and therefore the cleanest river in the Washington, D.C. area.

Samples from each of the three rivers were collected three different days in January. These samples were tested for nitrates, phosphates, turbidity, pH, coliform bacteria, dissolved oxygen and temperature. The factors were sampled using commercial test kits and a dissolved oxygen meter. The results were then compared to each other and then measured against current EPA standards for cleanliness.

The nitrates and dissolved oxygen levels of all three rivers were safely within EPA standards. Only the Potomac, however, had consistently acceptable levels of phosphates and pH, and the turbidity of the Potomac was much clearer than that of the Anacostia and Occoquan. All three sites tested positive for coliform bacteria.

The hypothesis that the Occoquan River was the cleanest river was disproved. The measurements of Potomac River were most compatible with EPA standards. Therefore, the Potomac is the cleanest river in Washington, D.C. A limitation was that this experiment was completed during the coldest days of the year. Next, the rivers should be sampled during the summer months and the results compared with the measurements of this experiment.

2004 - EV109
OPTIMIZATION OF A NOVEL PROCESS OF REMOVAL OF ARSENIC RESIDUES FROM DRINKING WATER TREATMENT WASTE
Balaji V Sridhar
Cherry Creek High School, Greenwood Village, CO, USA

The source water in many public drinking water systems contains Arsenic at levels above the regulatory limit of 10 parts per billion (ppb). The most common method to reduce arsenic concentration is co-precipitation in ferric hydroxide sludge. The high arsenic levels present in the sludge, make it a toxic waste, requiring special disposal methods. Any process that would decrease the volume of sludge would be of environmental benefit.

Based on my past work, my new approach has been:

1. Removal of arsenic from the sludge by anion exchange (using phosphate), or by nitric acid elution, which is preferred. Experimental data is presented.

2. Commonly available denitrifying bacteria have been used to remove harmful nitrates from the eluate and convert them into harmless nitrogen gas.

3. The use of sulphate reducing bacteria (SRB) to precipitate As: The product from the denitrification process or the selective anion elution (phosphate eluate) is fed to an SRB reactor where sulphide anion is generated and reacts with the arsenic and other metals to produce an insoluble arsenic or metal sulphide. This precipitate is removed by centrifugation, thus greatly reducing the volume and mass of material that requires toxic waste disposal. I have calculated that all the arsenic from one (1) metric ton of sludge could be reduced to 200 grams of arsenic sulphide with this process.

Awards won at the 2004 ISEF
Trip to China to attend the CASTIC - China Association for Science and Technology
Second Award of \$1,500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV110
CO2 CONCENTRATION AND PHOTOSYNTHESIS
Bethany Rose Cartwright
Rossvie High School, Clarksville, TN, USA

The purpose of this experiment is to determine if any one mode of photosynthesis is better suited for high atmospheric levels of carbon dioxide. The two major forms of photosynthesis, C3 and C4, were studied in a CO2 enriched environment. Kentucky Bluegrass was chosen as the representative C3 plant, and Bermuda grass was chosen as the C4 plant. Two pots of each grass were seeded and placed in aquarium tanks after germination. Two aquariums were set up: one control and one that would contain a high CO2 atmosphere. A pot of Bluegrass and a pot of Bermuda were placed in each. CO2 content was enhanced in one aquarium by reacting Alka-Seltzer tablets with water. Data was taken once a week on height of the grasses and weight of the pots. At the end of the experiment, the grasses were removed from the soil and weighed.

 The masses taken of the pots over 31 days give no conclusive results when considering fluctuations of water loss and soil content. The measurement of height is also inconclusive, since it does not take into account density of grass growth. It is the final plant mass that seems to provide a conclusion. The C3 plant showed increased growth in a high CO2 atmosphere, while the growth of the C4 plant was inhibited when exposed to higher levels of CO2. This seems to indicate that C3 plants are better suited for the increasing levels of carbon dioxide in Earth's atmosphere.

2004 - EV111
THE EFFLUENT INFLUENCE A STUDY OF EFFLUENT POLLUTION
Anna Sutton Jordan
Mercy Cross High School, Biloxi MS, USA

The purpose of my project is to test the effluent of wastewater plants for remnants of caffeine, Paxil, and the female hormone estrogen. My hypothesis states that traces of these substances will be found in the water samples I have collected, because of the process of their expulsion from the human body. I collected a total of ten, one-Liter samples from wastewater plants in Jackson and Harrison Counties. In addition to the water, I also obtained sealed samples of Premarin, Stay Awake, and Paxil CR. I sent these along with the water samples to Argus Analytical, Inc. located in Ridgeland, MS. Each water sample was extracted three times: at a pH of 7, <2, and >10. Unfortunately, the Paxil contains a chemical binder that prevented breaking it down into its chemical components. However, the caffeine was successfully isolated from Stay Awake, and estrogen from Premarin. A High-performance Liquid Chromatography machine was used to detect traces of each of the standards: caffeine and estrogen. A presence of both caffeine and estrogen were found in all ten of the water samples. The greatest presence was found at a pH<2.

2004 - EV112

ALGAL BLOOMS: A STUDY OF ZOOPLANKTON-PHYTOPLANKTON INTERACTIONS IN EAGLE CREEK RESERVOIR

Annette Marie Trierweiler
Park Tudor School, Indianapolis IN, USA

Algal blooms pose a global threat to water quality when dense populations appear that are dominated by cyanophytes that can produce secondary metabolic compounds that are endotoxic or cause taste and odor problems. Current efforts to control these algal blooms tend to overlook biotic factors and rely on the application of chemical algacides or the control of abiotic factors such as nutrient enrichment. This study examines the role the biotic factor of zooplankton herbivory plays in the dynamics of late summer algal blooms.

The community interaction between zooplankton and algae was investigated using in situ floating mesocosms in a mid-latitude eutrophic reservoir that serves as the drinking water supply for 80,000 residents in central Indiana. All mesocosm exposures were inoculated with baseline zooplankton species compositions that closely resembled the conditions found in the larger reservoir. Treatment exposures were enriched with morphologically distinct cyanophytes; either Anabaena sp. which is a filamentous, heterocyst-forming cyanophyte or Microcystis sp., a coccid, non-heterocyst-forming cyanophyte. Results confirmed the hypothesis that total zooplankton populations have a slower growth rate in exposures enriched with Anabaena due to the high energy cost of processing filaments. Observed taxa specific shifts in zooplankton populations can be explained by the effect of their generalist or specific feeding behavior on their reproductive rate. The complexity of the zooplankton-phytoplankton interactions will require more research before the biological control of algae populations based on zooplankton herbivory will become practical for lake management. Nevertheless, current research raises questions to consider in a revising lake management practices.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV113

AN ENVIRONMENTAL STUDY OF A PEDIATRIC CANCER CLUSTER

Peyton Russell Johnson
Classen School of Advanced Studies, Oklahoma City, Oklahoma, United States

In reference to pollutants, are there or have there been contamination sites located in the vicinity of the defined pediatric cancer cluster that have possibly contributed to the diagnosis of cancer in the pediatric residents in that area? In regard to electromagnetic field (EMF) exposure, is there a correlation between the intensity and long-term exposure of EMF and the established childhood cancer patients? Various sources from the city of Moore, Oklahoma, along with the Oklahoma Corporation Commission, the Department of Environmental Quality, the Environmental Protection Agency, among many other agencies in the state of Oklahoma were contacted for researching the history of contamination within the area of concern, as far back as information allowed. Investigation of particular areas of suspicion were researched specifically in relation to the addresses of the pediatric victims residing in the 2.5 sq. mile cancer cluster proximity. Data collected revealed contamination sites such as petroleum tank leaks in which public water wells were contaminated and were not fully remediated, high levels of chemicals known to dililitate the human immune system found in the public water system in the years of the highest number of diagnoses, sewage leaks, a high presence of EMF exposure near many of patients' homes, along with many other possibly hazardous contamination sites. The compiled information surfaced that there were not only specific locations of contamination present within the area of concern, but also that there are some seemingly clear correlations between those locations and the 35 children diagnosed within the 2.5 sq. mile area.

2004 - EV114

PHOSPHOROUS REMOVAL FROM EVERGLADES AGRICULTURAL AREA FARM DRAINAGE WATER: A FOUR YEAR STUDY

Patrick Laurence Geer
Wellington Community High School, Wellington, Florida, USA

Through a four-phase investigation, the researcher has explored methods for reducing water phosphorous concentrations in the Everglades Agricultural Area (EAA). Excessive phosphorous in a body of water can cause eutrophication. In the previous phases of the experiment, the researcher has determined that phytoremediation is an effective means for reducing water phosphorous concentrations, that flowing filtration marshes are 58% more effective at reducing total phosphorous concentrations than stagnant filtration marshes, and that a large flowing filtration marsh reduced water phosphorous concentrations to 29 ppb. While a reduction of total phosphorous concentrations to 29 ppb is significant, it is not low enough to prevent eutrophic effects. Studies have shown that 60% of the phosphorous leaving farms is in the form of decomposed plant biomass. The purpose of the fourth phase of the experiment was to determine if a flowing filtration marsh would be more effective at reducing water phosphorous concentrations if the aquatic vegetation in it was periodically harvested. By harvesting vegetation, it cannot die in the water, and release the phosphorous in its biomass back into the water. A filtration marsh was constructed, and the aquatic vegetation in it was periodically harvested. The filtration marsh reduced total phosphorous concentrations to as low as 9 ppb, significantly more than marshes that weren't harvested, that only reduced total phosphorous concentrations to 29 ppb. From these findings, the researcher recommends that instead of spraying aquatic vegetation in the EAA and Stormwater Treatment Areas with herbicide, that the vegetation be mechanically harvested, and that flowing filtration marshes be constructed on fallow lands on farm property. By implementing these recommendations, the researcher believes that total phosphorous concentrations throughout the EAA could be reduced to the governmentally recommended 10 ppb.

Awards won at the 2004 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency

2004 - EV115

PROTECTING ILEX CASSINE SEEDLINGS ON ARTIFICIAL TREE-ISLANDS FROM EXCESSIVE PREDATION: DETERMINING THE PREDATOR AND

TESTING A SYSTEM OF PROTECTION.

Anmari Rivera
Forest Hill Community High School, West Palm Beach, Florida, U.S.A.

Protecting Ilex cassine seedlings on artificial tree-islands from excessive predation: Determining the predator and testing a system of protection.

Rivera, Anmari

Forest Hill High School, West Palm Beach, Fl

 This project deals with the effects of excessive predation from an undetermined predator on Ilex cassine (Dahoon Holly) seedlings found on artificial tree-island habitats in the Arthur R. Marshall Loxahatchee National Wildlife Refuge. The project consisted of two parts: determining the unknown predator and devising a noninvasive system that will protect the trees from excessive predation.

 To determine the predator, six trees were plants along the same transect during each of three trials. During the course of the first two trials, information about the predator, such as consistency of herbivory, and possible size, was gathered. Infrared cameras, along with sand boxes, were used to confirm the predator's identity. In the second portion of this project, a device consisting of PVC pipe and twine was created and placed around the seedlings. This device was tested against unprotected trees.

 The information gathered from the first two trials, including fur and scat samples, and the photographs collected from the infrared cameras established the predators' identity, Sylvilagus palustris (marsh rabbit). The protective device was tested during the third trial and proved to be successful.

 The research done in this project will contribute to the overall Loxahatchee Impoundment Landscape Assessment (LILA) project. The device tested may be used throughout the everglades to protect several species of seedling trees.

2004 - EV116
STREAM RIPARIAN ZONE INFLUENCE ON TERRESTRIAL INVERTEBRATES: PART II
Christina Lynn Faust
Cedar Shoals High School, Athens, Georgia, USA

Riparian zones are the areas of land along a stream that play an important role in a stream's ecosystem. Terrestrial invertebrates that fall into streams are an important food source for drift-feeding fish. The purpose of this project is to determine the role forested riparian zones play in the biomass input of terrestrial invertebrates into streams. Since forested areas provide coverage and protection of a stream, it was hypothesized that open stream segments will have a higher biomass related to the abundance of invertebrates falling into the stream in relation to forested segments.

 Preserved invertebrates from five streams in the Etowah River Basin in Northwest Georgia were classified to order and the abundance recorded. A site's terrestrial invertebrate biomass was measured to determine the mass of food that was available for consumption by drift- feeding fish. Preserved specimens from each site were combined into boats, dried in an oven for 48 hours, and weighed to determine biomass.

 The abundance of terrestrial invertebrates was higher in all open segments, mostly driven by high populations of Dipterans and Collembolans. More importantly the data demonstrated that forested sections had a greater biomass in three streams and in the cumulative average for all five streams. The higher biomass in forested reaches may be due to specimens with large bodies. This study demonstrates the importance of forested riparian zones to stream food webs; they supply a larger biomass input, enabling a larger food source for consumption.

Awards won at the 2004 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by the U.S. Environmental Protection Agency
First Award of \$500 - North American Benthological Society

2004 - EV117
ENVIRONMENTAL BENEFITS OF ZINC ANODES IN THE PREVENTION OF CORROSION IN WATERCRAFT PROPULSION SYSTEMS
Brett David Jackrel
Sandalwood High School, Jacksonville, FL USA

This project was conducted to discover what effect a zinc anode would have in preventing corrosion to the metallic parts of the propulsion system of a watercraft, and the resulting environmental benefits. It was realized that in order to minimize pollution in our waterways and landfills, it would be necessary to have every boater do their part in controlling corrosion. Five simulated boat propellers were constructed. Zinc anodes were then attached to four of the setups at varying distances from the metal samples, leaving one without a zinc anode (control). All setups were placed in a salt-water lagoon for several months. Each metal sample was carefully installed so no two metals could come in contact with each other, and were mounted in the same order.

 Digital pictures were taken at various stages of the corrosion process. Observations were made with comparisons of each metal type, over specified time spans, as well as the effect the zinc had on each metal over the varying distances mounted from the metals.

 The data generated by this project support the hypothesis that the zinc anodes do aid in reducing corrosion. Stainless steel showed no form of visible corrosion. Of all the other metals, the plated steel showed signs of the highest percentage of corrosion while brass and aluminum showed a minimal amount. In addition the percentage of visible corrosion increased with the distance of the anode from each of the tested metal samples.

 Of all of the setups, the zinc anode that showed the most pitting/corrosion was on the setup in which the zinc anode was closest to the metal sample. This suggests that there is an optimum position for the anode. It has also been suggested that the order of the mounting of the metals may have caused a reaction between the metals themselves. Future studies will address these questions.

2004 - EV301
SAHVING CREAM IN AQUATIC LIFE
Sadie Hack, Kathryn Wirtz
Wisconsin Career Academy, Milwaukee-WI, USA

In our project we wanted to see what shaving cream does to our environment. Everyday people shave. Shaving cream goes down our drains into our rivers, lakes and water resources. We want to see what the effects on plants and animals in aquatic life and study any harmful effects in marine ecosystems.

To test the effects of shaving cream we had four sets of experiments with Elodea, Euglena, Daphnia, and Catalase enzyme. First we took the one-celled organism Euglena and prepared a 1% shaving cream solution. Taking different amounts from the solution, we prepared diluted mediums for Euglena. After one day, we counted living euglenas in the medium. We repeated the same experiment for daphnia by waiting one day to get the results. Thirdly we investigated the effects of shaving cream on the photosynthesis rate by putting 15 grams of Elodea in different shaving cream solutions. Two days later the toxic effects of shaving cream were obvious. Finally we used the catalase enzyme reaction rate experiment, by using pieces of filter paper, dipping them into the enzyme, and dropping them into the water with the shaving cream solution to see whether they get carried up to the surface by the oxygen after the chemical reaction of the enzyme. We noticed that increasing amounts of shaving cream in the solution slowed down the reaction mechanism. As a result of these experiments we can conclude that increasing amounts of shaving cream are a danger for the aquatic life and has to be eliminated.

2004 - EV302
A STUDY OF WATER HYACINTH FILTRATION OF HEAVY METALS IN WATER SYSTEMS
Ra'isha Monique Florence, Aria Lynn Celestin
St. James High School, St. James, LA, USA

Water hyacinths from local waterways were collected and cultivated in the high school greenhouse. The hyacinths were seperated into four thirty-liter containers. One container was filled with tap water and the same nutrient mix. These containers were then supplemented with copper (Cu), chromium (Cr), and lead (Pb) salts to obtain 1, 5, and 10 times the action levels (EPA) of each metal, respectively. Samples of the water in each container were taken on a daily basis and analyzed for the three metals using AAS. Preliminary data is still being analyzed and results will be provided at the time of presentation.

2004 - EV303
DETERMINATION OF PERSISTANT TETRACYCLINE RESIDUES IN LIQUID MANURE BY HIGH PERFORMANCE LIQUID CHROMOTOGRAPHY WITH TANDEM MASS SPECTROMETRY
Brittelle Elyse Bowers, Heather McGuire
Woodlin, Woodrow, Colorado, United States of America

The purpose of this project is to determine the levels of the antimicrobials oxytetracycline, chlortetracycline and tylosin present in hog lagoons. Samples were collected and solid phase extraction and high performance Liquid Chromotography with Tandem Mass Spectrometry methods were used to separate and analyze each sample. Samples A and C were found to have relatively normal levels of oxytetracycline and tylosin. Chlortetracycline levels were found to be approximately 30 times larger. Samples B and E were found to have oxytetracycline levels of approximately 275 parts per billion. Chlortetracycline was found in levels 1000 times higher than method detection limit. The tylosin level in samples B and E could be considered normal. Samples D and F were found to have tetracycline levels of about twice the normal amount. It was found that hog farms carrying a larger capacity of livestock had considerably higher levels of tetracycline.

2004 - EV304
CONVERSION OF CARBON DIOXIDE AND SODIUM BOROHYDRIDE WASTE INTO SOURCES OF FUEL
William Kun Cheng, Henry John Foo
Sylvania Southview High School, Sylvania, OH, USA

Methane is a current fuel and sodium borohydride is a storage medium for hydrogen. The purpose of this project was to create an artificial energy cycle in which the production and use of carbon dioxide and hydrogen were used to produce methane and sodium borohydride. Increasing carbon dioxide levels may be reduced by reusing the gas as a fuel source in a Sabatier reaction. A Sabatier reactor was created using common household materials. The electrolysis device constructed last year was tested with borax and then laundry wastewater as an electrolyte to determine if borohydride could be produced from waste fluids through electrolysis. Next, the Sabatier reactor was tested with input from bottled carbon dioxide and electrolysis hydrogen. An investigation conducted last year showed that carbon dioxide may be captured from the atmosphere with molecular sieves. The output of the electrolysis reaction was verified to be sodium borohydride and the output of the Sabatier reactor was methane and water vapor. This project can be applied to ameliorate future global warming and provide a power source for the future.

Awards won at the 2004 ISEF
Fourth Award of \$500 - Team Projects - Presented by Science News

2004 - EV305
THE EFFECT OF KNO2, MGSO4, KNO3, FE2(SO4)3, AND AN ELEVATED CONCENTRATION OF AMBIENT CO2 ON THE ABILITY OF OEDOGONIUM FOVEOLATUM, VOLVOX, NOSTOC, DUNALIELLA SALINA, AND...
Daniel A. Schnall, Candice Weiner, Julia Ridgeway
Keystone School, San Antonio, TX, USA

The purpose of this project was to determine which species of plants and which algae would produce the most oil in order to find the best oil source for biodiesel production. The plants used were soybeans, radishes, and sunflowers. The algae species used were Dunaliella salina, Navicula, Nostoc, Oedogonium foveolatum, and Volvox. They were grown in five different environments in addition to the control environment. Environments were elevated carbon dioxide, potassium nitrite supplementation, potassium nitrate supplementation, magnesium sulfate supplementation, and iron (III) sulfate supplementation.

 The hypothesis was that the plants and algae grown in elevated ambient carbon dioxide environments would have the highest lipid

concentration and growth rates, followed by those grown with chemical supplements, and finally the control groups. The procedure was to grow the elevated carbon dioxide plants and algae in tanks, to water the chemically supplemented plants with aqueous solutions of the chemicals, and to grow the chemically supplemented algae in solutions of the chemicals and media. Growth rates were measured with absorbance and transmittance readings taken with a spectrophotometer, and lipid concentrations were found by staining samples with Nile Red lipid dye and measuring the fluorescence with a fluorometer.

The results for the plants were inconclusive due to insufficient data samples. For the algae species, the conclusion was that the best source of oil for biodiesel production was Oedogonium foveolatum grown in an elevated ambient carbon dioxide environment.

2004 - EV306

PAPEROOD - PAPER FROM WOOD? NO, WOOD FROM PAPER!

Srividya Swaminathan, Shriram Jayaraman
 Modern English School, Chheda Nagar, Chembur, Mumbai, India

Every year out of 1000 million tons of paper produced, only 30% is recycled. The remaining paper is usually wasted which is an indication that paper is not used to the full extent. For the production of paper, a large number of trees have been cut down. Our main purpose was to find an alternative method to recycle paper and to some extent, reduce deforestation by making a substitute for wood.

Paper was a key ingredient in the making of paperood. Waste paper was collected from various sources and sorted according to the size and type. This paper was then impregnated in the resin solution, which comprises of phenolic resin and some denatured alcohol for dilution. The paper was then subjected to drying using hot dry air. According to the thickness of the product desired, the stainless steel sheets under high pressure and heat. Safety measures were followed at all the stages of production of paperood.

The paperood thus obtained was tested for its mechanical properties. The results of the tests were compared with wood . Paperood is found to be better than wood in most of the properties. Flexural strength of paperood is twice that of wood whereas compression strength is 15 times that of wood. Paperood also shows fire resistance and minimum water absorption when compared to wood.

Thus paperood is better than wood in almost all structural properties. This encourages us to conclude paperood can be used for roofing, cabinets and insulators. In fact it can replace wood in several other articles, which are made of wood at present.

Awards won at the 2004 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News
 Scholarship award of \$1,500 - National Collegiate Inventors and Innovators Alliance/The Lemelson Foundation

2004 - EV307

A SIMPLE, RAPID, AND INEXPENSIVE DISSOLVED OXYGEN DETERMINATION OF WASTEWATER SAMPLES USING THE TUBE BIOLUMINESCENCE OF VIBRIO FISCHERI USTCMS 1063

Trina Granada Napasindayao, Melanie C. Melchor, Jayson Reggie T. Obos
 Quezon City Science High School, Quezon City, Philippines

This experiment proved that the Tube Bioluminescence Extinction Method using Vibrio fischeri is an effective, cheaper, and faster alternative to the Modern Winkler Method for determining the amount of Dissolved Oxygen of different wastewater samples. The experiment showed that the higher the concentration of wastewater, the lesser the time of luminescence of Vibrio fischeri, establishing a correlation of 0.92 between the duration of bioluminescence of Vibrio fischeri and the Dissolved Oxygen. From this correlation; a regression equation, $y=2.49438x+0.11220$, has been established where the amount of Dissolved Oxygen(y) in a certain wastewater sample can be determined given the duration of luminescence(x) exhibited by the bacteria.

The Vibrio fischeri was obtained and cultured on a tryptone-yeast extract-glycerol-saltwater-agar medium. Wastewater samples from the Pasig River, Manila Zoo, Project 6, Kalanchaw Creek, and Bago Bantay were diluted into concentrations of 100%,50%,25%,12.5%,6.25%, and 0%; and a deaerated distilled water was used as a blank.

For the Tube Bioluminescence Method, sample concentrations of 20mL were mixed with 2mL of 3% saline solution inoculated with Vibrio fischeri. The length of time of the luminescence exhibited by the bacteria in each of the concentrations was monitored. Similar concentrations of 350mL were subjected to the Winkler Method, which involve titrating the samples with sodium thiosulfate. The amount of dissolved oxygen in each sample was computed using the amount of sodium thiosulfate used to reach the endpoint.

Awards won at the 2004 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2004 - EV309

AN EVALUATION OF THE HARMFUL EFFECTS OF STORM WATER RUN-OFF

Monica Lisa Lamb, Zachary Lee Rawlings
 American Fork High School, American Fork, Utah, United States of America

This project is an evaluation of the harmful effects of storm water run-off in a freshwater aquatic environment. The storm water was collected from a drainage basin located in West Jordan, Utah, along 7800 South and approximately 1300 West. The storm water drainage basin empties directly into the Jordan River.

Toxicity was determined by the use of a chronic effluent toxicity test. Ceriodaphnia dubia were used as the test organisms. Toxicity was measured in terms of a decrease in total offspring produced as compared to a control.

The highest toxic level found being discharged directly into the river had a twenty-five percent inhibition concentration. If large quantities of storm water are discharged at the high toxicity levels found in this experiment, the freshwater aquatic environment could be negatively impacted.

2004 - EV310

THE DEVELOPMENT OF A SIMPLE MICROBALANCE FOR DETECTING VOLATILE ORGANIC COMPOUNDS IN CHEMISTRY LABORATORY.

Ting-Nien Lin, Ting-Chun Liu

National Taoyuan Senior High School, Taoyuan City, Taiwan, R.O.C.

Many volatile organic compounds accumulate easily in the laboratory and can have adverse impacts on students' health. In this study, a simple microbalance based on a commercial quartz crystal and polyaniline adsorbent was developed to detect volatile organic compounds. The experimental results show that the adsorptivity of the hydrocarbons is in the sequence: organic acids > alcohols > organic oxides > aromatic compounds > aliphatic compounds. The adsorptivity were found to be strongly affected by the chemical and physical properties of volatile organic compounds. In general, the adsorptivity increases with (1) the formation of hydrogen bond between the molecule and the adsorbent; (2) the higher polarity and (3) the higher abundance of pi electrons of the molecule. On the contrary, the adsorptivity decreases with higher steric hindrance because the contact area between molecule and adsorbent decreases. Due to its high polarity, the adsorptivity of acetic acid is the highest among the compounds studied. The utility of this simple device was demonstrated in detecting volatile organic compounds in a high school's chemistry laboratory.

Awards won at the 2004 ISEF

First Award of \$3,000 - Team Projects - Presented by Science News

2004 - EV311

STUDY ON THE ACTION OF POLLUTANTS AND ONE-RIVER-TWO-BANK ECO-CONTROL MODE OF TRIBUTARIES OF THE PEARL RIVER, CHINA

Yugang Ou, Yanyi Huang, Ning Chen

Tao Yuan Middle School, Fushan City, Guangdong, China

Study on heavy metals and organic pollutants, discloses the movement pattern and the action of pollutants in five respects (biological enrichment function, absorption of pollutants by suspended particles, deposit in the riverbed, movement pattern in the water and making use of water resources), analyzes the characteristics of the dynamic changes of the action of the pollutants in space and time. Based on the movement pattern and the action of the pollutants in the river, then looking for a feasible control mode for water pollution is the major purposes of this study. The study result indicates: 1. Heavy metals and organic pollutants are the typical pollutants in Yayao River, and the riverbed and the plants along the river are important sites of the action of the pollutants; 2. The absorption of pollutants by suspended particles and the movement with the water have become the decisive factor of the action and movement of the pollutants; 3. The general movement tendency of the pollutants is moving from the lower reaches to the upper reaches, and the pollutants deposit there, generally in the section in Songgang Town, where there are less pollutant-creating sources; 4. The re-suspension is the most important reason why the re-pollution and bio-effectiveness of the pollutants increase greatly; 5. Agricultural watering causes obvious movement and action of the heavy metals to the soil and crops along the river. Based on the result above and the study compared with those on other small rivers, combined with the malpractice in the one-river-two-bank project of Foshan City, puts forward an eco-control model for small tributaries, which is fit for the tributaries of the Pearl River.

Awards won at the 2004 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2004 - EV312

CONTROLLING ALGAL GROWTH IN PONDS AND RESERVOIRS USING BARLEY STRAW

Kimberli F. Patrick, Maia M. Ageson

Blue Sky High School, Rudyard, MT, USA

Algae are becoming a very big problem in many water sources. We are trying to find an environmentally friendly way of controlling the growth and reproduction of algae. The two most common types of algae are blue-green and green. *Spyrogyra* and *Oscillatoria* will be used for testing. Barley gives off certain chemicals that reduce growth in algae and is not harmful to nature. We believe that the barley straw will have a positive effect on controlling the growth of blue-green and green algae. Over the course of two weeks we grew and monitored the two types of algae. The light absorbance level of each type was also observed with a colorimeter to study the population of algae cells before and after the use of barley. Three grams of barley straw were added to each experimental beaker of the matured algae and compared with the controlled beakers. After one week, absorbance was again tested. Our observations showed that the population of the blue-green *oscillatoria* was reduced more than the green *spyrogyra*. In conclusion, the barley straw, proving our hypothesis to be correct, efficiently controlled and slowed the population of both the green and the blue-green algae. In cases where algae have become a problem, this method can be used while still being environmentally sound.

2004 - EV313

ACCELERATING DECOMPOSITION PROCESS TO CREATE COMPOST

Jaime Daril Rosado, Josue M. Rivera

Luis Muños Marín High School, Barranquitas Puerto Rico

This research had the purpose of accelerating the decomposition process of organic materials to create compost. To perform the experiment four plastic containers with threaded covers were used. These were labeled as A, B, C and D. Containers were perforated with 1/8 inch holes all around to maintain good oxygenation. Containers were silver painted to reflect solar light and to avoid overheating. Three different kinds of organic materials such as grapefruit, potato and plantain peelings were placed inside each container. No acid was placed in container (A) which was the control one. A 5% hydrochloric acid (HCL)

solution was placed in container (B), a 5% sulphuric acid (H₂SO₄) solution was placed in container (C) and a 5% acetic acid (CH₃COOH) solution (vinegar) was placed in container (D). A volume of 148 mL of these acid solutions was applied for fourteen alternated days. Decomposition levels of the organic material were recorded. To prevent possible contamination with pathogens, a greenhouse was built and the containers were placed inside it.

 The materials obtained from the containers with acid, were divided into two even parts packed in individual containers and were labeled groups1 and 2. Groups number two were treated with sodium bicarbonate (NaHCO₃) to control the acidity (pH).

 Laboratory tests were performed to all samples. It was found that the use of acetic acid (CH₃COOH) accelerated the decomposition process of these organic materials. This is important because it can be used to reduce the price of compost production without affecting meaningfully its quality.

2004 - EV314

A COMPARATIVE STUDY OF THE AMOUNT OF LEAF LITTER GATHERED IN DECIDUOUS AND EVERGREEN FOREST

Joshua Gonzalez, Miguel Oliveras
Teresita Nazario, Ensenada, Guanica, Puerto Rico

The problem for this study was: What would be the average amount of leaf litter gathered in the Deciduous Forest compared to that of the Evergreen Forest during the dry season? The hypothesis was: If the average amount of leaf litter on the ground of Guanica’s State Forest is to be measured, then the amount of leaf litter will be greater in the Deciduous Forest than in the Evergreen Forest during the dry season.

Two areas of the forest were chosen and identified as stations 1 and 2. An open canister was placed on each station to collect the fallen leaves. The experimental areas were checked weekly. The data collected was that of the leaf litter’s height inside each canister and was measured monthly for four consecutive months. The results demonstrated that in the Deciduous Forest 16.5 cm of leaf litter were gathered while in the Evergreen Forest only 5.0cm were collected.

In conclusion, the differences found between both forests provide a picture of the relationship between the amount of leaf litter with the characteristics of both forests. Since the Deciduous Forest needs much more humidity than the Evergreen Forest, the great amount of leaf litter will help to keep the soil moist and it will also provide nutrients for the soil.

This study would be an important contribution to understand that leaf litter should not be removed because of its benefits to the soil, the trees growth and the survival of the Deciduous Forest around the world

2004 - EV315

FORMING MULTIPLIERS ON A SEMI-QUANTITATIVE METHOD TO DETERMINE MERCURY CONTAMINATION IN FISH

Fernando Gonçalves Materna, Pedro Henrique da Silva Martins
CEFET de Química de Nilópolis, Rio de Janeiro, RJ, Brazil

Mercury can be found in the environment in its inorganic form. However, it causes more damage as methyl-mercury, its organic form, which has the capability of being bio-accumulated in fish bodies. Due to the increase of fish consumption in recent years, the products’ quality became the target of major researches to guarantee that the population will have access to quality products, which means, fish with legally acceptable contamination limits.

 A previous research work, done in the same school, has identified data from the consumption and sale of fish in the Grande Rio region, which allowed the mapping of species that may implicate greater toxicological risk.

 The goal of this research is to verify the feasibility of the use of a semi-quantitative technique to form multipliers. We studied and applied a semi-quantitative technique on fish samples in order to be able to evaluated the complexity of its implementation on a large scale and with low costs. The selection of the samples were based on a sampling plan established by the mapping of toxicological risks done on the previous research.

 As a result of this project, we conclude that this method is easy and low cost and can be used to form multipliers.

2004 - EV316

STUDY OF THE AIR QUALITY IN NOVO HAMBURGO CITY

Fabiano Thiele Fracassi, Éverton Hansen
Fundacao Liberato, Novo Hamburgo, Rio Grande do Sul, Brasil

chens are mutual association between algae and fungi, which are very sensitive to air pollution because they cannot eliminate any substances. In Brazil, there is a great variety of lichens, what makes it very hard to identify them.

The objective this project is to verify the air quality in some neighborhood of Novo Hamburgo city, through the observation of the presence and quantity of lichens on the trees.

Many types of lichens were observed on the trees, such as ‘Crostosos’, with grow in any environment; ‘Foliaceos’, with look like a fan and grow in dry places and are found in little polluted places; ‘Gelatinosos’, which inflate when they are wet and have a gray color; ‘Fruticosos’, which have a tuft format.

The methodology to be used is based on methods used in researches carried out in Germany. It consists on detailed observation, which focus on the quantity and variety of lichens. For this, a piece of equipment with 20 cm (width) and 50 cm (height), divided into 10 squares (10 cm) is used.

After the analysis of several trees at Liberato school, a great quantity and variety of lichens was found, what leads to a low level of pollution.

The method used does not determine the quantity of pollutant elements present in the air, but it is possible to evaluate their impact on the lichens and verify if the air people breathe have good quality.

2004 - EV317

FUENTE DE VIDA SUBTERRANEA "ACUÍFERO PATINO"

Willian Andres Bejarano Villalba, Jorge Manuel Ortiz Vazquez, Mateo Jose Gonzalez Casco
Colegio Nacional de la Capital "Gral. Bernardino Caballero". Asuncion - Paraguay

The underground water reserve Aquifer Patino provides fresh water to Asuncion, the Central Department and the Paraguari Department of the Republic of Paraguay, because it covers all this mentioned territory, where live more than two millions of people.

This Aquifer is contaminated with organic pollutants and in some areas the saline water is entering from the Chaco because people use its water excessively. We found that the problems come from

external factors as a society’s unconcern.

The research seeks to eradicate the ignorance of the Aquifer, as a first step to promote its preservation because the aquifer’s stability is in risk of getting lost, mainly for people’s irrational activities and the indifference of the government authorities.

We worked with a questionnaire directed to the population that lives along the aquifer, with questions that measure the people’s knowledge about the aquifer, and we obtained the population’s ignorance as a result.

We promote through this research:

1-) Campaigns of Educational Informations about the preservation of the Aquifer Patiño.

2-) To Educate young students about preservation forms of the aquifer, including lessons in the educational program.

3-) A legislation that regulates the use and care of the aquifer.

2004 - EV318

A STUDY OF THE EFFICACY OF HYPNUM CUPRESSIFORME AS A BIOLOGICAL RECYCLER OF ENVIRONMENTAL OXYGEN AND CARBON DIOXIDE GASES

Justin Michael Zorn, Robert Alex Eriov
Lake Brantley High School, Altamonte Springs, FL, USA

The purpose of this research is to determine whether densely-grown bryophytes, in the form of wall-surface coverings or in expansive chambers, can effectively function as biological recyclers of oxygen and carbon dioxide gases on space settlements and submarine vessels or within the vicinities of high-emission industrial plants.

 Hypnum cupressiforme, a cool-to-cold climate moss, was grown on porous capillary matting under natural conditions for a two-week acclimation period. For the study regarding light, eight 20 cm. by 25 cm. portions of the hypnum were transferred to steps distanced 30 cm., 76 cm., and 122 cm from a light fixture containing six 60-watt, 870 lumen incandescent bulbs, which incubated the moss for 14 hours each day. These distances (which affected the light received by the hypnum) emulated the lighting conditions on the International Space Station or on a large submarine vessel. Analysis of the specimens' photosynthetic rates with an Infrared Gas Analyzer (IRGA) indicated that hypnum still conducts photosynthesis under these extremely low light levels.

 For the study regarding carbon dioxide gas levels, two exposure chambers were constructed (one for natural air and one for carbon dioxide enrichment). The carbon dioxide enrichment chamber was maintained at a carbon dioxide concentration of between 550 and 650 PPM. The analysis from the IRGA showed that photosynthetic rates in the enriched chamber always exceeded those of the natural chamber (by 27.5% to 34.3%), which suggests that hypnum cupressiforme is conducive to use as a recycler of carbon dioxide in areas of increased carbon dioxide concentrations.

2004 - EV319

THEORY AND PRACTICE ON ECOLOGICAL RESTORATION IN SMALL SHALLOW EUTROPHIC WATERS

Yajia Lu, Yi Zhang, Chen Lin
Wusong High School, No.99, Taihe Rd, Shanghai, P.R.China

NUMEROUS water bodies are suffering from etrophication, which is a major factor of malign algae reproduction, or algal bloom, throughout the world. Most eutrophic small waters are unable to conduct self-purification, so the equilibrium state is easily disturbed. It is difficult for them to restore to a healthy state even if point pollutant sources are controlled.

How to restore the eutrophic aqua-system for a sustainable and healthy development of human civilization is an important and practical problem. We set up a etrophic small shallow water body named Ziqing Creek on campus as the study base. With an idea of water virescence in restoration of eutrophic waters, suitable aquatic macrophytes for nutrient removal was selected by means of constructing seven artificial eco-models (Ceratophyllum demersum, Potamogeton crispus L., Elodea nuttallii, Myriophyllum sp., Eichhornia crassipes, combination, control group) in the lab. Meanwhile, outdoor pilot study of artificial ecosystem designing was also carried out. Results showed that total nitrogen (TN), total phosphorus (TP), biochemical oxygen demand (BOD5) have been reduced by 63.2%, 53.9% and 76.3% respectively, while the transparency and dissolved oxygen (DO) increased.

Statistical analysis indicated that rebuilding a 4D aquatic plan system on the basis of submerged vegetations would be feasible to restore ecosystems of eutrophic waters. The relationship between biomass production and nutrient enrichment rates of aquatic macrophytes was also discussed. In the practice, physico-ecological engineering projects have been designed for the eco-restoration of different small shallow water bodies and an expert system is on the development.

Awards won at the 2004 ISEF

- Honorable Mention Award - Bureau of Reclamation/U.S. Department of the Interior
- Second Award of \$500 - Eastman Kodak Company
- Award of \$5,000 - Intel Foundation Achievement Awards
- Second Award of \$1,500 - Team Projects - Presented by Science News
- Second Award of \$250 - Society of Environmental Toxicology and Chemistry
- Merit Team Award of \$100 - Society for Technical Communication
- Second Award of \$450 - Sigma Xi, The Scientific Research Society

2004 - EV320

COLLECTING AND RECYCLING R22: THE MOST VIABLE SOLUTION

Claire Girardi Domeles, Gustavo Semensatto, Jonas Obert Martins Osorio
Fundacao Liberato, Novo Hamburgo, Rio Grande do Sul, Brasil

For many decades, men have been searching for a solution to the problem of the ozone layer's destruction caused by the liberation of ozone depleting gases. Through descriptive research, we were able to find a reaper of R22 gas, gas that is a component of a majority of air conditioners. Currently available removal systems are very expensive and complicated to use. Without restrictions on the release of these gases, technicians choose not to buy this reaper.

 The R4 is primarily a reaper of gases with the capacity to recycle the fluid. We improved the mobility and reduced the dimensions, keeping the cost low. The prototype is efficient, very easy to use, and protects the ozone layer.

 Originally, when the compressor burned it could not recycle the gas because the

R22 mixed with the oil. In order to allow for recycling a special filter that would eliminate the residues was added.

 In conclusion, it was possible to build a cheaper, more efficient piece of equipment that was able to respect the ozone layer and satisfy the market's demand. The addition of filters IN4864HH made the recycling of R22 possible even when the compressor burned.

2004 - EV321

DEATH BY GAS ATTACK

Eletha Joy Flores, Justin Racadio

Charles Herbert Flowers High School, Springdale, MD, USA

Investigations were conducted in this project in the effort to simulate the greenhouse effect using three greenhouse gases: carbon dioxide, nitrous oxide, and methane. This work studies the effects of these gases on the population of crickets. Experimentation took place within enclosed, glass jar habitats, in which one of the gases was inserted in a controlled concentration. Use of constant electric light over the habitats heated the gases in a similar manner as the sun does to our atmosphere. Daily observations of the population in each habitat were recorded. After the data analysis, it was found that most of the cricket population, overall, survived. Nitrous oxide proved to be the most potent gas, which means that strict regulation of N2O in our atmosphere is essential to prevent losses to biodiversity. Further research can be obtained by studying the greenhouse gas effect on plants and employing radiation to simulate UV rays from the sun.

2004 - EV322

USING STRONG ACID DIGESTION AS A COST EFFECTIVE WAY OF MILLTOWN DAM SEDIMENT REMEDIATION

Graham Kyle Meng, Joshua Larson Hurd

Sentinel High School, Missoula MT, USA

The goal of this project was to find a cost effective way to remediate the sediments of the Milltown Dam. While moving the contaminated sediments may be the easiest procedure, the sediment would still potentially be able to contaminate water sources to toxic levels. Our project looked at several strong acids and their abilities to remove the heavy metals from the sediments.

 In our study, 0.1M H2SO4 and Aqua Regia, a very strong acid solution (in a 1:3 NO3 to HCl ratio), were used in the digests test pit soil from the Milltown Dam. They were analyzed as to their ability to remove heavy metals from the soil, meet EPA environmental standards, and be cost effective.

 In all cases at least 70% of the metals were removed and, by decreasing the pH from 2 to 1, virtually all of the metals were removed. The sediments would then be neutralized back to a neutral pH using basic river water before being exposed back in the environment. A computer program was then made to model the cost effectiveness of the system, depending on remediation variables. Using a break-even economic model, a 0.125M solution, 1:1.5 solution to sediment ratio, and 5 reuses of the solution yields the optimal remediation efficiency.

2004 - EV323

SALT RIVER WATER QUALITY

Andrea Rosenthal Finch, Abbey Gail Hart

Good Hope School, Frederiksted VI, USA

Salt River Bay, in the United States Virgin Islands, is historically important because it is one of the few places in the U.S. that Columbus landed. Although it is a National Park and the largest mangrove habitat in the V.I., it is currently listed as one of the eleven most endangered locations in the U.S. Because it is used for recreation, it is important to understand risks related to human and environmental health. An important factor in assessing the safety of a water body is the water quality. Good water quality provides a safe place for recreational and commercial activity, as well as ensuring a safe environment for marine life. The purpose of this Science Fair Project was to compare the water quality in Salt River Bay with the V.I. and E.P.A. water quality standards. Water samples were taken from three distinct areas in Salt River: the mouth, the mangroves, and the marina. The water was tested from a non-polluting kayak, at 9:00am, 1:00pm, and 5:00pm on five Sundays, the most recreational day of the week, for dissolved oxygen and turbidity. A four-hour time interval was used to determine if the time of day affected pollution levels. Fecal coliform was tested on Fridays at 5:00pm and Sundays at 5:00pm for the same five weeks to determine if the weekend had any effect on the amount of fecal matter in the designated areas. Results were compared with the "Water Quality Standards for Coastal Waters of the Virgin Islands." Dissolved oxygen parts per milliliter (ppm) fell within the limits, whereas turbidity fell outside the parameters 75.5% of the time. All fecal coliform readings were far beyond the limit according to V.I. standards. A possible solution for this problem could include incorporating a pump-out station in the marina as an alternative for boat users to dispose of their wastes. Further studies could include continuing similar testing processes to determine improvements in compliance with the standards.

2004 - EV324

THE DETECTION AND REMOVAL OF 17BETA-ESTRADIOL FROM CENTRAL ARKANSAS WATERWAYS: YEAR 2

Amy Lynn Dickson, Nancy Rocio Rodriguez

Hall High School, Little Rock, Arkansas, USA

is evidence that 17Beta-Estradiol is in many waterways and affects animals. Studie to see if this type of estrogen is present in Arkansas waterways are needed . The pur ose of this experiment was to determine if 17Beta-Estradiol is still present in the Arkansas water system, and then try to remove the 17Beta-Estradio l.

 Water samples were collected from 6 various un-treated sites around Central Arkansas and 4 various treated sites. The conotration of 17Beta-Estradiol in each sample was determined with an ELISA kit. The values for 17Beta-Estradiol at the tested sites were as follows: 1) Cyprus Swamp < 0.05-micrograms/Liter; 2) Arkansas River- 0.05-micrograms/Liter; 3) Little Maumelle River- 0.05-micrograms/Liter;

4) Butler Park < 0.05-micrograms/Liter; 5) Hensley < 0.05-micrograms/Liter;

6) Clear Mountain Bottled Water > 3.0-micrograms/Liter;

7) Woodland Spring Bottled Water > 3.0-micrograms/Liter;

8) Tap Water- 0.5-micrograms/Liter;

9) Sewage Water (pre-treatment) < 0.05-micrograms/Liter;

10) Sewage Water

(post treatment) < 0.05-micrograms/Liter

These data indicate that Arkansas waterways are contaminated with 17Beta-Estradiol. The effect of this on wildlife and humans in this state is not known. Studies have shown that anaerobic bacteria living in deoxygenated environments are capable of degrading estrogen-like compounds. Using a deoxygenated environment, water samples with detected 17Beta-Estradiol concentrations were incubated for 48 hours. A significant decrease in concentration of 17Beta-Estradiol was detected in sample 2 using the ELISA assay. There was no change in sample 3. Further study is warranted, but a closer look should be taken on this cost effective way of removal.

2004 - EV325

MAGNETISM AND ALTERNATIVE TRANSPORTATION

Benjamin Jeffrey Poss Gulak, Mark Josef Brejnik
Hillfield Strathallan College, Hamilton, Ontario Canada

The scientific investigation of this project involved exploring the factors which impact how magnets, electro magnets, and specifically magnetic levitation, can be applied to move an object, in this case a model car. The topic quest was “it would be possible to create an innovative form of transportation, using magnets and electromagnets, to move vehicles, and that this could be cost efficient as well as environmentally and people friendly.”

Information was gathered from a wide range of sources regarding the current state of knowledge surrounding magnetic levitation in transportation applications. This included data on energy consumption, capital costs of vehicle and track construction, engineering challenges, and ongoing maintenance issues. This was framed in the context of global energy consumption patterns, costs of alternative energy sources, and health and safety issues as well as environmental risks. All of the information was then incorporated into the design and construction of a working model to demonstrate, on a prototype scale, the feasibility of using magnets and electromagnets to eliminate friction and improve efficiency of motion. Our project established working tolerances for the prototype which would maintain critical fits while still allowing free movement, determined the optimal materials to minimize friction while also not adding unnecessary weight, and selected the best magnet profiles for the different vertical levitation and lateral repulsion applications which were in the prototype.

It was possible to create an innovative form of transportation using magnets and electromagnets to move vehicles that would be cost efficient, people friendly and environmentally sound.

2004 - EV326

THE BIOACCMULATION OF METHLY MECURY IN GIZZARD SHAD AND AQUATIC PLANTS/ ALGAE AT THE SALT PLAINS NATIONAL WILDLIFE REFUGE.

Morgan Anna Schoeling, Chelsea Staats, Levi Daniels
Alva High School, Alva, Ok, US

The purpose of this research project was to determine if a significant difference in mercury concentrations existed between aquatic plants/algae obtained from the Salt Plains National Wildlife Refuge and the EPA standard for mercury concentration levels in aquatic plants/algae. In addition, this project was designed to determine if a significant difference existed between the mercury concentrations of Gizzard Shad from the Salt Plains and the EPA standard for mercury concentration in fish. Mercury contamination starts at the bottom and goes through the food chain. Mercury travels from herbivore fish to omnivore humans when it is converted to a toxic form of mercury known as methyl mercury. In a short period of time, the entire food chain can become contaminated. Mercury poisoning is one of the most dangerous health risks posed to women with developing fetuses. To determine the mercury concentrations of fish and aquatic plants/algae, ten samples of Gizzard Shad and twenty-one samples of aquatic plants/algae were collected from the Salt Plains. To further extend the research of mercury accumulation in fish, eight Gizzard Shad were dissected separating the guts from the outside structures. The samples were prepared and then analyzed by an Atomic Absorption Spectrometer. T-values were calculated comparing the average mercury concentrations to the EPA standards for mercury concentration. Mercury concentrations of Gizzard Shad and the aquatic plants/algae were shown to be significantly higher than the acceptable EPA standard for mercury concentration.

2004 - EV327

THE EFFECT OF DISTANCE FROM SOURCE ON THE CONCENTRATION AND TOXICITY OF ATMOSPHERIC CHLORINE ABOVE HOT TUBS

Jason Philip Stein, Jon Gelber
Los Gatos High School, Los Gatos California, United States of America

The purpose of this experiment was to find out if the concentration of gaseous chlorine close to the surface of hot tubs could be dangerous to one's health. Drosophila melanogaster (wild type) were used as indicator organisms. The experiment focused on two questions:

1. How does the concentration of atmospheric chlorine vary at different heights above hot tubs?

2. Will these concentrations affect the mortality rates of fruit flies at these heights?

To determine the concentration of atmospheric chlorine above hot tubs four 60 mL vapor samples were collected at 2, 4, 8 and 16 cm above the surface of 48oC hot tub water. Each sample was analyzed by combining the vapor with distilled water, then calculating the parts per million by using Hach powder pillows and a Spec 20.

Fine wire cages were constructed to hold the flies at the given levels above hot tub water. Ten healthy flies were placed in each cage for three hours. Mortality rates were calculated. For a control, the procedure was repeated using 48oC tap water. Three trials were run on both the experimental and the control.

A significantly greater amount of atmospheric chlorine was found at 2 cm above hot tub water than at the other levels. The fly mortality rate was also significantly greater at 2 cm than at other levels. In, addition the fly mortality rate was significantly greater at 2 cm above hot tub water than at 2 cm above the control water. Results of this experiment suggest that people sitting in hot tubs should sit so that their lips are at least 4 cm above the water level.

Awards won at the 2004 ISEF

REMOVE FROM AWARD SCRIPT>>> Honorable Mention - American Statistical Association

2004 - EV328

IMPROVED FOREST CARETAKER

*Kai Chiat Yeoh, Wang Hui Ni, Zurriya Hayati Hasnan
Sultan Ismail 2 Secondary School, Kemaman, Terengganu, Malaysia*

Forest fire and illegal logging cause serious environmental problem in many countries. The goal of this project is to invent a simple device called 'Improved Forest Caretaker'. IFC can detect smoke from forest fire and chainsaw sound so that an alert will be sent to the Forestry Department and authorities can take appropriate action at once.

To assemble the device we modified an optical smoke detector, a sound detector with a band pass filter, solar cell and a used mobile phone.

The band pass filter was modified to allow only sound of a chainsaw to pass through while animals' sound, insects' sound and ruffling of tree brunches will not.

The smoke detector was modified so that it will not cause false alarm due to mist or small insects. Once the smoke detector or sound detector is continuously activated by smoke from forest fire or sound from chainsaw for about 40 seconds, a message will be sent to a mobile phone in the Forestry department.

This device had been tested on a tree in our school and also in Ketengah forest, Terengganu, Malaysia to evaluate its practical performance, practicality and reliability.

As a conclusion, we found that IFC is able to detect the sound of chainsaw as well as smoke form fire effectively.

2004 - EV329

ROCK LEACHING EFFECTS ON BRINE SHRIMP POPULATION SIZE IN RELATIONSHIP TO CONSTRUCTED WETLANDS

*Amelia Sullivan, Natalie Sinyella and Kerwin Powsey
Music Mountain High School, Peach Springs, Arizona, Hualapai Indian Nation, USA*

This experiment was to determine if leaching rocks had any affect on brine shrimp population size compared to non-leaching rocks. The implications of brine shrimp population growth is important in the use of brine shrimp in constructed wetlands on the Hualapai Indian Nation for water treatment as well as for food for migratory birds in constructed wetlands.

The hypothesis that was tested in this experiment was that leaching rocks would produce higher brine shrimp populations than non-leaching rocks.

Five types of leaching rocks were compared to three types of non-leaching rocks. The rocks were put in 300 ml glass beakers with tap water and the pH's were tested for fourteen days in order to obtain stability before the brine shrimp were added. The brine shrimp were then added along with 1.0 grams of aquarium salt. The pH's continued to be tested until the end of the experiment. The populations of the brine shrimp were determined after 18 days of growth.

The leaching rocks did have an effect on the growth of the brine shrimp. Some leaching rocks promoted high population sizes, while some leaching rocks actually inhibited the population growth as compared to the population sizes of the brine shrimp exposed to non-leaching rocks. The populations of brine shrimp exposed to non-leaching rocks were almost identical to each other and quite low in numbers.

2004 - EV330

THE PROCESS OF RECUPERATION OF STIYERENE FROM POLISTERENE WASTE MATERIALS AND ITS ECOLOGICAL BENEFITS

*Giannina Tedesco, Maria del Rocio Romero, Mariela Campos
Academia Teocali, Liberia, Guanacaste, Costa Rica*

This investigation is about the huge dimension issue which is the wrong management of solid waste, mainly Polystyrene producing a massive pollution globally at a high cost for the environment, and a pollutant factor for air because when it's incinerated, it frees the CFC (Chloral Flour Carbonate gas), a huge menace and main destructive factor of ozone.

Having this problem in mind, an experiment was made in which waste Polystyrene was mixed with D-Limonene.

After this, by a physical mean of separation (Distillation), the dissolution was divided again into D-Limonene and Styrene, which is the raw material for PS(Polystyrene or as high impact plastic) and for EPS (Styrofoam)

As a result from this research, we effectively found this method ecologically and economically viable for reasons like:

The process of distillation doesn't involve any hazardous substances that can eventually harm the environment. The solvent used(D-Limonene)is an organic substance that isn't harmful nor toxic and doesn't cause side effects on living things.

The process is a solution for the wrong management of this solid waste(Polystyrene)because instead of disposing it into a filled dump ,Styrene could be extracted as a result of the distillation, and could be used to produce PS(Polystyrene)or EPS(Expanded Polystyrene).

The method used is a solution for the massive Global production of Styrene.

It is also a economical solution for Sub-developed countries that have to import it.

2004 - EV331

THE EFFECTS OF VARIED CONCENTRATIONS OF A COOLING TOWER WATER TREATMENT CHEMICAL ON THE POPULATION AND DIVERSITY OF SOIL MICROBES

*Kevin Y.W. Luu, Vaseem B. Anwar
Maryknoll High School, Honolulu, Hawaii, United States*

At Maryknoll High School, the cooling tower of the air conditioning system disposes enormous amounts of toxic water into Hawaii's sewer system. A chemical, known as Chem. Systems scale inhibitor/Algaecide 7618, is added into the water of the cooling tower to reduce the residue formed by the evaporation of the water and the growth of algae.

The project in hand consisted of two primary procedures. A Lactucia sativa lettuce seed bioassay was used to measure the toxicity of the solution after the solution was soaked in the soil. Results from the experiments showed that as the concentrations of the C.S. 7618 increase, the growth of the Lactucia sativa decreases.

The plating of microbial colonies from serial dilution/enumeration process (the second portion of the project) was to analyze the microbe's response towards various concentrations of C.S. 7618. From the experiment, results showed that as the concentration increases, the total number of microbial colonies appear to remain constant. However, one astounding discovery reveals that the number of different colonies decreases as the concentration increases.

Through these two aspects of the project and the supplementary procedures, the team concluded that although the total number of microbial colonies remain constant throughout the various concentration of C.S. 7618 solution, the decrease in diversity among the colony suggested that there are a few dominating colonies that expanded as the vulnerable microbes deteriorate. These particular microbes may have the

potential needed to degrade the toxicity level of the C.S. 7618 solution.

Awards won at the 2004 ISEF

Third Award of \$100 - Society of Environmental Toxicology and Chemistry

2004 - EV332

A STUDY OF THE EFFECTS OF COMMON ACIDIC AND BASIC HOUSEHOLD CHEMICALS ON THE GROWTH RATE OF HELIANTHUS ANNUUS

*Thurman Jamayl Robertson, XZanthea Plunkett, Aziza Felton
Yazoo City High School, Yazoo City, MS, United States of America*

The purpose of this project is to determine the possible helpful or harmful effects on growth of *Helianthus annuus* (sunflower) when strong and weak acids and bases are introduced. We hypothesize that citric acid will be more detrimental when compared to caffeine, ammonia will be more detrimental when compared to sodium fluoride, and citric acid will be more detrimental when compared to ammonia. We planted 25 sunflower seeds and divided them into 5 experimental groups. Experimental groups 1,2,3 and 4 were exposed to citric acid, caffeine, ammonia, and sodium fluoride in that specific order. Plants within the control group will be watered on a daily basis. Plants in experimental group 1 will be watered on a daily basis with a solution consisting of lemon juice and water in a 1:1 ratio. Plants in experimental group 2 will be watered daily with a solution consisting of caffeine in a 1:1 ratio. Plants in experimental group 3 will be watered daily with a solution consisting of ammonia in a 1:1 ratio. Plants in experimental group 4 will be watered daily with a solution of sodium fluoride in a 1:1 ratio. Plant growth will be measured and recorded on a daily basis following sufficient germination. Leaf color and texture will also be observed and recorded upon the appearance of leaves. After organization and analysis of data the effect of common acidic and basic household chemicals will be determined.

2004 - EV333

A NOVEL MMOLECULAR METHOD IN MUTAGENINITY AND CARCINOGENICITY TESTING: PLANARIA REGENERATION MODEL

*Ferhan Ayse YESIL, Fatma Nadide OCBA
Private Fatih Science Lycee, Beylikduzu Istanbul, Turkey*

DNA-adduct formation, mutagenicity and subsequently carcinogenicity are detrimental consequences of chemical genotoxicity. But these end results are very difficult to evaluate with short term tests because these are cronic effects that can be evaluated after exposures in the long term.

In our study we exploited the regeneration process of planaria to evaluate genotoxicity of chemicals in vitro and at the molecular level with planaria regeneration model. Our novel system relies on the following background informations: Chemicals attack DNA forming DNA-adducts that can cause mutations during DNA replications; regeneration accelerates the mutagenesis process when there is an exposure to a mutagen; and the DNA in every tissue of the same organism should be the same unless there is a mutation (spontaneous, sporadic or acquired).

Ethidium bromide although not concidered and regulated as a hazardous substance it still a mutagenic and carcinogenic agent and a suspected reproductive toxicant. The mutagenic effect of this chemical is tested by using our model system. Two groups were formed, one is the control group without exposure, the other is the experiment group exposed to EtBr (40microliter/100ml). Both groups were cut into two and let regenerate and then their DNA were extracted, RAPD-PCR was performed for both groups to get a comperative difference in between both groups as expected after exposure to the mutagen. the banding patterns were evaluated qualitively for their shared and unshared bands with and without an exposure and result are promissing in assessing the mutagenic effect.

2004 - EV334

THE DETERMINATION OF "SOLUNUM TOURUUM'S" PERFORMANCE WHICH IS USED FRUIT-BEARING IN THE SOIL ORIGINATED ILLNESSES IN EGGPLANT

*Ahmet Selim Baskaya, Ali Buyuktahtakin
Antalya Yilmaz Private High School, Antalya, TURKEY*

Cultivation of eggplant occupies the third rank in our countries under covering vegetable cultivation after tomato and pepper. One of the most important problem in eggplant cultivation is soil – based diseases. Most effective way to get rid of these diseases is to use resistant types against diseases. But source at resistances are usually found in wild types and as we face problems while transforming these genes to culture farms, it is hard to develop resistant types. Another way to struggle is to use chemicals as soil sterilant. "Metil Bromid" which is going to be banned to use in 2008,has been used intensively as a sterilant up to now. That's why usage of graft seedling is in our agenda as alternative. The aim of this present project is to determine the performance of "solanum torvum" that is a resistant wild type and has been used as fruit bearing in our country's ecology. And we are researching possibility of usage of this type as grafted seedling and want to contribute our country's economy and villages. In the project as material Faselis F1 and as wild type "solanum torvum" which is known to be resistant against diseases. When the thickness of plant's trunk reached 3 cm plants were planted in greenhouse and their fruit-bearing eggplant harmony was observed and their yields were noted down seeds of "solanum torvum" which is used as wild type were seeded. At the and of the grafting plant kept growing healthy during 5 months and approximately the plant, initial length of which was 10 cm reached to the 1,60 cm height. This plant is convenient for organic agriculture. While getting 250-300 kg eggplant once in 15 days in 1000 square meters land, we got 500-600 kg , with in 10 days in 1000 square meter in greenhouse as we did the grafting eggplant experiment. As a result it means 3 times much more production in a month.

2004 - EV335

RESEARCH ON TRANSPORTATION AND CHARACTERISTIC OF YELLOW SAND

*Seung Chan Lim, Min Ho Hong, Ji Yun Kim
Daejeon Science High School, Daejeon, S. Korea*

This research is on transportation(inflow and deposition) and physical/chemical characteristic of Yellow Sand in Eastern Asia. We analyzed the origin and the route of Yellow Sand, the amount of inflow and deposition of Yellow Sand in Korea, and physical/chemical characteristic(density, composition etc.). Especially, we studied on Yellow Sand as a air-pollutant by analyzing Yellow Sand that occurred in 2003.

 According to the analyzation of the Yellow Sand that occurred from 1961 to 2003 in Korea, the frequency of occurrence of Yellow Sand increase by the rate of 1.6 times per 10 years, and the origin is the arid region of North-western of China(upper stream of Hwang-ha River) and Gobi Desert in Southern Mongol. It takes about 2-3 days to reach Korea and it moves as far as Hawaii and even Western America.

 According to the analyzation of photographs taken by satellite, weather chart, and the trajectory of the upper current, the origin of Yellow Sand is the arid area of North-western China and the velocity is about 45 km/h. The influx of Yellow Sand in Korea is about 1750000 ton and the amount of Yellow Sand deposited in Korea is about 180000 ton in maximum. For sampling Yellow Sand particle we made "Yellow Sand particle gathering machine", and we gathered Yellow Sand particle, normal raised dust, pine pollen and then analyzed physical/chemical characteristic by ICP and SEM. Yellow Sand particle has the radius of about 3-7 μ m and the roundness is small and particles are separated. The principal element is silicate mineral which is compose of O and Si (iÅ70%) and Yellow Sand compose more Al, Fe then normal dust. A little amount of heavy metal pollutant was also detected.

Awards won at the 2004 ISEF

Recognized by AGI on behalf of the Association of Engineering Geologists (AEG) this awardee will receive a subscription to the AEG journal, "Environmental and Engineering Geosciences". - American Geological Institute

2005 - EV001

WATER-BORNE PAH CONCENTRATIONS ASSOCIATED WITH FOSSIL FUEL PRODUCTIONS AND THEIR IMPACT ON APOPTOSIS-RELATED PROTEINS

Megan Marie Kuper
Greybull High School, Greybull, Wyoming, USA

Coal mining is the second largest mining industry in Wyoming. Wyoming is the largest coal producer in the United States and the state has the third largest coal reserves. Its top mining industry is gas and oil. Five of this state's thirteen gas fields are in the top 100 U.S. fields ranked by oil production. The third largest mining industry is the trona and soda ash industry. This industry was ranked as the number one soda producer in the world. Wyoming also produces uranium. All of these reserves are capable of producing chemicals known as polycyclic aromatic hydrocarbons, or PAHs.

 This research investigated any potential link between PAHs that might have been produced in conjunction with various mineral production activities and health risks resulting from exposure to different levels of PAHs. To analyze variations in apoptotic proteins, PC-12 cells were exposed in-vitro to varying concentrations of benzo (a) pyrene and pyrene. After treatment, cells were processed using primary and secondary antibody ICC. Stained cells were observed for expressio0n of Fas-L and caspase-3. Counts were recorded for all slides.

 The results of this research provided a strong indication that exposure to polycyclic aromatic hydrocarbons such as benzo (a) pyrene and pyrene contributes to the apoptotic process and ultimately the death of cells. However, the means by which this takes place varies with the specific polycyclic encountered.

 Accumulation of benzo (a) pyrene, pyrene, and likely their structurally similar compounds could mean increased cell loss. This could easily lead to conditions such as Alzheimer's, Parkinson's, and other neurological disorders. Regardless of the mechanism, cellular apoptosis from polycyclic aromatic hydrocarbons is best avoided from the beginning.

Awards won at the 2005 ISEF

First Award of \$3,000 - U.S. Air Force

2005 - EV003

A STUDY OF THE EFFECTS OF LIGHT ON TEMPERATURE STRESSED ACROPORA VALIDA

Thomas Lee Powell
Trinity Catholic High School, Ocala, FL 34474

Coral bleaching is a world-wide reef problem. While most of these corals do recover, the process can be slow, and the weakened corals become susceptible to other environmental hazards, such as bacterial infection. Biologists have since discovered that there are many stressors, mainly temperature and light, which trigger this phenomenon. The focus of this project was to examine the possibility that the removal of light could extend the amount of heat stress a coral could undergo before it bleached.

Procedure: The coral species selected was a fast-growing reef building coral known as Acropora valida. 10 sister colonies of this coral were procured for this experiment. The experiment involved three steps: 1. determining the bleaching point water temperature, 2. removing the light variable and testing for bleaching at the above previously determined temperature, 3. removing the light and increasing the water temperature to discover the new bleaching threshold.

Observations and Data: Data analysis showed that at 32 degrees centigrade (the commonly accepted number) the corals bleached. Full bleaching without the light was achieved at 33 degrees centigrade. The partially bleached corals were able to recover; the rest suffered 100% mortality. No fish were used in the experiment.

Conclusion: The removal of the light variable lowers the stress on the corals at high temperature, and in turn, raises the bleaching threshold. High water temperature denatures many protective proteins to both zooanthellae and coral tissue. These proteins play a pivotal role in protecting the coral from short-wave length light damage.

2005 - EV004

ASSESSING THE RISK OF A POTENTIAL BIOLOGICAL CONTROL AGENT: OVIPOSITION TESTS ON WETLAND PLANTS

Sheena Bhalla
Lincoln Park Academy, Fort Pierce, Florida, United States

The West Indian Marsh Grass (Hymenachne amplexicaulis) is one of the many invasive species currently invading the Florida wetlands. In this study, the insect

Ischnodemus variegatus was tested as a potential biological control agent of the exotic grass. The host range of the insect was assessed by measuring the survivorship and oviposition preference on the wetland plants, Panicum hemitomon, Thalia geniculata, and Urochloa mutica. One female and one male I. variegatus were placed in an oviposition cage containing the plant to be tested. 20 females were tested per the four plant species. Every three days, survival of females and number of eggs laid on each grass were recorded. The average numbers of eggs, survival of females, and oviposition periods were compared. The female insects performed best on the invasive West Indian Marsh Grass. Two of the surrounding wetland plants, P. hemitomon and T. geniculata, were suitable hosts for oviposition. Nevertheless, the number of eggs, survival of females, oviposition period and frequency were all significantly less than those found in the West Indian Marsh Grass. Therefore, under field conditions, where the insect is exposed to other plant species, the West Indian Marsh Grass will contain the greatest population density of the insect. Since this biological control insect is restricted to the invasive Marsh Grass, there is little threat of its shifting to more distantly related plant species. Thus, this biological control agent may allow ecologically and economically important wetland systems to be saved from invasion of the West Indian Marsh Grass.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2005 - EV005

THE EFFECTS OF INCREASED NUTRIENT LEVELS ON AQUATIC ORGANISMS A BIOASSAY OF CAVE SPRINGS BRANCH AND HONEY CREEK

Molly Kathryn Steen

Grove High School, Grove Oklahoma, USA

In 1996, an industrial waste water accident in Cave Springs Branch of Honey Creek in NE Oklahoma caused outrageous spikes in nutrient levels. Many organisms are vulnerable to sudden changes in their environment. What are the immediate effects of elevated nutrient levels on smaller aquatic organisms? It is hypothesized that higher nutrient levels will have a greater negative effect than the lower nutrient levels, the test group with nitrates and phosphates together will have a greater effect, and the more delicate organisms will be more dramatically affected. Daphnia, planarian, snails, crayfish, and frog embryos were tested. Each group of organisms was placed in solutions of 10, 50, and 100 ppm nitrates; .04, 5, and 10 ppm phosphates; and nitrate & phosphates together in the fore mentioned levels. During each test, organisms were checked regularly for survival rates. The nitrates had a more drastic effect on the organisms than the phosphates. During the planarian, snail, and frog embryo tests, the test of nitrates and phosphates together, had a greater effect, as hypothesized. The daphnia were affected more dramatically by the nitrates than the nitrates and phosphates together. Overall, the phosphates were not as harmful as the nitrates. The information gained from this experiment shows that nutrient-loading into our streams and creeks is dangerous. If large amounts of nutrients are released into the waters quickly, these organisms stand little chance of surviving. The results of these tests should serve as a warning that nutrient levels need to be more strictly controlled in order to protect our environment.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2005 - EV006

PHYTORMEDIATION OF ARSENIC IN DRINKING WATER USING PTERIS CRETICA

Jared David Reigle

Evangelical Christian, Fort Myers, Flordia, United States of America

The purpose of my experiment was to determine if filtering materials used to remove arsenic from drinking water in third world countries could be recycled by phytoremediation as to eliminate the pollution caused by the typical practice of dumping of these materials back into the environment. The researcher first obtained 220 liters of contaminated arsenic water. The arsenic was naturally occurring in the water at 23.6ug/L. The water was filtered by using a 3stage 19.5-liter charcoal, gravel and fine sand filter. The filtering material was then placed in a gravel tray containing Pteris cretica and backwashed from a 380-liter reservoir tank for one week. Water samples collected were #1 raw water from the well, #2 filtered water sample, #3 filtered water sample, # 4 was filter charcoal before backwash, and sample #5 was the Pteris cretica Fern after backwashing was completed. The results were not exactly what the researcher thought they would be. The filtering system did not remove the amount of arsenic as expected. The researchers filtering system needs to be modified to increase filtration. This increase can easily be achieved by slowing down the water flow through the filter. The charcoal after filtration contained .05mg/kg dry wt. The Pteris cretica Fern, after backwashing was complete contained .89mg/kg dry wt. The researcher concludes that the fern did absorb the arsenic from the charcoal during the backwash procedure, which would allow the charcoal to be recycled for future filter use.

2005 - EV007

EFFECT OF SALINITY ON POPULATION DENSITY OF BENTHIC FORAMINIFERA IN THE INDIAN RIVER LAGOON

Phaedra Calista Tinder

Sebastian River High School, Sebastian, FL, USA

The purpose of this study was to determine the effects of salinity on population density of benthic foraminifera in the Indian River Lagoon, which is the most diverse estuary in North America. It was hypothesized that salinity and foram density would be independent of one another. Two sites in the Indian River Lagoon, Florida were selected: site 1 on the north side of Memorial Island in Vero Beach; site 2 at the mouth of the St. Sebastian River. Two replicate samples were collected from each site weekly in the months of November, December, and January 2004-2005. On each day of collection, temperature, pH, and salinity were measured. Five 100mm sediment slides from each sample were analyzed for foram shells using a light microscope at 40x and 100x magnification. Sediment composition was then analyzed to determine grain size. The mean salinities at site 1 and 2 were 30.85ppt and 24.4ppt with mean foram densities of 21.45 per 500mm sediment and 5.75 per 500mm sediment, respectively. Both the correlation coefficient between salinity

and total foram density ($r=0.5279$) and the P-value of 0.001 from the multiple-regression model indicated that there was a relationship between the two factors. Based on these results, the null hypothesis was rejected. It was concluded that decreased salinity results in decreased foram densities. Lower foram densities directly correlated ($r=0.8235$) to decreased genus diversity. Because forams are an indicator of water quality, freshwater discharges into the Indian River Lagoon could result in a decreased overall health in the lagoon. Therefore, it is of utmost importance that environmental organizations continue to work to decrease freshwater inflow into the Indian River Lagoon.

Awards won at the 2005 ISEF

Second Award of \$500 - American Statistical Association
Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh
Honorable Mention Award - North American Benthological Society

2005 - EV008
AN ANALYSIS OF SHALLOW GROUNDWATER CHEMISTRY IN BETSCH FEN

Sara K. Sullivan
Unioto High School Chillicothe, Ohio United States of America

Fens are peat-forming wetlands that receive the majority of their nutrients through drainage from surrounding fields and from groundwater movement. Important features of fens are their ability to improve water quality by removing or slowing the movement of sediment, extracting excess nutrients, and removing pesticides and pollutants. Types and quantities of vegetation and communal plants play an important role in the ability of a fen to be effective. This project is designed to determine if the spatial variations between vegetation zones in Betsch Fen impact the chemistry of shallow groundwater. It is hypothesized that the shallow groundwater chemistry inside southern Betsch Fen will vary significantly between the vegetation zones. Sixteen shallow groundwater wells were constructed from 2.5 cm PVC pipe for use in collecting groundwater samples. Four wells were located in each of four distinct vegetation zones. Weekly, water samples were collected over a five-week period. Using computerized water sensors, each sample was tested for the following chemical variables: pH, ammonium, nitrate, and conductivity. The spatial variation of each chemical variable was determined by calculating the arithmetic mean and standard deviation of each variable within and between each vegetation zone. The rate of variation between each vegetation zone was determined by calculating the coefficient of variation for each chemical variable. This analysis revealed that the chemistry of shallow groundwater in Betsch Fen did vary significantly between vegetation zones. Conductivity varied by 15.44%, pH by 6.58%, nitrate by 8.11%, and ammonium by 66.7%. Therefore, the hypothesis was correct.

Awards won at the 2005 ISEF

Award of \$200 - North American Benthological Society
Award of \$250 - National Ground Water Association

2005 - EV009
POTENTIAL AMELIORATION OF FESCUE TOXICOSIS BY INCLUSION OF CLAYS IN DIET

Loren Kaye Liebrecht
Southwest Virginia Governor's School, Dublin, VA , USA

The beef industry alone loses over six hundred million dollars a year to the effects of fescue toxicosis. Many tall fescue plants are infected with an endophyte, a fungus that grows internally and can only be transmitted through the seed. It produces various mycotoxins that can be harmful to livestock. The addition of adsorbents to feed (e.g. mineral, concentrates), in hopes of binding the toxins within the gastro-intestinal tract, is the most practical and promising approach, rivaling costly and only partly effective preventative methods. This objective was to determine the most efficient adsorbent in binding ergovaline, the most prevalent fescue toxin, to potentially ameliorate fescue toxicosis in the cattle and horse industries. Various adsorbents were screened in a 400ppb solution of ergovaline by means of high performance liquid chromatography with fluorescence detection, to determine percent adsorption. Adsorbents with the highest binding rates continued to the next round. At the end of testing, the large-pore zeolite was the top adsorbent, having an average percent adsorption of 98.63. Zeolite is a promising alternative approach in physically binding the toxins that cause fescue toxicosis. The large pore size, physical spongy pore structure of a molecular sieve, and high cation exchange capacity all contribute to make this an excellent adsorbent for ergovaline. Specificity in vivo testing would be crucial in further experiments. The introduction of zeolite to the market as an additive could be an extremely effective and economic strategy in the fight against fescue toxicosis in the cattle and horse industries.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV010
THE COMPLEX MONITORING OF THE STATE OF DIFFERENT WOODEN KINDS IN THE CITY CONDITIONS WITH THE USAGE OF BOTANICAL AND CHEMICAL METHODS

Uladzimir Bury
Secondary School #95, Minsk, BELARUS

The author has worked out and published the system of the botanical observation to mark the wooden green plantations' state, has studied their species' staff – 61 species (15000 trees), has pointed out 10 species which form the basis of the city green plantations, has carried out the chemical analysis of the soil on its pH in five modal parks, has created the illustrated "Definer of the city green plantations' species", has worked out the programme of the complex observation of the state of different wooden kinds for the usage in the public ecological observation. The programme of the complex observation of the city wooden

green plantations includes:

1. Botanical methods of estimation the wooden plantations' state.

2. Chemical methods of estimation their state (the level of acid in soil, the pollution of air and etc.)

3. "The field definer of wooden kinds".

4. The comparison and the analysis of the research results (botanical and chemical) with the help of the statistical methods.

5. The conclusions and recommendations.

2005 - EV011

THE USE OF BARLEY STRAW TO CONTROL ALGAL AND MACROPHYTE GROWTH ON WILD RICE LAKE— PRE AND POST EUTROPHIC CONDITIONS (PHASE V)

Elizabeth Jean Welsh
Proctor High School, Proctor MN, USA

Eutrophication is a problem for many of Minnesota's lakes (MN DNR, 1995). Available phosphorous is often a limiting factor in algal blooms. Wild Rice Lake is a shallow, 2100-acre lake north of Duluth, Minnesota and the site of this study. Discovering if barley straw application can reduce algal growth in a preexisting eutrophic situation and how barley straw treatment impacts available phosphorous is important. The hypothesis was that barley straw would control and diminish algal growth in Wild Rice Lake even in post eutrophic situations. Also, barley straw applications would have an affect on macrophyte growth and phosphorous availability. Three experimental trial sets of twelve buckets placed in groups of four had 31.5 grams of fertilizer added to one bucket with barley (240 grams) and one without. To one of three experimental trial sets barley straw was added two weeks after initial setup to simulate post eutrophic conditions. Once a week, for eight weeks, chlorophyll a, oxygen, pH, temperature, and conductivity were measured. Using a technologically advanced phosphorous analysis, available phosphorus was measured two times during the experiment, initially and after the eighth week. The hypothesis was supported. Barley straw treatment did significantly reduce algal growth after eutrophic conditions had already been established (ANOVA p<.001). In all barley treated buckets (pre and post eutrophic), available phosphorous was diminished, even though chlorophyll a concentrations were reduced. Possibly available phosphorous was being diverted by the microbial loop. The final macrophyte biomass was also significantly affected by the application of barley straw.

Awards won at the 2005 ISEF
Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2005 - EV012

THE EFFECT OF A SELECTED HERBICIDE (TRIFLURALIN) ON THE FLAGELLAR REGENERATION AND RESORBTION ON CHLAMYDOMONAS REINHARDTII

Cherry Dawn Tomscheck
North Toole County High School, Sunburst, MT, USA

This study consisted of three parts. The first part was done to determine if a selected herbicide (Trifluralin) would affect the rate and percentage of flagellar regeneration in Chlamydomonas reinhardtii at concentrations of .1, .5, and 1 micromolar. The second was done to determine whether or not Trifluralin would affect the rate and percentage of flagellar regeneration in Chlamydomonas reinhardtii when applied at different time intervals (30 and 60 min) after regeneration has begun. The third part was done to determine if the incubation of Chlamydomonas reinhardtii in Trifluralin at concentrations of .1, .5, and 1 micromolar would lead to the resorption of their flagella. To complete the first part of my experiment, I added 1 mL of Trifluralin in .1, .5, and 1 µmol solutions directly after I deflagellated a culture of Chlamydomonas. For the second part, Trifluralin was added at either 30 or 60 minutes after regeneration had begun. For the third part of the experiment, Trifluralin was added to a non-deflagellated culture. Motility rates and flagellar lengths were recorded for all parts and t-tests were done to determine significance. T-test results revealed that .5 and 1 µmol Trifluralin produced a significant effect on the flagellar regeneration and microtubule formation of Chlamydomonas reinhardtii. Trifluralin at a concentration of .1 µmol, however, produced very little effect as significance was shown at only one time period. Therefore, I accept my expected hypotheses for .5 and 1 µmol Trifluralin, but reject them for 1 µmol Trifluralin.

2005 - EV013

THE EFFECTS OF POLLUTANTS ON FRESHWATER ALGAE AND PLANARIA FROM LOCAL EUTROPHIC WATERS

Veniece LaShawn Kirksey
Yazoo City High School, Yazoo City, Mississippi, United States

The purpose of this project is to determine how household chemicals affect the living conditions and growth of Oedogonium and Oscillatoria algae, and Dugesia tigrina (planaria). Culture the algae. Add 20ml of Oedogonium to 1 liter of Alga-Gro Freshwater Medium and do the same for Oscillatoria. Place the cultures in an environmental chamber for 5-10 days. Collect water from three freshwater ecosystems. Set out 45 Petri dishes. Label 15 Yazoo River Oedogonium 1-5, Broad Lake Oedogonium 1-5, and Andrews Pond 1-5. Conduct the same process for Oscillatoria and the planaria. Conduct experimentation for the algae and planaria. The control is in spring water. Introduce all of the cultures to the eutrophic water labeled on its Petri dish. Place 3 planaria in each of the 15 Petri dishes. Groups 1 are used as the experimental control. Introduce Groups 2 to a pine based cleaner. Introduce groups 3 to bleach. Introduce groups 4 to anti-bacterial soap. Introduce groups 5 to washing powder. After observing living conditions, growth, and the time it took the chemicals to affect the cultures, it was found that cultures from the Yazoo River survived longer than those of the other two local eutrophic waters. This is because the Yazoo River cultures built up a resistance to the pollutants already in the water. In conclusion, my hypothesis was correct. The cultures from the Yazoo River survived longer than the other cultures. My research may help contribute to more environmental observation of local eutrophic waters in the Yazoo County area.

2005 - EV014

SARCODINE BIOREMEDIATION IN STREAMS: PHASE II DETERMINING THE UPTAKE OF HEAVY METAL CONTAMINANTS

Anne Marie Thaemert

Merino High School, Merino, CO, Logan County

This study is a continuation of last year's work. Last year it was determined that a model stream contaminated with heavy metals was bioremediated with the use of an amoeba, *Arcella vulgaris*. The purpose of Phase II was to determine the exact course or process that *Arcella* uses to lower copper and zinc levels. It was hypothesized that the heavy metals would be either absorbed into the contractile vacuole or metabolized. An Atomic Absorption Spectrometer was used to quantify the heavy metal present after exposure to *Arcella*.

Two experimental tests were run to determine if heavy metal contamination could be bioremediated. The experiment test were conducted in a stream model that simulated a natural stream with *Arcella* and heavy metals present. Control test were run to narrow down what in fact was doing the bioremediating. The control groups consisted of the PVC pipe(stream model), *Paramecium* test, *Arcella* test, and polyurethane foam (PF) test.

With the use of the Atomic Absorption Spectrometer the experimental trial containing heavy metals and *Arcella* showed an 88% decrease from 22.47 ppm to 2.59 ppm, after the model had been running for 48 hours. Applying this use of bioremediation would be efficient because all that is needed are stations in the inside curve of a stream, where *Arcella* could naturally be.

2005 - EV015

SELECTIVE FEEDING OF PROCAMBARUS CLARK ON THREE DOMINANT SUBMERGED MACROPHYTES

Sai Ge
Wuchang Experimentaental High School, Wuhan, China

As an invasive omnivorous species, crayfish,*Procambarus clark*,can seriously damage aquatic vegetation in lakes in China. *P. clark* is regarded as an important factor accounting for the declining of aquatic vegetation in many lakes, and a major factor affecting the re-construction of aquatic macrophytes. In this paper, we studied the selective feeding of *P. clark* on three dominant macrophytes in lakes and the lower part of the Changjiang River,in order to shed light on the effect of plant species on the water ecosystem.

 The result showed that the crayfish,especially in higher density can cause serious damage to macrophytes,. Of the 3 macrophytes studied, *P. clark* preferred 2 *Potamogeton*.

 This study suggested that we have to pay more attention to the effect of invasive species on the restoration of aquatic vegetation, as well as the water ecosystem.

Awards won at the 2005 ISEF
Honorable Mention Award - North American Benthological Society

2005 - EV016

CHANGE OF PHOTOELECTRIC PROPERTIES OF SEMICONDUCTORS AS A TOOL FOR THE CONTROL OF ENVIRONMENTAL

Marina Andreevna Novikova
Secondary school #33, Odessa, Ukraine

With development of human civilization decreases the negative influence on the environmental. Some of the factors, which pollute our biosphere, are infrared-illumination and strange admixtures, they are dust, pieces of solids and etc. I study estimation of these pollutions in my work by means of proceeding physical processes' analysis in the semi-conductors. Surface condition of the sample directly depends on environmental quality. That's why shortwave slump's analysis of the spectral distribution of the curve permitted to estimate the quantity of additional admixtures, which penetrated into the sample from outside. The steeper is this slump; the more our environmental is polluted. The research of luxamper characteristics gives us quantitative estimation of pollution by strange admixtures. As a result of an experiment we get the lower limit of additional admixtures' concentration and it is the reflection of the environmental condition.

 Also the pollution by chemical active matters is possible. High concentration of these matters around the sample adverbs creation of additional centers to capture electrons. The experiment of IR-extinguishing permits to calculate depth of these centers. So far as IR-light's energy, which provokes the least photo current in the sample, is comparable with energy distance between R-center and valent zone, we got these depths equal 1,1 and 0,9 eB. Turns out that the sample is the most sensitive to the IR-light with wavelength in the field 1000 and 1320 nm.

 In the work was got the expression for dependence coefficient of IR-extinguishing from intensity of light streams. It permitted to create a supersensitive gauge on intensities of IR-light. This gauge helps to turn out IR-light on the environment and calculate its intensity.

 In the work were find out many particularities of proceeding IR-extinguishing in the sample and the theory, which is interpreting these particularities, was found.

2005 - EV017

PROACTIVE TREATMENT OF AGRICULTURAL NITRATE RUNOFF: IMPROVING THE PRACTICALITY AND EFFICIENCY OF RIPARIAN BUFFERS FOR SUSTAINABLE WATER QUALITY AND WATERSHED HEALTH

Jason Frederick Kniss
Southridge High School, Beaverton, Oregon, United States

Riparian Buffers, strips of vegetation between cropland and surface water, are used to reduce fertilizer runoff. Although buffers provide a remedy to excessive runoff, recent studies show they loose their efficiency in storm conditions (Ozawa 2000). The goal of this investigation is to develop an apparatus that utilizes the negative charge of nitrate that can be used in conjunction with buffers to improve efficiency in storm conditions. The first two of five test series examined the possibility of using electromagnets and fully charged panels to reduce nitrate runoff but showed no change due to the non-polarity of nitrate. Series 3 tested the use of anode and cathode panels to reduce runoff. These panels were placed apart at three separate increments while a simulated runoff solution of ammonium nitrate ran between the charged panels. Two panels placed 5mm apart reduced the nitrate runoff concentration by 50%. Series 4 examined the efficiency of these panels in a practical situation with the influence of soil. Decreases in nitrate concentrations were observed in all trials, with reduction levels up to 26%. This test also showed that nitrates accumulate on the positively charged panels, then loose this bond once the charge is removed. The final test series examined the environmental safety of the charged panels by comparing germination and growth rates between charged and non-charged soils. A t-test was used to determine a difference in grass growth rates - no significant difference was measured, meaning that dioxin levels are not high enough to pose an

environmental risk. These charged plates can be placed in areas of high runoff flow within riparian buffers. After the high velocity water flow has passed, the charge can be turned off and plants within the buffer can assimilate accumulated nitrates. Electrostatic buffers provide a significant improvement in the efficiency and sustainability of buffer systems in reducing the risk of excessive nitrate runoff and its associated environmental effects.

Awards won at the 2005 ISEF

First Award of \$500 and a matching \$500 award to the winner's school - Bureau of Reclamation/U.S. Department of the Interior

2005 - EV018

THE EFFECT OF HEAVY METALS ON THE GROWTH OF HYACINTH ROOTS

Precious Raspberry

Wisconsin Career Academy, Milwaukee, WI, United States

My project is to show how heavy metals, used by factories, affect the world we live in today. I had to get three different concentrations of three different heavy metals and compare the root growth, wet weight and dry weight of ten hyacinth plants. One of the plants was the control plant. The three heavy metals were Nickel Sulfate, Copper Sulfate, and Lead Nitrate. The three different concentrations were 0.5mg/L of each heavy metal, 0.3mg/L of each heavy metal, and 0.1mg/L of each heavy metal. Every plant containing 0.5mg/L was the least to grow roots and they weighed the least. Each plant having Copper Sulfate mixed in the roots were the least to grow roots over all. The control plant which is the test was the healthiest. Since heavy metals aren't necessities for plant growth, I knew that the test would turn out to be the best. My project is to show that heavy metals are really destroying our soil and water and without a healthy foundation we cannot live.

2005 - EV019

PLANT DERIVED CORROSION INHIBITOR

Samuel Batista

Colquitt County High School, Moultrie, GA, USA

While researching possible science fair ideas the experimenter read an article written by a dentist who stated that tobacco chewers had less corrosion of their fillings than non-tobacco chewers. This led the experimenter to conduct an experimental research project on the effects of plant extracts on the corrosion of metals.

The 1st line of experiments was conducted using Red Man, Levi Garret, and Taylor's Pride chewing tobacco extracts. A rectangular piece of iron 10cm by 5cm was divided into two. One half was coated with the extract and allowed to dry. Once dry, a 1% saline solution, obtained by mixing 1gram of salt and 99grams(ml) of water, was applied equally to both sides. Observations were made for every week. To test whether the corrosion inhibitor was a natural chemical in tobacco or an additive the experimenter used green tobacco. The tobacco obtained were "suckers" since the tobacco crop had already been harvested. The previous procedure was followed with the green tobacco as well. To determine if Nicotine is the corrosion inhibitor in tobacco pure Nicotine was obtained and coated on one half of a rectangular piece of metal. After the coating dried out distilled water was applied to both sides and the growth of corrosion was recorded. Similarly, other plants related to tobacco were tested along with other plants/fruits until a highly effective corrosion inhibitor was derived from sugar beets.

Awards won at the 2005 ISEF

Honorable Mention Award of \$100 - U.S. Coast Guard

2005 - EV020

THE EFFECT OF VARYING PHOSPHATE CONCENTRATIONS IN GROWTH MEDIUMS ON N. EUROPAEA NITRIFICATION ACTIVITY AS INDICATED BY THE NITRITE CONCENTRATION USING SPECTRAL ANALYSIS

Kathleen Elizabeth Fleming

Yorktown High School, Arlington VA, USA

The purpose of the experiment was to determine the effect of varying phosphate concentrations in growth mediums on Nitrosomonas europaea nitrification activity. In the nitrogen cycle, N. europaea bacterium oxidizes ammonia into nitrite. In order to test the effect of phosphate concentrations present in the environment of N. europaea on nitrite production, a stock culture of N. europaea was grown and then dispensed into flasks containing media with different concentrations of phosphate (four flasks for each medium type). The phosphate concentration of the recommended medium was quartered (medium 1; 1.50g Phosphate/L), halved (medium 2; 2.99g Phosphate/L), kept standard (medium 3; 5.98g Phosphate/L), doubled (medium 4; 11.97g Phosphate/L), and quadrupled (medium 5; 23.94g Phosphate/L); the control (medium 6; 0g Phosphate/L). The concentration of nitrite in the flasks was tested every other day for two weeks using a spectrophotometer. The following were the hypotheses for the experiment: 1. The presence of increased amounts of phosphate (mediums 4 & 5) and decreased amounts of phosphate (mediums 1&2) would inhibit the growth and oxidation of ammonia into nitrite, thus causing the nitrite concentration level for the samples in which phosphate is present to be lower than the standard medium; 2. The nitrite concentration of the control would not change. Both higher and lower than the recommended phosphate concentration in the growth medium resulted in a significant decrease in nitrite production by the N. europaea (Two-way ANOVA; p<0.05). The experiment indicates that phosphate interferes with the nitrogen cycle, specifically nitrification.

2005 - EV021

COPPER TOLERANCE OF NON-MYCORRHIZAL AND MYCORRHIZAL EUCALYPTUS AND ACACIA SEEDLINGS

Brian James Siababa Agangan

University of the Philippines Rural High School, Bay, Laguna, Philippines

This study was conducted to screen ectomycorrhizal (ECM) fungi that can increase copper (Cu) tolerance of Eucalyptus urophylla and Acacia aulacocarpa seedlings for the phytoremediation of Cu mine tailings. Two laboratory experiments were done following a Completely Randomized Design (CRD) with four replicates. Pisolithus 23-01 yielded the highest mycelial growth and was unaffected by Cu addition up to 750 µM. Likewise, Pisolithus H6394, Scleroderma sp. and Streus sp. were not affected by Cu but the growth was slower than Pisolithus 23-01. Under nursery conditions, E. urophylla and A. aulacocarpa seedlings inoculated with Pisolithus (23-01 and H6394), Scleroderma and Streus and planted in garden soil amended with 250, 500 and 750 µM Cu and no Cu, grew better than the non-mycorrhizal ones. Root colonization (10 to 30%) by ECM fungi was not affected by Cu. Seedlings inoculated with Pisolithus (23-01 and H6394) and Scleroderma promoted the greatest height increment, stem diameter and dry weight. Pisolithus H6394 consistently gave the highest seedling growth, dry weight, P and Cu uptake irrespective of Cu level. Phosphorus uptake was inversely related with Cu uptake in E. urophylla. The addition of 750 µM Cu reduced the growth of non-mycorrhizal seedlings and those inoculated with Streus. In Cu mine tailing soil, A. aulacocarpa survived and grew better than E. urophylla, E. deglupta, and A. mangium. Pisolithus 23-01 promoted the best growth. Hence, A. aulacocarpa could be a potential species in reforesting Cu mine areas coupled with inoculation with Cu tolerant ECM fungi particularly with Pisolithus species.

2005 - EV022
GERMINATION AND SEED VIABILITY OF COLEOGYNE RAMOSISSIMA (BLACKBRUSH)

Kris Sorensen
Pine View High School, St. George, UT, USA

Blackbrush is becoming less common in the southwestern deserts and is at risk of becoming endangered. If an efficient method was established for growing blackbrush in great quantities and in optimal conditions, then blackbrush could be transplanted into the desert as an adult shrub and the factors that inhibit blackbrush growth as a seed embryo would be reduced. My research has led to the following questions:
1) What is the best method of germination for Coleogyne ramosissima seeds, and
2) What method of seed pre-treatment will produce the most viable seeds? My procedures include taking 7 samples [1-Control, 2-Stratification (14 days), 3-Stratification (23 days), 4- Acid Scarification (Seed coat), 5-Acid Scarification (No seed coat), 6-Mechanical Scarification (Pliers), and 7-Mechanical Scarification (Teeth)] and testing each sample for germination and seed viability. I have come to the following conclusions:
Mechanical Scarification (Teeth) was the best method of germination because the amylase in saliva broke down the starch in the seed and triggered germination. This was not an efficient method because the seeds were exposed to unsuitable conditions and were not viable for long-term growth.
My hypothesis was correct in that stratification was the best method of seed pre-treatment for seed viability. The most efficient method of growing blackbrush is to stratify the seeds at 4° Celsius for 14 days. After understanding the conditions and dormancy patterns of blackbrush seeds, it is understandable why stratification is the most efficient method for long-term viability.

Awards won at the 2005 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV023
STREAM RIPARIAN ZONE INFLUENCE ON DRIFT-FEEDING FISH AND THEIR TERRESTRIAL INVERTEBRATE PREY: PHASE III

Christina Lynn Faust
Cedar Shoals High School, Athens, Georgia, USA

The purpose of this project was to examine the effects of riparian zones on the upper trophic levels of stream food webs. Riparian zones are the areas of land bordering a stream and, if forested, can provide many benefits to a stream ecosystem. Terrestrial invertebrates fall into streams and are incorporated into a stream's food web. A portion of drift-feeding fish diets are terrestrial invertebrates. Because a larger amount of terrestrial invertebrates fall into open sections, fish in these reaches will consume a larger percentage of terrestrial invertebrates.
Three streams in the Oconee Watershed in Northeast Georgia, USA, were chosen for this study. Each had a 200 meter reach of open and forested stream. To determine the amount of terrestrial invertebrate input into stream food webs, floating collection bins were placed in streams for 24 hours. The samples were collected and invertebrates were identified to order. Four species of drift-feeding fish were collected in open and forested reaches for gut analysis. The specimens were brought to a lab, dissected, and their stomachs and intestines were removed. The guts were dissected and the ingested invertebrates were classified to order.
There was a significantly larger amount of terrestrial invertebrate input in open sections. This is most likely a result of higher temperatures and lack of canopy cover in open reaches. Of the fish species, two had significantly higher percentages of terrestrial invertebrates consumed in the forested sections. This can be explained by a larger dry mass input of terrestrial invertebrates in forested sections. Because fish in forested sections consume a larger amount of terrestrial invertebrates, forested riparian zones are beneficial in providing a food source to upper trophic levels.

Awards won at the 2005 ISEF
First Award of \$3,000 - Environmental Sciences - Presented by Ricoh
Honorable Mention Award - North American Benthological Society

2005 - EV024
POISONOUS PLAYGROUNDS PART 2: PLAYING WITH ARSENIC

Kaitlyn Rebecca Milman
Thomas Stone High School, Waldorf Maryland, United States

Abstract: My project "Playing at Your Own Risk-Part 2" focuses on the amounts of dangerous arsenic found in the surrounding plants and soil at the sites from last years project. The purpose of my project was to determine how much arsenic leached out of the wood play sets children come in contact with and the picnic tables families utilize, into the soil and plants that surround them. For my procedure I collected a soil sample 4-6in below the surface of

the ground and plants that were in the soil below the wooden object. I then went 50 feet to collect a sample 4-6in below the surface. All plant samples were washed with distilled water to remove any soil particles adhering to the plant tissue. Each sample was placed in a separate beaker, covered with aluminum foil, and placed in a 70oC drying oven for 24 hours. Once the samples were dried, they were ground using a Capresso Model #501 stainless steel coffee grinder. Soil samples were air dried, ground, and passed through a 2mm sieve. I then took all my samples to the Virginia Tech Science lab where the samples were processed.

I discovered that almost all the samples I collected either met or exceeded the EPA standard for arsenic levels.

The arsenic that is leaching into the ground is going to become an even greater problem if nothing is done to prevent the leaching. The wood could be painted with a sealant or totally replaced.

2005 - EV025

A NOVEL, COST EFFECTIVE APPROACH FOR REMOVING ARSENIC FROM DRINKING WATER IN BANGLADESH

Douglas Calvin Naftz
Park City High School, Park City Utah, USA

Elevated levels of arsenic in groundwater affect approximately 80 million people in Bangladesh, putting many of them at high risk for cancer. Countries like Bangladesh lack infrastructure to remove arsenic from water. Previous work has been focused on developing a cost-effective and efficient means of removing arsenic from drinking water in Bangladesh. A solution to this problem was developed, and the Personal Arsenic Removal (PAR) system was created in 2004 using Bayoxide E33 iron reactive material.

Oxidation state of arsenic is an integral phase of my current (2005) research. During background research it was found that the most common form of arsenic in Bangladesh was arsenic (III). Arsenic (V) has a higher adsorption affinity for the iron (III) reactive material used in the PAR system, than its other predominant oxidation state, arsenic (III). It is hypothesized that arsenic can be oxidized to the (V) species using UV light or chemical oxidation in the PAR system, to increase removal efficiency.

Oxidation experiments indicate that UV light does not significantly oxidize arsenic; while even low concentrations of an oxidizer, potassium permanganate, oxidizes 100% of the arsenic in every trial. Ongoing research is being conducted concerning the logistics of distributing the PAR system in Bangladesh and alternative oxidation pathways. Using computer modeling experiments, a method has been designed that would place an expiration date on the PAR system reactive material (based on regional arsenic concentration), so the user would know when it was no longer viable for arsenic removal, and could replace it.

Awards won at the 2005 ISEF

Second Award of \$250 and a certificate - American Intellectual Property Law Association
Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh
Award of \$200 - National Ground Water Association
Second Award of \$150 - Patent and Trademark Office Society

2005 - EV026

COPPER CONDUCTED DEHYDRATION SYSTEM CAPABLE OF REDUCING FORMADEHYDE LEVELS FROM THE WATER AND SOIL OF CEMETERIES

Pedro David Gil de Rubio - Cruz
Colegio San José, San Juan, Puerto Rico

Formaldehyde is the main liquid used to slow the decomposition process of corpses while buried. There comes a time when formaldehyde starts filtrating through the coffin and gets to the soil. Eventually this will go all the way to the water that runs near cemeteries and probably will arrive into a big water body used by humans. That is why this research intends to create a copper conducted dehydration system capable of reducing formaldehyde levels from cemeteries' soil and water.

Two cemeteries were visited in Puerto Rico: Cemetery A (located in Bayamón) and Cemetery B (located in San Juan). A total of 1600g of soil were collected from each cemetery and tested for pH, moisture, temperature, conductivity and formaldehyde levels; also 500mL of water were collected and analyzed using an ultraviolet spectrophotometer. After obtaining the results of each parameter analyzed at a laboratory, each soil was individually dehydrated in a pot-kettle connected to an Erlenmeyer flask using a copper tube. After twenty minutes of heating, the soil in the pot-kettle and the water inside the Erlenmeyer flask were tested for the same parameters as when collected. The same procedure was done three times a month for six months.

Results show that a copper conducted heating system is capable of reducing and eliminating formaldehyde levels from cemeteries' water and soil. They also show that after dehydration, soils gain a 10 High conductivity level, allowing the system to have a great amount of natural energy which eventually inhibits the entrance of pollutants.

2005 - EV027

A COMPREHENSIVE ANALYSIS OF INSECT DIVERSITY AS A RESULT OF TERRESTRIAL FEATURES AND AQUATIC VEGETATION

Elise Laine Larson
Bagley High School, Bagley, Minnesota, United State of America

urpose of this project is to determine whether vegetation density or land features effect macroinvertebrate levels more. Macroinvertebrates are essentially the s tart of the food-chain for a freshwater ecosystem. They generally consume the vegetation at the bottom of a lake. They in turn are a main source of nourishment for some fish in that ecosystem. Using these insects, I derived my hypotheses about the water quality and effects different factors had on Minnow Lake. My first hypothesis was that land features would significantly affect my biotic index levels. My second hypothesis was that land features would significantly affect the bio-diversity of macroinvertebrates in an area. My third hypothesis was that vegetation density would affect the bio-diversity of macroinvertebrates in a site. I sampled twelve sites and determined their biotic index level (using Hinsonhoff's biotic value equation), bio-diversity level (using Simpson's bio-diversity equation), and vegetation number (using an equation I produced). I found that the biotic index level in the lake was of "very good" water quality. There was no significant differentiation between the biotic index value and land features. I found that the bio-diversity was not greatly affected by the land features, but the vegetation number significantly affected it. I then tested the areas of the lake with the lowest bio-diversity and found that the bio-diversity significantly went up in

the winter and the biotic index value went down. This exhibits that because of the winter climate various species of macroinvertebrates were better able to succeed.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2005 - EV028

WATER QUALITY IN A VARIETY OF VERY DIVERSE AQUATIC HABITATS

Cory Ray Knowles

Drew Central High School, Monticello, AR USA

The purpose is to determine if water quality is affected due to a variety of very diverse aquatic habitats. In trying to prove the hypothesis, water samples were taken three times, once a month for three consecutive months. The dates chosen were December 4, 2004, January 1, 2005, and February 5, 2005. A pond, a river, a wetland, a creek, a lake, and a bayou were tested. The tests were for water and air temperature, dissolved oxygen, water hardness, total alkalinity, pH, turbidity, nitrate-nitrogen, phosphate, total dissolved solids, iron, copper, acidity, and carbon. The range results for air temperature degrees Celsius were from 12.0-17.0, water temperature degrees Celsius: 7.0-10.0, dissolved oxygen: 8.0-17.0, water hardness: 2.5-17.0, total alkalinity: 3.3-17.0, pH: 5.8-8.03, turbidity: 3.43-34.5, nitrate-nitrogen: 0.0-0.3, phosphate: 0.01-13.0, total dissolved solids: 10.0-70.0, iron: 0.0-3.0, copper: 0.6-3.0, acidity: 85.0-99.0, carbon dioxide: 6.0-9.80. All of the results were completed and compared from all locations and three dates. The experiments proved that there is a significant difference in water quality due to a variety of very diverse aquatic habitats.

2005 - EV029

OIL WELL HALOPHILES

Stephanie Elizabeth Rector

Deer Creek-Lamont High School, Lamont, OK, USA

The purpose of this project was to see if bacteria could be found in the salty soils around oil well tank batteries. The Hypothesis for this project was that extremophilic bacteria would be found.

 The procedures in this project consisted of obtaining soil samples from well sites, checking the salt concentration levels, measuring the pH, culturing moist samples on agar plates. To see if bacteria were present, slides were made of the bacteria found and the gram stain technique was used to try to classify the bacteria found.

 The independent variables in this project were the soil types. The control was an agar plate without moist soil sample. The dependent variable was the bacteria that were observed.

 The conclusions from this experiment showed that a gram- positive bacillus was present in the soil samples from the oil well areas. These bacteria live in soils with high concentration of salt and acidic pH. The bacteria could not be identified further due to the lack of resources at our local school.

2005 - EV030

DETERMINING THE ENVIRONMENTAL IMPACT OF SODIUM CHLORIDE FROM ROAD DE-ICING IN NORTHERN AREAS

Laura K. Jones

University School of Milwaukee, Milwaukee, WI 53217, USA

Salting is commonly used in northern areas to de-ice roadways, but there is a concern that sodium chloride may have damaging effects on the environment. An experiment was devised which examines materials that might be added to roadways or topsoil that would be efficient and economical as salt absorbing or neutralizing agents.

 Two materials, gypsum and zeolite, were examined for both their ability to decrease the salinity of soil and to see whether they were helpful, harmful, or neutral to plants that use the soil. Gypsum was found to be superior for this use. There was then a concern that if gypsum was spread on a road surface, it may become slippery and therefore dangerous. Since there is no standard measurement for the “slipperiness” of a substance, I had to create a method and a database for this measurement, and then relate it to gypsum.

 Field tests were then conducted to test whether sodium chloride does in fact impact the environment negatively. I tested snow by the sides of the road, and water from the Milwaukee River and from Lake Michigan. In order to do this testing I had to create my own inexpensive testing equipment and apparatus. Future tests will include a bacterial study to find out at what chloride concentration are soil and aerobic bacteria inhibited. Tests would also be conducted on the effects of the road salt anti-caking additive ferrocyanide on air and water quality.

2005 - EV031

BIOREMEDIATION OF CRUDE OIL IN PRISTINE AND CONTAMINATED SOIL ENVIRONMENTS WITH NATURAL ENHANCEMENT OF DEGRADATION

Srishti Deepak Mirchandani

DuPont Manual High School, Louisville, KY, USA

Oil spills are a significant threat to the environment and cleanup measures are often costly or ineffective. This research focuses on the augmentation of natural processes by means of fertilizers to degrade crude oil and examines the applicability of bioremediation in different soil environments: one “pristine” and the other “contaminated”. It was hypothesized that fertilized soils would degrade the oil at a greater rate than the unfertilized, and the contaminated soil would degrade the oil faster than the pristine.

 In bioremediation, microbes mineralize the crude oil from its harmful state. The primary product, carbon dioxide (CO2), was measured using a gas chromatograph to determine its concentration (ppm). The CO2 concentrations were monitored weekly for 70 days. Weekly averages were compared and the rate of CO2 production per day was calculated, showing the trends of degradation.

 Results show that the addition of fertilizer increased the rate of degradation as expected. However, the pristine soil maintained a higher rate of CO2 production than the contaminated. The

degradation had a noticeable peak in the pristine soil between 7 and 14 days after incubation while the contaminated soil had a smaller peak from 7 to 14 days and again at 63 to 70 days.

 For further comparison, a Sheen Screen MPN was conducted to enumerate the petroleum-degrading microbes in the soils. Supporting the mineralization data, the pristine soil contained roughly 4800 microbes per gram of soil versus 3600 in the contaminated soil; evidence that bioremediation is an effective cleanup method, especially in pristine environments.

Awards won at the 2005 ISEF

Honorable Mention Award - American Statistical Association
Tuition Scholarship Award in the amount of \$8,000 - Office of Naval Research on behalf of the U.S. Navy and Marine Corps.

2005 - EV032
IMMOBILIZATION OF HAZARDOUS MATERIALS UTILIZING GALLIONELLA SP, KLEBSIELLA SP, AND DESULFOVIBRIO SP BACTERIA
Morgen Elizabeth Anyan
Selah High School, Selah, WA

To determine if Gallionella sp, Klebsiella sp, and Desulfovibrio sp bacteria can immobilize contaminants in water, which contaminants they immobilize more readily, and if iron and sulfur bacteria are immobilizing contaminants in the Yakima River.

I hypothesized that the bacteria would immobilize the contaminants, they would immobilize copper or boron the most, and iron and sulfur bacteria were immobilizing contaminants in the river.

Phase one: Iron and sulfur bacteria, and water samples were collected from four sites along the river and analyzed for boron, copper, nitrate, and zinc using a spectrophotometer. The results were compared to the EPA's Maximum Contaminant Levels.

Phase two: Five mini-river environments were created. Iron and sulfur bacteria were added to each, and 50mL of each contaminant solution was added to a container. A mixture of the contaminants was added to the fifth container. Every day for three days enough water was removed from the containers to conduct one test per contaminant(s). The process was repeated twice.

My first hypothesis was accepted because the levels of soluble contaminants decreased. My second hypothesis was partially rejected because the bacteria immobilized zinc the most but copper second. My third hypothesis was accepted because the bacteria contained higher levels of the contaminants than the water samples. My results may aid groups like the EPA that are looking for natural means of cleaning up contaminated water. I plan to test factors that may affect the bacteria's ability to immobilize contaminants and methods for removing the bacteria from the environment.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV033
COMPARATIVE ASSESSMENT OF IN VITRO GROWTH OF PERKINSUS SPECIES
Kiran Jay Harding
River Hill High School, Clarksville, MD, USA

The in vitro growth profiles of two Perkinsus species, P. andrewsi and Perkinsus species M5 (PspM5), and their responses to selected culture conditions were compared to those published for P. marinus. Sampled on a time course, using O.D.600nm measurements and direct cell counts by hemocytometer with high correlation between the two methods, it was observed that unlike P. marinus growth curves, in which cell densities level off after 12 days, both P. andrewsi and PspM5 grew in a multiphasic pattern, with no plateau after 37 days. Unlike P. marinus, both P. andrewsi and PspM5 sporulate spontaneously in vitro, and current year's data from morphotypes in culture assessments suggest that the multiphasic profiles observed represent overlapping growth curves of trophozoites generated by released zoospores. Because pH changes in the culture medium were observed between growth "phases", however, an alternative explanation is that, multiphasic growth may constitute a response to environmental stress. Thus, growth in a range of salinities and pHs was studied. Salinities near 12ppt resulted in optimal growth. Between pH 6.6 and 7.6 growth was enhanced, whereas at 5.6 growth was inhibited. This study may provide further understanding of how Perkinsus species proliferate within the host, and respond to environmental and host stressors.

2005 - EV034
THE EFFECT OF SOIL TEXTURE ON THE ADSORPTION OF ESCHERICHIA COLI
Jonathan Edward Chester
The Peddie School, Highstown NJ, USA

Escherichia Coli (E.coli) are the chief constituent of fecal coliform, which are specific indicators of microbial pollution of water. In order to prevent contamination of public drinking and recreational waters, the transport characteristics of E.coli through soil must be determined. The objective of this study was to examine the effect of soil texture and E.coli concentration on the percentage of E.coli adsorption to soil particles. Two soil samples different in texture were exposed to subsequent dilutions of lower concentration stock solution, and another two soil samples (also different in texture) to subsequent dilutions of highly concentrated stock solution. Concentrations of E.coli in both stock and supernatant solutions were determined through subsequent dilutions, plating, and colony counts. The hydrometer method was used to analyze the soil texture. The two soil samples exposed to lower concentration stock solution showed 99.6% adsorption for the soil with 36% clay, and 86.8% adsorption for the soil with 11.6% clay. This could be explained by the larger total surface area of clay particles. The two soil samples exposed to stock solution with lower concentration showed 99.4% and 99.2% adsorption even though the clay content was 7.7% and 25.8%. This bacterial adsorption to soil particles is no longer dependent on the texture of the soil due to possible saturation or formation of bacterial conglomerates. Statistical comparison confirmed significant difference of adsorption for lower concentration stock solution and no significant difference for higher concentration of stock solution.

2005 - EV035

CONTAMINATION OF PROXIMATE WELLS IN THE PIEDMONT REGION

Afton Kerry Vechery
Glenelg High School, Glenelg Maryland, United States of America

is no city water around here! WesterHoward County homes are served by over 13,000 wells drilled into the fractured bedrock of the Piedmont region. Fractures in the bedrock feed wells their water, but since no natural filtration occurs in fractured bedrock, a fracture connecting wells could transmit contaminated water. This is a community concern, because contaminants in the water supply can present serious public health risks. It is hypothesized that if a contaminated well is found in fractured bedrock, wells in close proximity will have a higher risk of being contaminated. Sixty-five samples were taken from mixed (1-5 acre) and cluster (1 acre) housing developments. All were tested for pH, nitrates/nitrites, and bacteria, including E.coli and coliform. Distances between wells were measured in the largest development (Subdivision One) and were then compared to the bacteria (including coliform and E.coli) nitrate and pH levels. Wells in closer proximity to a contaminated well were found to have higher levels of bacterial contamination. Wells with no contamination had no correlation with proximate well bacterial counts. It is concluded that wells in close proximity should be monitored closely, and results from well testing should be made available to neighbors through government health agencies. Meetings were held with the Department of Environmental Health and with a Maryland state legislator who has pledged to further investigate the conclusions of this study.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh
Award of \$500 - National Ground Water Association

2005 - EV036

STORMWATER DRAINAGE SYSTEMS

Kacee Jo Bootsma
Sunnyside High School, Sunnyside, Washington, United States of America

Objectives: To determine how drainage systems affect water flow on simulated road surfaces. To determine how these drainage systems affect water clarity, deicer and fertilizer runoff. Methods: Simulated road designs were constructed and the flow rates were calculated. Water from the drain and the road design boundary were collected and filtered. Recovered sediments were dried and weighed. Water samples were spectrophotometrically tested for clarity as well as the algal growth from the fertilizer samples. Specific gravity determined the amount of magnesium chloride present after the run-off. Results: The depressed kerb, depressed gutter and combination gutter inlet reduced the flow rate the most in all solutions. For depressed surfaces, more soil was collected from the bottom of the drains than the road design boundary. For the others there was more soil collected at road design end. The banked and screen gutter had the clearest water. The banked gutter inlet had the least amount of salt. Algal growth increased the most when fertilizers ran through the square lattice paver. Conclusion: The depressed kerb, depressed gutter and combination gutter inlet reduced the flow rate the most with all of the solutions. Overall the banked gutter and the screen gutter had the best water clarity compared to the rest of the designs. The banked gutter had the least amount of salt present. The fertilizer increased the algae growth. The greatest increase occurred in the square lattice paver design. Combination gutter inlet had the least amount of algal growth.

2005 - EV037

AUTOMOBILE POLLUTION: HIGH MILEAGE VS. LOW MILEAGE

Randi Jo Riegel
Reserve High School, Reserve NM, USA

Do the effects of automobile pollution differ in more or less efficient vehicles? I decided to do this project because I had been reading about global warming and the green house effect. I became interested in the difference between pollution from high mileage versus low mileage cars, so I decided to conduct an experiment. I created a device that circulated exhaust from a vehicle into several jars of duckweed plants (Lemna sp.). Duckweed plants are small water plants that reproduce by budding. I circulated exhaust from one high mileage car and one low mileage car into 15 different jars of duckweed. I then observed the mortality rates of the duckweed over a ten-day period. Of the 225 original plants, 18% died. More than half of the dead plants were found in the jars exposed to low mileage pollution. According to my results there appears to be a greater toxicity to duckweed plants from low mileage car exhaust versus high mileage car exhaust. Although all pollution is bad for the environment, pollution from low mileage vehicles is definitely much worse than pollution from high mileage vehicles. To continue my experiment, I would test a greater variety of both low mileage and high mileage vehicles, I would extend the experiment for a longer period of time, and I would use statistics in my analysis.

2005 - EV038

ONE "MITE"Y MISSION: COMPENSATION SUPPRESSION OF CONVULVULUS ARVENSIS IMPLEMENTING HOST -SPECIFIC ACERIA MALHERBAE.

Kaitlyn Jeanne Lingus
Branson High School, Branson, CO, United States

A. How can I control Field Bindweed using biological methods?
B. Aged Plants
1) 2 Plants/Aged Infested
2) Count Stems, measure length of stems, Record Data
3) Record change in data bi-weekly
4) Keep fluorescent lamp on plants during entire experiment
5) Record seed count on final day
Seedlings
1) 20 tubes w/ non-infested bindweed seedlings w/ 3 seeds each
2) 20 tubes w/ infested bindweed seedlings w/ 3 seeds each
3) Keep infested away from non-infested to eliminate infested of control
4) Count stems, measure length of stems, Record data
5) Record change in data bi-weekly
6) Keep fluorescent lamp on plants during entire experiment

Record seed Count on final day
C. 20% Reduction in stem count. 30% Reduction in stem length. No seeds were produced.
D. The hypotheis was supported. For intensifying this project data will be taken during the 2005 growing season. Aceria malherbae will be infested in several land plots to observe and record thier effects.

2005 - EV039
FRESHWATER, ROAD SALT, & SPINELESS CREATURES

Eric Lee Keeling
La Veta High School, La Veta, Colorado, United States

This project was designed to test the short and long-term effects of road salts on Daphnia. Road salts enter freshwater through direct and indirect means. Daphnia are common crustaceans found in most freshwater systems.
Methodology was based on guidelines set forth in Standard Methods for the Examination of Water and Wastewater. This project consisted of two sets of tests: an acute (72-hour) survival test and a chronic (21-day) test to measure reproduction. In the acute test, Daphnia magna were exposed to salt/freshwater solutions in a logarithmic scale, 0 to 1000mg/l. Each solution was replicated three times. Six Daphnia were added to each sample. Water chemistry tests were conducted daily to monitor water quality. Number of live organisms per solution was tallied daily. Parameters for salt dilutions in the chronic test were determined by acute test results and research findings for salt loads found in freshwater. Chronic test dilutions ranged from 0 to 600mg/l road salt. Eight Daphnia were added to each test sample. Each solution was replicated three times. The number of live organisms in each sample was recorded daily. Water chemistry tests were run every five days to monitor water quality.
Water tests indicated road salt does have an effect on water quality. In the acute test, D. magna survival was best in 10mg/l and lowest in the 1,000mg/l solution. In the chronic test, 600mg/l had the highest birth rate. These results would be useful in identifying environmental risks associated with road salt application.

2005 - EV040
POLLUTION SOLUTION-A STUDY OF THE CHEMICALS IN THE DETROIT RIVER

Dilara Kadriye Uskup
Renaissance College Prep High School, Detroit, MI USA

The investigation Pollution Solution is a project testing the chemicals in the Detroit River. It's purpose is to determine which chemicals, natural and un-natural, exist in the body of water and the precise or exact amounts. This investigation also compares the time of year and weather to understand its effect on water quality.
To collect test samples, a water extractor was created and used. Samples were collected from eight points along the riverfront. Various testing kits and other equipment were used to determine river content, ppm and other water quality information such as phosphorus, silica, water hardness etc.
The experimental results showed that the area of the river which has the most industrial activity has the lowest water quality. Results also juxtaposed the Canadian side of the River to that of the USA. The experiment dis-proved previous thoughts of the river being very poisonous, although it is not suitable for drinking. Thus, finding a solution for the problem of pollution!

2005 - EV041
BULRUSH BURNING AS A SOLIDS REMOVAL MANAGEMENT TECHNIQUE A STUDY OF RUBY LAKE NATIONAL WILDLIFE REFUGE YEAR THREE

Lindsay Rose Gilbertson
Elko High School, Elko NV, USA

The purpose of my project was to investigate why Ruby Lake National Wildlife Refuge is a freshwater system since many inland lakes in the Great Basin with no outlets are saline. The first and second years of the project determined water sources feeding the lake contained dissolved solids (calcium and magnesium carbonates) and they can be removed from a body of water by mechanical removal and by precipitation out of solution caused by subsequent cooling and warming cycles. This year, I confirmed last year's work concerning carbonate precipitation with water from Ruby Lake instead of lab-made solutions along with different technology for carbonate testing. I then looked for solids removal mechanisms that could be controlled. I used a dilute sulfuric acid solution to dissolve calcium and chloride ions contained in plant tissue of samples of bulrush from Ruby Lake and confirmed the presence of these ions. I looked for a way this information could be used as a management technique by burning samples of bulrush, dissolving the ashes into a dilute sulfuric acid solution, and testing for calcium and chloride ions to confirm their presence in the ash, which could be removed from the system when it is carried away mechanically after the fire. I used estimates of the total amount of bulrush to estimate amounts of calcium and chloride contained in the system at Ruby Lake. I confirmed the presence of calcium and chloride ions in bulrush and found burning could be a management technique used to remove them.

2005 - EV042
TREELESS PAPER PART TWO

Katherine Karie Denham
Spring Creek High School, Spring Creek, NV 89815

As shown in the previous year of experimentation it has been proven that it is possible to create a sheet of paper using Sagebrush, Rabbit Brush, Crescent wheat and recycled paper. But from the results of last test the better question would have been can I create a "decent" sheet of paper?
The purpose of this year's continuation is to better improve existing Shabit paper by altering the plant ratios of plants to recycled paper. My Hypothesis was: "If a mixture of local plants (Sagebrush, Rabbit brush, Crescent Wheat) is mixed with recycled paper, providing different ratios between the two, can a more flexible form of paper be created?"
The procedure is similar, yet unique, to last years including the six basic steps: fermenting, cooking, draining, grinding/mixing, dipping, and drying. However in some of the experiments the cooking stage has been taken out and the fibers have been broken down by further machine grinding. Each step has also been perfected so that the new paper formed is more consistent.
Another vital addition to Part two of this project is the

testing, which now includes flexibility. Strength, starting product ratios and weight is also still being tested. With these tests the paper can be more fairly judged to decide which piece is the ultimate piece of Shabit paper.

2005 - EV043

A COMPARISON OF HERBS AND BTI AS LARVICIDES ON CULEX PIPPIENS AND THEIR EFFECT ON DAPHNIA MAGNA-YEAR 2

Abigail Marie Hines
Orchard Day School, Fort Wayne,Indiana, USA

to programs are failing because of increasing insecticide resistance. Environmentally safe alternatives are needed. One natural larvicide is Bacillus thuringiensis israelensis (Bti). However, Bti has caused effects on the food web.

 The purpose was to find a natural larvicide/emulsifier safe for aquatic environments. It was hypothesized that controlling pH of herbal oils between 7.0-8.0 would aid in killing larvae, but not Daphnia.

 Infrared spectra of five emulsifiers were compared to Ezmulse. Dimethylformamide was chosen due to differing composition from Ezmulse, and being least harmful to Daphnia.

 A range-finding using emulsifier and oils (Yarrow, Wormwood, Basil, Patchouli, Orange, Cinnamon, Tomato Seed, Neem/Tagetes) at pH 7.0 and 8.0 was performed on larvae and Daphnia, using serial dilutions from 3.125ppm-1000ppm.

 Cinnamon, Patchouli and Orange were most lethal. A definitive bioassay using these oils with 30 larvae and Daphnia was performed using 125ppm-1000ppm at time intervals: 15 min to 96hrs. LD50 and LD90 for 48hrs were calculated using probit analyses when mortality data was varied enough. Order of toxicity of oils against mosquitoes for LD90: Cinnamon 7.56>Cinnamon 8.0, Orange 7.01, and Patchouli 7.0>Patchouli 8.0 > Orange 8.0. Order of toxicity against Daphnia for LD90: Patchouli 7.0, Patchouli 8.0, and Cinnamon 7.56>Cinnamon 8.0>Orange 8.0>Orange 7.01. Oils were toxic to larvae, but more to Daphnia. Higher concentrations of oils lowered survivorship of Daphnia. Bti killed all larvae in 24hrs without harming Daphnia. pH did affect toxicity of oils to Daphnia.

 Continued diligence is needed to find environmentally safe larvicides to sustain our wetlands and rivers.

Awards won at the 2005 ISEF

First Award of \$500 - American Society of Pharmacognosy
Second Award of \$1,500 - U.S. Air Force

2005 - EV044

EFFECTS OF WALLS AND WALL ARCHITECTURE ON WIND SPEED FOR ENERGY GENERATING TURBINES

Matthew George Czapar
Rochester High School, Rochester Illinois, United States of America

This experiment was conducted to test different ways to increase wind speeds and therefore increase the energy that could be produced by windmills. While windmills are a valuable way to generate energy, in many areas the wind is not strong enough to create enough energy to justify a windmill. It was hypothesized that angled walls on either side of a windmill would increase the wind speed to that windmill. It was then further hypothesized that walls with the smallest angle would yield the greatest wind speed.

 To test this, three different angled walls were constructed. The angles 90°, 60°, and 30° were chosen to represent sharp, medium, and gradual angles, respectively. Each of the walls was placed in a wind tunnel, and the wind speed was measured behind the mouth of the angle.

 The results of the experiment were mixed. The walls increased the speed of the wind. The 45° walls more than doubled the energy available in the wind at all speeds. However, the more severe the angle became, the more the wind speed increased. This was counter to what was predicted by the research and the experts with whom I spoke. It was suggested after testing that the duct-like nature of the wind tunnel had affected the air pressure, which affects the wind speed through the area. Still, in a wind tunnel, the trend was very clear at all wind speeds, that the sharper the angle, the greater the increase in wind speed.

2005 - EV045

IDENTIFICATION OF A BENTHIC MICROBE UTILIZING BIOREMEDIATION AND MFCs

Abigail Frances Groff
Conestoga Valley High School, Lancaster, Pennsylvania, United States

The goal of this experiment was to create a functioning Microbial Fuel Cell (MFC), and then, by observing characteristics of a microbe in the anode, conclude with a supposed general identification of the microbe.

It has been hypothesized that such observations will aid in creating ideal conditions for the microbe, and thus increase voltage output.

MFCs were constructed and modified throughout experimentation. The anodes were inoculated with benthos from Mill Creek, a lower order stream located in southeastern Pennsylvania. During three trials, condition variables and voltage production were tested, and qualitative observations were made. Voltage was also measured over resistance to prove that current was present even though quantitatively minuscule.

In each trial, a dark streak of matter occurred near the location of the electrode in the anode chamber. This streak indicated the presence of a mediatorless microbe, and since the streak did not extend to the

surface, it also suggested the presence of an anaerobic organism. A red precipitate generated during trial two suggested that the microbe is a dissimilatory iron reducer capable of accepting acetate as an electron donor. The health of the culture was determined by observing the voltage changes in the MFCs.

These results strongly suggest that the microbe is a member of the Geobacteraceae family, known for their hydrocarbon oxidizing, and metal reducing tendencies. Future studies to definitively identify the

microbe responsible for energy production will allow for the design of an optimally efficient bioremediatory system.

2005 - EV046

EFFECTS OF PAPER SLUDGE ON EFFLUENT FROM RECLAIMED SURFACE MINE SITES

Jared Benjamin Steed

Buckeye Valley High School

Paper sludge, a by-product of paper fibers and CaCO₄ from the Kraft manufacturing process, has been show to increase buffering capacity (Steed, 2004) on reclaimed Gilpin soils without adverse effects at rates up to 450 dry tons/acre (T/A). Over Ohio EPA concerns of surface water contamination, sludge producers are currently limited to applying 300 dry tons of sludge per acre. Increased application rate would divert more sludge from landfills and increase acid neutralizing potential of soil. Un-glaciated southern Ohio has mostly Upshur and Gilpin soils.

Four replicates of sludge additions of 0, 300 and 450 T/A were made to 7190 cm³ soil and placed in a controlled environment. Each pot received 2000 ml of purified water twice weekly. Water adsorption (WA), pH, total solids (TS) and electrical conductivity (EC) were recorded from collected effluent. Effluent was tested eight weeks after initiation for chemical oxygen demand (COD) with EPA method 410.4 using a spectrophotometer. Water holding capacity (WHC) was determined at weeks 0, 4 and 8. Initial and final acid neutralization potential (ANP) was determined. The data from each test was analyzed for significance using analyses of variances. A p-value that was less than five hundredths was considered significant. Paper sludge addition at either rate significantly lowered the effluent's TS and pH while significantly increased WA, WHC, ANP, and EC. The sludge also was found to have no significant effect on the COD. Even though the EC and COD rates were raised they were found to be within published acceptable rates.

Awards won at the 2005 ISEF

Scholarship Award of \$10,000 per year, renewable annually - Florida Institute of Technology

2005 - EV047

LICHENS AND BIOMONITORING: THE EFFECTS OF VEHICLE EMISSIONS

Drew Elijah Kamper

Kingston High, Cadet, Missouri, U.S.

For a long time, people have been focused on the industrial revolution. It has helped produce more and more goods in shorter amounts of time. But it has also been destroying the environment. Gaseous emissions from machinery have been decaying the land, as well as the health of all living organisms world-wide. St. Louis, Missouri alone spends over \$2.5 million in medical expenses annually, due to atmospheric pollution.

Lichens are a major component of biological diversity. Since lichens soak up everything that comes their way, including air pollution, they may be used to monitor ecosystem continuity. I performed a fumigation study to determine the effects of vehicle emissions on the photosynthesis, reproduction and structural growth of lichen. I chose to study Flavoparmelia Caperata, Punctellia reducta and Physcia milligrana (all collected from a natural environment), to support my findings. Based on my research, I have concluded that vehicular emissions cause the majority of lichen death.

In my future studies, I would like to conduct a DNA analysis of lichen, chosen from environments with various emissions. I also want to develop a scientific formula to determine when vehicular emissions are becoming a problem. Another part of that study would be to create a bioindicator chart that could be used in monitoring the effects of air pollution. I strongly encourage others to perform base studies on measuring air quality in order to make society more aware of the detrimental cause of the so called new and improved machinery revolution.

2005 - EV048

MONITORING WATER'S HEALTH

Larkin Elizabeth Hottel

James Wood High School, Winchester, Virginia, United States of America

This longitudinal study has been conducted over the past four years. During the first three years, no significant changes were recorded in the levels of dissolved oxygen, pH, phosphate, and nitrate. Based on this, two more tests, ammonia and iron, were added, and the water sources were modified, in the hope of finding a change in the water's health. The hypothesis is that there will be very little variance in the levels over a short or long period of time. The problem is whether or not these levels are healthy, and if the water sources are positive contributors to the watershed.

The current four bodies of water tested are: a creek after the sources merge, another creek, a spring pool directly from the ground, and a sinkhole. Bi-weekly water samples are collected from the water sources and are immediately tested for levels of dissolved oxygen, pH, phosphate, nitrate, ammonia, and iron. These levels are recorded, along with the rainfall for the test period and temperature at time of collection.

Over the course of the study, testing showed changes due to the amount of actual rainfall. Some examples of changes due to seasonal use of the land include: fertilizing in the spring that affects phosphate, iron and ammonia levels; raising livestock during the summer and fall that would affect nitrate and ammonia levels; and putting lime on the fields as needed in the winter which affects pH and iron levels as run-off from the rain enters the water sources.

2005 - EV049

"BOARDS AND BRANCHES" A MULTIVARIABLE STUDY OF SNOW INTERCEPTION

Erica Elizabeth David

Pinedale High School, Pinedale, Wyoming, USA

What are effects of snow fences and conifer branches on interception of snow? Intercepted snow is potential water supply, and therefore a vital consideration during drought.

The project included two experiments. The first experiment used one-meter tall snow fences to test effects of changing horizontal board thickness on wind patterns and snow drift geometry, and to validate results of previous small scale modeling. The second experiment dried Lodgepole Pine and Subalpine Fir conifer branches to varying wood moisture contents and measured the force needed to bend branches at subzero temperatures, which affects snow retention.

All snow fence design hypotheses were supported. As board thickness increased, wind speed decreased further upwind, drift apex occurred further upwind, and total volume increased. Snow fences tested in field conditions did create similar relationships between wind patterns and snow drift geometry to those of small scale models tested in a wind tunnel, thus validating results of previous models.

The fir data supported all branch

resistance hypotheses, because as moisture content decreased, branch resistance increased, and sapwood temperature did fluctuate less. Yet, the pine had mixed results, which supported differences between the genuses. Drier, more resistant fir trees intercept and expose more snow to sublimation, further increasing their drought condition. Pines, more flexible when drier, unload more snow into ground snowpack to be retained for water supply. These results will help scientists use “Boards and Branches”, snow fences and trees, to understand snow interception for better use of winter’s snow as water supply during drought.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2005 - EV050
ENVIRONMENTALISM AND LEISURE: AN ECOLOGICAL TRAIL AT SCHOOL SURROUDINGS

Bibiana Maite Petry
Escola Técnica Liberato Salzano Vieira da Cunha - Novo Hamburgo/ RS - Brasil

Environmental degradation isn't caused only by man, but also by the lack of species diversity in a determined area. The presence of native trees is extremely important to correct this environmental imbalance. The Fundação Liberato (Liberato Foundation) is situated in a large area, characterized not only by spaces where there's diversity of vegetal species, but also by regions surrounded by eucalyptus, where trees were planted during this project development. An ecological footpath was created in this newly native-trees planted area, which goal is to create a space where environmental education involving the school community might be practiced, as well as preserving native woods in an urban belt, making this a perfect spot where birds from irregular captivities might be freed. In the ecological footpath, all the trees were identified with their respective names, both popular and scientific. Each species has an identification number, totaling about 40 species. Beyond the footpath's construction, a manual was elaborated, containing information, pictures, and description of every species found in the area. With this project, it was concluded that building an ecological footpath in a recovery process area in Fundação Liberato is viable, intended to bring leisure and proportionate direct contact with Brazilian native vegetation. Besides, the manual with information about identification, and description concerning the existent species in the area is becoming to that school community a permanent material for support and research. It was also concluded that despite the considerable number of trees in the area, those are not sufficiently developed yet to feed off birds released from illegal captivities, preventing the area, at this present moment, to become a discharge place.

2005 - EV051
THE EFFECTS OF FREEWAY POLLUTION

Darryl LeAndrew White
Campaigna Academy Charter School, Gary, IN

people don't even know that living near a freeway for a long period of time can damage their bodies. Although the very young and old are the most at risk by pollution, it also effects everyone in between. I tested the air that I collected near my home that is located a few yards from a large freeway. The polluted air was pumped from outside my home through water. I also collected air from a suburban site near my school. I collected particulates from the air with squares of contact paper and counted the particles from each site. I found that the air near my home turned the water a brown color while the water from school remained clear. I also found that there were significantly more particles in the air collected on the contact paper squares. I tested the pollutants on radish seeds and yeast. I did not find a large difference in the germination rates of radishes but there was some difference in their patterns of growth. I hope to draw attention to the health hazards of living near a large freeway. Young children, pregnant women and their unborn infants, and older adults may be able to find alternate places to live if they are made aware of the hazards. The hazards presented by the pollution are too serious to ignore.

2005 - EV052
COBUS CREEK RESTORATION: PERIPHYTON AND MACROINVERTEBRATES AS LOTIC INDICATORS

Auna Rae Badke
Marian High School, Mishawaka IN, United States

Stream restoration attemptst to reverse the degradation of streams and their ecosystems. Cobus Creek is a third-order tributary of the St. Joseph River (Lake Michigan drainage). It is one of the few ground-fed, cool-water streams in Northern Indiana with reproducing trout populations. Sedimentation and habitat loss have reduced macroinvertebrate densities, and suitable spawning habitat for cool-water fish. The creek was restored in 2004 by reconstruction of several meanders, each about 300 m long. The restoration design incorporated biological, hydrological, and geomorphic principles to address high sediment loads, and degraded fish habitat. Rock, wood and coniferous tree trunks were added along the stream channel to stabilize eroded banks and to narrow the channel. Riffle sequences and pools were constructed, and banks were stabilized and revegetated. Habitat, macroinvertebrates (density and diversity), periphyton (chlorophyll a), and CPOM (course particulate organic matter) retention were measured before and after restoration in a restored reach, and compared to a similar natural reach, as well as a dissimilar unrestored upstream reach. Within six months after restoration, major trophic groups (macroinvertebrates and periphyton) recovered to, or exceeded, levels in the natural reach. Biotic recovery was relatively rapid, but because of continued sedimentation at a watershed scale, long-term persistence is uncertain. This study documents the early stages of recovery of the creek, and demonstrates the need to assess a suite of parameters for a thorough understanding of stream responses to restoration. Long-term assessments of stream restorations can improve knowledge and management of stream ecosystems.

2005 - EV052
COBUS CREEK RESTORATION: PERIPHYTON AND MACROINVERTEBRATES AS LOTIC INDICATORS

Auna Rae Badke
Marian High School, Mishawaka, IN, U.S.A.

Cobus Creek is a groundwater-fed, cool-water stream in northern Indiana with reproducing trout populations. Sedimentation and habitat loss have reduced macroinvertebrate densities, and suitable spawning habitat. In February 2004, to reverse the degradation of the stream and its ecosystems, reconstruction began on several 300 meter meanders, incorporating biological, hydrological, and geomorphic principles to address high sediment loads, and degraded fish habitat. Rock, wood and coniferous tree trunks were added along the stream channel to stabilize eroded banks, and to narrow the channel. For this study, three areas of the creek were identified for evaluation. Habitat, macroinvertebrates (density and diversity), periphyton (chlorophyll a), and CPOM (coarse particulate organic matter) retention were measured prior to, and for one year after restoration in a reconstructed reach, and compared to a similar natural reach, as well as a dissimilar unrestored upstream reach. Organic matter retention is essential for the nutrition and colonization of algae and macroinvertebrates, and was evaluated to determine if the retention capacity of the stream was improved by the restoration. Within six months after restoration, major trophic groups (macroinvertebrates and periphyton) recovered to, or exceeded, levels in the natural reach. The change in hydraulics and physical properties of the reconstructed reach improved the organic retention of this reach, and was a factor in the improvement of macroinvertebrate density and diversity. This study documents the early stages of recovery of the creek, and demonstrates the need to assess a suite of parameters for a thorough understanding of stream responses to restoration.

2005 - EV053
TOXINS OF THE ROUND GOBY: PHASE I A STUDY ON THE PRESENCE OF MERCURY IN THE FLESH OF THE ROUND GOBY

Amanda Marie Bennett
Marysville High School, Marysville, Michigan, United States

This project is a study on the presence of mercury in the Round Goby, an invasive fish to the Great Lakes. It was discovered that there was a possible correlation between population levels of Round Gobies and mercury toxicity of predatory Great Lakes fish. The first step in developing this correlation is proving the presence of mercury in the Round Goby. Eight 10mL liquid samples of Round Goby flesh were prepared at approx. 34°F, preventing mercury evaporation. A black sample of fecal flush from 7 fish (+1 more) was run to determine the amount of mercury being secreted. The samples were run through a combustion spectrometer to determine toxicity levels of mercury. They were run against a standard test solution of 1ppm at first. This proved to be too strong, so they were run against a 1ppb standard. It was predicted that the largest of 7 fish contained the most mercury, the smallest would contain the least, and the black sample a median amount. After running a series of tests, the largest Goby (4.7") resulted with the most mercury at .7207ppb. The smallest Goby contained a zero value of mercury. Its minimum and maximum spectrum points were below the levels of water, therefore, they were zero. The black sample did not come out as the median sample, but a lower mercury concentration of .5423ppb mercury. Comparing growth rates of Round Goby population to the growth rates of mercury concentration in Great Lakes sport fishes is completely new. The tests revealed a presence of mercury in all but one of the fish tested. Although the numbers seem exceptionally low, mercury is bioaccumulative. As it is consumed by larger fish, its concentration worsens making it dangerous for humans to consume. This study can help identify the source of high mercury concentrations in Great Lakes fish.

2005 - EV054
EFFECTS OF PINUS MONOPHYLLA AND JUNIPERUS OSTEOSPERMA EXPANSION ON THE COMPOSITION OF SAGEBRUSH PLANT COMMUNITIES IN EASTERN NEVADA

Owen William Baughman
White Pine High School, Ely Nevada, United States of America

Great Basin Ecosystems are losing important components as native trees expand. Two tree species, 'Single-leaf Pinyon' and 'Utah Juniper', together, have been known to expand out of their historical ranges into other plant communities. It is known that this expansion changes the composition of the plant community into which it expands. I investigated these changes in a sagebrush plant community using changes in the percent cover of three plant categories (forb, grass, and shrub) as Pinyon and Juniper cover increased. Data were collected at a study site, located about 13 miles northwest of Ely, Nevada, using point-intercept sampling procedures. Microsoft Excel was used to process the data. The following results were observed: a) Shrub species percent cover appeared to decrease steadily as Pinyon and Juniper cover increased. b) Grass species appeared to experience a very moderate decrease in percent cover as Pinyon and Juniper cover increased. This decreasing trend was weak and not supported by the mathematical procedures used. c) Data compiled for forb species were not adequate enough to show a trend relating to Pinyon and Juniper expansion. In summary: a) Shrub species experienced the greatest loss in cover as Pinyon and Juniper cover increased. For every 1% increase in Pinyon and Juniper cover, a 0.64% decrease in shrub cover was observed. b) Grass cover appeared to decrease slightly but this decrease is not supported mathematically. c) Forb cover was too small and random to show any trends. d) None of the species categories increased their cover as Pinyon and Juniper cover increased.

2005 - EV055
ACID MINE DRAINAGE REMEDIATION TECHNIQUES & THEIR EFFECTIVE REDUCTION IN CONCENTRATIONS OF LEAD, CADMIUM, CHROMIUM, ZINC AND PH

Aaron M. Ritter
Bedford-North Lawrence High School, Bedford, Indiana 47421 USA

Acid Mine Drainage (AMD) is the number one problem facing the mining industry today. Past methods of reclamation have been almost impossible, however, as costs have been daunting and the types of effective treatments have been unavailable. Low pH, high metal concentrations, waste rock, and sediments characterize AMD waters. These are harmful to aquatic life, may cause streams to be barren, and make water unfit for human consumption. This project investigated different methods of remediation for use in Indiana coals. Tests were made with the following materials, either alone or in combination:

(a)PIMS Apatite II, a new patented substance based on the mineral apatite,(b)ZVI(zerovalent iron),(c) CaSO4 (d)CaCO3 (e)CCB-Coal Combustion Byproduct. Spoil samples were obtained from two locations above Augusta Lake in Pike County, Indiana, where previous mining had left wastes and highwall lakes. The samples were loaded into a student-built square plexiglas column holding 12200 cm^3. Materials were tested, effluents drained, and analyzed by GC/MS. The control showed very low levels of heavy metals, most likely due to long-time leaching. The remediation materials showed a notable effect. Apatite II, Apatite with limestone, and apatite with ZVI all had notable effects on metal concentrations. Zn, having the highest water and sediment concentrations, was best removed by Apatite +Fe or limestone +Fe. Apatite was the most effective on Cd. Chromium levels were already low, with Apatite less effective than Fe. CCB material was the most effective on Pb, followed by CaSO4 or Fe, then Apatite. CaSO4 was the most effective on pH, but since pH was already in the 6-7 range, slight differences might be inconclusive. Several materials did prove effective and the phosphate-induced metal stabilization process is promising. Permeable reactive barriers with these may be very effective.

2005 - EV056
EFFECTS OF TOXIC RIPARIAN WEEDS ON THE SURVIVAL OF AQUATIC INVERTEBRATES

David Colin Conway Llewellyn
Great Lakes College, Senior Campus, Tuncurry, NSW, Australia

In order to assess the toxicity of introduced weeds on aquatic invertebrates, the survival of four species of aquatic invertebrates was assessed in the laboratory in the presence of three weeds that occur along the banks of rivers and ponds in New South Wales, Australia. Damsel Fly nymphs, Mud Eyes, Mayfly nymphs and Backswimmers were placed in petri dishes with minced leaves from either Crofton Weed, Camphor Laurel or Privet (weeds), Black Wattle (native comparison) or Derris dust (known ichthyocide comparison), or no plant material (control). The toxicity of the weeds was determined by the lifespan of the invertebrates exposed to them.

Damsel Fly nymphs were adversely affected by Camphor Laurel, Crofton Weed and Derris dust, but not the other treatments. Mud Eyes were most affected by Black Wattle and Crofton Weed, though results were variable and inconclusive. Mayfly nymphs were most affected by Crofton Weed and Derris dust. Backswimmers were killed very quickly by all three weeds and Derris dust.

These results show differential toxic effects of the three weeds on different invertebrates, suggesting that the distribution and abundance of aquatic invertebrates may be significantly influenced by the presence of toxic weeds along the waterway. These results add to the understanding of negative impacts of bank disturbance which leads to weed infestation of stream banks.

Awards won at the 2005 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh
Award of \$500 - North American Benthological Society

2005 - EV057
MULTI-TIERED WETLANDS A TECHNIQUE FOR IMPROVING THE EFFICIENCY OF ARTIFICIAL WETLANDS

Andrew James Stewart
Karabar Distance Education Centre, Queanbeyan, New South Wales, Australia

nts from human developments have impacted on our natural wetlands ability to keep waterways pollutant free. These developments have increased nutrient concentrations within waterways causing eutrophication and subsequently toxic blooms of algae. Artificial wetlands provide a sustainable method of preventing eutrophication.

Central to wetland design is the study of the interaction between nutrients and the plants within them. This research focused on the ability of Carex appressa to reduce concentrations of nutrients to World Health Organisation standards.

This continuation is a pilot study aimed at confirming previous findings to a 'real world' two tiered wetland. Data was obtained using an automated, computer-interfaced apparatus to take readings continuously. This apparatus utilised electrical conductivity to measure the total concentration and ion selective electrodes to measure individual ionic concentrations. Research is also underway to determine the destination of nutrients within the wetland ecosystem.

The removal of nitrogen in tiered wetlands has been found to follow an exponential decay function. In the first wetland, the concentration reaches a limiting value from where the reduction of nitrogen slows. It was found that wetlands could be conditioned so that a second wetland resumes a high rate of reduction that returns to the exponential curve. A solution at a concentration of 420 mg/L ammonium nitrate reached a limiting concentration of 135 mg/L in approx. 5.2 days. Transferring the solution to a second wetland, a limit is reached at 50 mg/L in a further 3.5 days. This is a significant improvement over treating effluent in a single wetland. Multi-Tiered Wetlands assist sustainable development.

Awards won at the 2005 ISEF
Second Award of \$300 and a matching \$300 award to the winner's school - Bureau of Reclamation/U.S. Department of the Interior
Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh
Honorable Mention Award Certificates for International students and students under the age of 16 - National Aeronautics and Space Administration

2005 - EV058
THE IMPACT OF ANTIBIOTIC USE ON THE AQUEOUS ENVIRONMENT OF SCOTT COUNTY

Hannah Marie Schneider
Belle Plaine High School, Belle Plaine Minnesota, U.S.A

Antibiotics in waterways is becoming an emerging issue. The purpose of this project was to find out if the antibiotics Tetracycline and Tylosin are present in Scott County waterways. Testing will show that Tetracycline and Tylosin levels will be present in all waterways. Testing will also show that Tetracycline and Tylosin levels will be lower in the effluent water of the sewage treatment plants compared to the runoff from feedlots. Water samples were collected from the effluent water of 5 sewage treatment plants and runoff from 5 feedlots. Tetracycline and Tylosin ELISA (enzyme-linked immunosorbant assay) tests were done

according to the proper outlined procedure. Testing showed that the hypotheses were partially correct. Tetracycline was found at 7 of the 10 sites. Tetracycline levels were lower in the effluent water of the sewage treatment plants compared to the runoff from feedlots 80% of the time. The greatest concentration of Tetracycline was found at a feedlot in Jordan collected at a nearby ditch. There were no levels of Tylosin found. Even though the levels found in this experiment are low, they still can cause the emergence of antibiotic resistance in the environment and humans. When low levels of antibiotics show up in the environment it can cause the emergence of antibiotic resistant bacteria in soil and water. These bacteria can share their plasmids to humans and animal pathogens, which would also make them resistant. Overall most of the antibiotic pollution in our waterways is caused by agricultural pollution.

2005 - EV059

DO LIVESTOCKS ANTIBIOTICS AFFECT SOIL BACTERIA? A COMPARISON OF OXYTETRACYCLINE-RESISTANCE IN ORGANIC VERSUS COMMERCIAL CATTLE FARMS

Laura Ann Huppert
Piedmont High School, Piedmont, CA, USA

The purpose of this experiment is to determine how antibiotic use in cattle feedlots affects the soil bacteria of that environment. My hypothesis was that soil bacteria collected from farms using antibiotics would have more resistance to these substances. Four different locations that provided a spectrum of grazing and antibiotic use were compared, including a site that had never been grazed, an organic cattle farm, a commercial cattle farm that spot-used antibiotics, and a cattle company that was a heavy antibiotics user. The soils collected at each site were diluted by a factor of 10 E-5, 10 E-6, and 10 E-7 grams / mL saline solution. Two replicates of each dilution were plated on tryptic soy agar medium, one with the antibiotic oxytetracycline, and the other without antibiotic. Antibiotic resistance was assessed by comparing the number of bacterial colonies on plates with and without antibiotic. Also, organic carbon and soil moisture content were determined for site characterization. After monitoring bacteria growth, it was found that bacteria from the heavy antibiotic-using farm appeared the most resistant to oxytetracycline. The difference in the number of bacterial colonies between the antibiotic-positive and antibiotic-negative plates was relatively small for that site, with 52.2% of bacteria resistant, unlike the large difference in bacteria growth between treatments for the other sites. This is significant because antibiotic resistance could lead to greater difficulties in treating livestock and human bacterial infections.

Awards won at the 2005 ISEF

Scholarship Award of \$5000 per year for four years - Albany College of Pharmacy of Union University
Trip to China to attend the CASTIC - China Association for Science and Technology
Second Award of \$250 - Society of Environmental Toxicology and Chemistry

2005 - EV060

DETERMINATION OF THE ABILITY TO USE PONTEDERIA CORDATA (BLUE BROAD LEAF PICKEREL RUSH) PLANTS AS BIOMONITORS FOR MONITORING TRACE HEAVY METAL CONTAMINANTS IN DRAINAGE CANALS

Elizabeth Anne Lopez
East Jefferson High School, Metairie, LA, USA

This project is a continuation of a project begun in 2003 entitled "Plants with a Purpose, The Role of Phytoremediation on Non-Point Source Glycol and Hydrocarbon Pollution in Jefferson Parish Canal Bottoms." This project identified and proved that pickerelweeds growing in the drainage canal could be used to successfully remove non-point source pollutants. A continuation of that project in 2004 resulted in a second year study that used hexadecane as a tracer to successfully provide evidence that the process of phytoremediation of hydrocarbons was phytotransformation and phytovolatilization. As a continuation of last two year's work; the purpose of this project was to provide evidence that the process of phytoextraction of heavy metal pollutants could also occur. This study investigated the ability of Pontederia cordata (blue broad leaf pickerel rush) to absorb and remove selected heavy metals from a constructed test pond. The pond was maintained in an open air / natural sunlight environment and kept with a one inch water covering. Vegetation for this study was collected from a selected drainage canal site in Jefferson Parish, Louisiana. The pickerelweeds plants were allowed to establish themselves for a two-week period prior to testing. For a period of thirty (30) days the pond was spiked with 15 to 20 milliliter of a spiked heavy metal solution. This project was undertaken to identify if phytoextraction in pickerel weeds could be used to remediate polluted sites and as biomonitors for continuous monitoring of heavy metal pollutants in canal water. The presence of heavy metals in the pickerelweeds was determined through the use of atomic emission spectroscopy based on EPA SW 846 Methods. Portions of different methods were adapted for this project.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV061

PHYTOREMEDIATION OF SULFOLANE, NONYLPHENOL, AND TRICHLOROACETIC ACID AND THEIR ENTRANCE INTO THE HUMAN FOOD CHAIN: PHASE III

Blake Robert Wilde
Fremont High School, Plain City, UT, US

Phytoremediation is the process of remediating contaminants from the biosphere using plants and their associated microorganisms. It is evolving into a cost-effective method for treating polluted groundwater and soil and is being used more frequently as more data becomes available. Understanding the fate of organic contaminants in plants and soils is critical in evaluating the efficiency of the phytoremediatory system, performing risk assessments, and quantifying the relative impact of the plants on natural attenuation. The experiment focuses on identifying the risk of sulfolane, nonylphenol, and trichloroacetic acid (TCAA) to the human food chain through phytoremediation using Raphanus sativus (radish) and Spinacia oleracea (spinach). Raphanus sativus and Spinacia oleracea

plants are spiked with sulfolane, nonylphenol, and trichloroacetic acid solutions. The plants are analyzed using extraction methods and headspace gas chromatography/mass spectrometry (gc/ms). The data indicates that phytoremediation of sulfolane using *Raphanus sativus* and *Spinacia oleracea* stores the contaminant in the leaves. Due to the hydrophilic properties of sulfolane, it is concentrated at higher levels in the area where most transpiration occurs, which is the leaves. The spiking solutions of trichloroacetic acid and nonylphenol are not concentrated enough to provide detectable data. Phytoremediation of sulfolane is a risk to the human food chain.

2005 - EV062

AN INVESTIGATION OF TITANIUM DIOXIDE SUSPENSIONS FOR USE IN A FLOWING CATALYTIC HEAVY METAL REDUCTION APPARATUS

Megan Moulding

Wahlquist Jr. HS, Ogden UT USA

Titanium dioxide, in the presence of ultraviolet light can reduce heavy metal ions, removing them from contaminated waste waters. This study developed an apparatus that allows water to flow through an exposure chamber where titanium dioxide, added to the system, would be exposed to UV light and thus reduce the metal ions. The primary purpose of this study was to investigate the suspension properties of titanium dioxide. The suspension properties were investigated in three studies: a) the settling rate for various concentrations of titanium dioxide; b) the settling rate at various temperatures; and c) the quantities in suspension after flowing through the apparatus over various substrates. Various concentrations of titanium dioxide were prepared using 1.25 g, 2.50 g, 5.00 g, and 10.00 g suspended in 450 mL of water. Four samples of each concentration were agitated to full suspension then allowed to settle. To describe the amount of settling, printed letters of various sizes were placed behind the containers and photographed at various time lapses. The results indicate that settling rate for the smallest particles of titanium dioxide is approximately equal, regardless of initial concentration suggesting that very small amounts could be used in the apparatus, thus reducing waste. The study was repeated with jars cooled to 8 degrees Celsius and similar results were found suggesting no need to keep the apparatus at "room" temperature for optimum suspension. Finally, titanium dioxide (10.00 g/L) was added to the apparatus and flowed over various substrates. The substrates were a) control, no substrate, b) ridged plastic mat, c) rubber grip, d) ridged carpet. Solutions were run through the system for one minute prior to a 450 mL sample being extracted. The system was flushed with 2 liters of water between trials. Samples were allowed to dry to determine amounts remaining in suspension. Results indicate that ridged plastic is likely to capture the most titanium dioxide and allow for reuse.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV063

ALIMENTARY BEHAVIOR OF BELOSTOMA ELONGATUM AND THEIR SANITARY IMPORTANCE.

Antonio de la Cruz Cáceres.

Normal "Juan García de Cossio". San Roque. Corrientes. Argentina.

With the objective of evaluate the feeding behavior of *Belostoma elongatum* (Insecta: Hemipterous) and its influence in the biocontrol of spineless of sanitary interest; adult individuals of this species were fed, under controlled conditions, with *Culex quinquefasciatus* fourth stadium larvae and specimens of *Biomphalaria tenagophila*, which are vectors of illnesses that affect human beings. As alternative preys, *Drepanotrema* sp., *Ampularia* sp., coleopterons, nymphs (naiad) of odonatos and *Hyalella* sp. were offered in different proportions. We registered the consumed specimens and the obtained data were analyzed calculating the alimentary preference index. The results obtained showed that, in all the experiences and independently of the type and density of the alternative food, *B. elongatum* has ingested preys of sanitary importance, suggesting that this species would be an important biocontrol agent. Therefore, *B. elongatum* constitutes an alternative to be considered in the population control of these vectors, especially in temporary water bodies in which these organisms are considerably developed.

2005 - EV064

PHYTOPURIFICATION: A SUSTAINABLE NATURAL SYSTEM FOR THE TREATMENT OF URBAN WASTEWATER

Olivia Reyna

C. B. Tecnológico Industrial y Servicios 165,CP 91500 Coatepec, Veracruz, Mexico

ern times, the development of sustainable technology for treating wastewater is necessary, which would be able to reduce the increasing deterioration of the environment at a low or moderate cost. This sstem would, as far as possible, meet criteria such as recovery, reuse, easy operation, and maintenance.

 In orde to comply with high water quality standards, it is usually necessary to combine different treatment processes. Currentl, the majority of water treatment methods require specialized equipment and operation by qualified experts.

 My projec will test the following hypothesis: Plants and bacteria can naturally clean urban wastewater; this process will be called "phytopurification." Phytoperification will take place in a series of artificial ponds, also known as artificial swamps, containing gravel, bacteria, and aquatic plants. Wastewater will enter at one end of the series, and purified water will exit at the other end. Such a process could be introduced as a very attractive alternative for wastewater treatment, since it offers the possibility of removing polluted residues and the production of useful byproducts.

 Through phyturification, plants, with the help of bacteria, break down organic material and accumulate minerals and nutrients in the wastewater (Reed et al. 1998). With the goal of changing the organic material into easy-to-harvest biomasses, like flowers, foliage, and fodder on the water's surface, this production can be used as an excellent source of protein-based energy for animals or as a fertilizer produced through the composting process.

2005 - EV065

DOES BUBBLE SIZE AFFECT RECYCLING PAPER?

Tanner Michael Hento
Avon Public School, Avon, South Dakota, United States

Recycling paper is an important process in today's society. However, in order to successfully recycle paper, contaminants such as ink need to be removed. One such method is to bubble air through a mixture of newspaper, water, and soap. The purpose of this experiment was to look at the relationship between bubble size and the amount of ink removed. Using a blender, I ground up used copier paper with a common dishwashing surfactant, water, and then bubbled air through the mixture. A mixture of foam and ink would rise to the top. This was then collected and filtered. Using a stereomicroscope, I then counted the number of ink specks that remained on the filter paper. I then amassed this filter paper and compared it to the mass of filter paper for the control solution for which I had not bubbled air through. I then repeated this experiment for different sized bubbles. By comparing the number of ink specks and the difference in mass between the sample and the control filter paper, I could determine which bubble size removed the most ink. The smallest bubble averaged 17 ink specks/0.5 mm square. The smallest bubble recorded an average mass of 0.39 grams, while the largest bubble had an average of 0.32 grams. I concluded that the smallest bubble size collected the most ink. Better ink-removal techniques could produce significant savings on the 50 million tons of paper recycled last year.

2005 - EV066
INHIBITION OF PHOTOSYNTHESIS BY AIR POLLUTANTS QUANTIFIED BY THE PHOTOACOUSTIC METHOD

Aaron Tzeyang Kuan
Horace Greeley High School, Chappaqua, NY, USA

While experiments done in controlled lab settings have shown that certain air pollutants reduce photosynthetic efficiency of plants, the inhibitive effects of air pollution have not been effectively quantified in natural environments. The photoacoustic method was used to compare photosynthetic efficiency of polluted and unpolluted leaves from outdoor trees. Acoustic waves resulting from leaves absorbing light flashes were used to quantify energy consumed in photosynthesis.

 Leaves picked from Ginkgo biloba trees grown by a busy Brooklyn street were determined to be less efficient than leaves from trees grown in a nearby park. The polluted leaves convert a smaller percentage of incoming light energy and thus release less oxygen than unpolluted leaves. The photosynthetic efficiency of the polluted leaves was depressed even though no visible leaf damage occurred.

 The photoacoustic method is demonstrated to be an effective way of quantifying photosynthetic efficiency of outdoor trees. Thus, photosynthetic inhibition can be used as a new metric for gauging pollution damage.

Awards won at the 2005 ISEF
First Award of \$1,000 - American Statistical Association
Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2005 - EV067
BARNACLES BE GONE 2 CAN ULTRASONIC ACTIVATION PREVENT THE ADHESION OF THE BALANUS GLANDULA?

Ryan John Clark
Hilton Head Preparatory School; Hilton Head Island, South Carolina; USA

The purpose of this experiment was to determine if ultrasonic activation can prevent the adhesion of barnacles on fiberglass.

 A 25 kilo-hertz ultrasonic transducer was bonded to a gel-coated fiberglass box. The box was placed in saltwater, and a plain piece of fiberglass was placed approximately four meters away. A second piece of fiberglass was placed approximately 1600 meters away, nine weeks after the onset. The numbers of barnacles were recorded each day for eleven weeks.

 There are currently no barnacles on the vibrating or non-vibrating gel-coated fiberglass pieces that were in close range to each other. Additionally, the vibrating gel-coated fiberglass had much less algae growth than that of the non-vibrating gel-coated fiberglass. There was barnacle growth on the second piece of fiberglass placed 1600 meters away.

 On the vibrating fiberglass box's base, there is "raw fiberglass". This base doesn't have a gel-coating on it. The raw fiberglass is consistent with what is on the inside of boats, and the gel-coated fiberglass is consistent with what is on the outside of boats, where there is normally barnacle growth. Barnacles should have grown on the non-vibrating gel-coated fiberglass placed four meters away because there were 197 barnacles on the raw fiberglass. The ultrasonic transducer prevented growth in a four meter radius. Although there was barnacle growth on the raw fiberglass, there was a distinct patterned area where the ultrasonic transducer prevented barnacle and algae growth.

Awards won at the 2005 ISEF
Third Award of \$1,000 - U.S. Coast Guard

2005 - EV068
BLACK MUREX SNAILS (HEXAPLEX NIGRITUS) AS A HABITAT FOR JUVENILE PACIFIC CALICO (CATRINA) SCALLOP, ARGOPECTEN VENTRICOSUS.

Chelsey Ann Yingling
Tucson Magnet High School, Tucson, Arizona, USA

The Black Murex snail, Hexaplex nigrilus, is a very important commercial species in the Gulf of California. In the summer months these snails form large breeding aggregations. Chemical and structural traits of the Black Murex snail may promote larval settlement of the Pacific Calico (Catrina) scallop, Argopecten venricosus, which is another very important commercial species in the Gulf of California. Chemical and structural cues were investigated in laboratory experiments in which scallop larvae were given eight different substrates on which to settle. Substrates represented the range of settlement choices available in Baja California, along with controls. The experiments revealed significant positive inductive stimuli from both chemical and structural cues associated with clean (epibiota removed) and dirty (epibiotic untouched) snails. In the series of trials where substrates differed in chemical and structural complexity, larval settlement

was significantly higher on both the live clean(mean=46.8) and dirty snails (mean=84.9)as compared to sand(mean=3.4) and control(mean= 2.7)(ANOVA, p>.0001). The experiments also revealed that settlement was lowest when structural complexity and the presence of associated epibiota was reduced. These results are of great interest for trying to set fishing limits on both A. ventricosus and the Black Murex snail in the Gulf of California.

Awards won at the 2005 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2005 - EV069

MOVEMENT OF NITRATES IN THE SOIL PROFILE

Andrew Masatoru Abe

Pearl City High School, Pearl City, Hawaii, United States of America

When three times pan (average evaporation of water per day from the soil) amount of water is applied to the nitrate treated, it will travel further down the soil profile than soil watered at a rate of pan. The amount of nitrate used to treat the soil will not affect how far the nitrate will move down, but it will affect the concentrations of the nitrates in the soil at the different depths. This experiment will be carried out on a randomized plot consisting of 24 2x2 foot plots. The plots will be testing 200 lbs/acre (using 40% nitrate urea fertilize), 400 lbs/acre, and 800 lbs/acre, with pan evaporation rate and three times pan evaporation rate. Water the plots three times a week for a period of time. After the watering period is complete, collect 5 core samples at every 6 inches of depth for a total depth of 30 inches from each plot. The nitrates are extracted from the soil sample and then analyzed using a colormetric nitrate tester. There was only a small amount of nitrate in the control plots, which shows that the soil wasn't already treated with heavy amounts of urea fertilizer. When comparing the 200 lbs/acre to 800 lbs/acre plots, the levels of concentration is drastic. And when comparing the 200 lbs/acre pan, the nitrates moved less down the soil profile when compared to the same amount of fertilization, but at a different watering rate.

2005 - EV070

NATURALLY OCCURRING RADIOACTIVE MATERIAL: WHERE ARE YOU SAFE?

Nancy Nichole Wallace

Andrews High School, Andrews Texas, United States

Naturally Occurring Radioactive Material: Where are you Safe? Wallace, Nancy N. Andrews High School, Andrews TX The purpose of my project is to determine if employees at Waste Control Specialists (WCS) a low-level radioactive storage and treatment center encounter significantly more or less background radioactive material and Naturally Occurring Radioactive Material (NORM) than every day individuals. My experiment involved testing various places and items that contain NORM that individuals are faced with everyday. I first tested bananas. I placed the survey meter that was issued to me three to five inches away from the bananas for one to two minutes while the meter picked up all of the radiation that was present. I then recorded my results. This procedure was continued with Fiesta-Wear, lantern mantles, "No Salt", a microwave, Brazil Nuts, and a television. I attended WCS once again in order to perform my testing of their facility. I followed the same procedure that I used when testing the bananas at the grocery store to test background material at WCS. I tested thirteen different places on the actual work site and recorded the results. I then took the results of the totals, WCS background radiation at 194 micro R/hr and everyday NORM at 162 micro R/hr, were compared to the minimum standards of radiation exposure set by the Conference of Radiation Control Directors as well as the Railroad Commission of Texas. In conclusion my project scientifically proved that those at WCS are not encountered with more NORM or background material that those of the everyday NORM effecting individuals.

2005 - EV071

WHAT IS THE EFFECT OF ACID RAIN ON THE CELL STRUCTURE OF SPIROGYRA?

John A. Burns

Yucca Jr. High, Clovis New Mexico, USA

I autoclaved test tubes, a transfer instrument, and a graduated cylinder, to ensure that no contaminates would get into the mediums. Next, I poured 10 mL of nitrogen oxide and 10 mL of sulfur oxide into the graduated cylinder. I poured 100 mL of distilled water into each of the test tubes. I labeled each test tube to indicate the pH level that was desired. I then added a few drops of the nitrogen oxide/sulfur oxide mixture into each of the mediums, gradually increasing the amount of acid until the pH of each medium was 6, 5, 4, or 3. The control medium did not receive acid; its pH read 7. Next, I evenly divided the culture of Spirogyra into 5 parts, and photographed a sample of each part under a microscope. I transferred each part into a medium. Finally, I set the test tubes into a test tube rack, and put them under a fluorescent fixture. The Spirogyra was grown under 16 hours of light and 8 hours of darkness.

 Every forty-eight hours, a sample was obtained from each of the cultures using the transfer instrument. The sample was put on a slide and photographed at a 10x objective and a 40x objective. The number of healthy and dead cells was noted in each sample.

2005 - EV072

A WATERSHED IN RECOVERY?

Sarah Katherine Fisher

Catholic High School, Huntsville, AL, United States

For this longitudinal study, I have observed the biological and chemical changes over time in the Aldridge Creek watershed. The chemical techniques, I tested pH, dissolved oxygen, total alkalinity, and total hardness. The biological technique, I used benthic macroinvertebrates to assess the aquatic life of the water. I monitored areas on the creek near Mt. Gap Road and Green Cove Road in Huntsville, Alabama. At the Mt. Gap test site, biological results confirmed the

chemical results- this area is on the way to recovery. Last year I found no right-hand-twist snails, but this year, I found right-hand-twist snails. Since right-hand-twist snails are an excellent indicator of high water quality, the "return of the snails" signals the improving condition of the Mt. Gap area. On the other hand, the Green Cove site has declined in the past year. Lower dissolved oxygen levels, more runoff, more sediment, and pollution contributed to the biological decline. One disturbing aspect of this site is the near absence of aquatic life. After observing the entire watershed, I noticed an interesting trend- houses and businesses near the healthier areas are not as well maintained. These homeowners are probably less inclined to put excess fertilizer onto their lawns that release chemicals, therefore protecting the creek. In conclusion, my hypothesis was partially proven. Some areas of the watershed are declining but other areas are improving. This contradiction reveals that the future of Aldridge Creek is questionable, thus- "A Watershed in Recovery?"

Awards won at the 2005 ISEF

Honorable Mention Award - North American Benthological Society

2005 - EV073

OPTIMIZING BIOREMEDIATION: CHEMICAL EFFECTS ON THE BIOSTIMULATION OF PSEUDOMONAS FLUORESCENS

Caaminee Mayank Pandit

Noblesville High School, Noblesville, IN, USA

The project was created to determine how different chemicals would enhance the productivity of pseudomonas fluorescens when used to bioremediate oil. Six chemicals were used as variables: fertilizer, magnesium sulfate, calcium sulfate, sodium chloride, iron, and zinc. Solutions of three concentrations were made for each chemical: 0.05M, 0.01M, and 0.002M. It was to be determined how much of 2.0mL oil pseudomonas fluorescens would consume in a period of one week.

An inoculating loop was used to transfer the bacteria into the solutions contained in glass jars. A pipet was used to add 2.0mL of canola oil (a hydrocarbon) to each jar. The jars were left in the greenhouse for a period of one week and then each jar was frozen for six hours at -5°C until all the water was frozen but the oil was not. The amount of oil left after the week was measured with a graduated cylinder.

The most oil was bioremediated by the 0.05M fertilizer solution (13.8 times more than the control) and then the 0.01M fertilizer solution. For every chemical except sodium chloride and iron, the 0.05M solution bioremediated the most oil. For iron and sodium chloride, the 0.01M solution bioremediated the most oil, indicating a saturation point. All results were highly significant to the <0.0001 level.

The chemicals in fertilizer (nitrogen, sulfur, potash, and phosphate) allowed it to best optimize bioremediation. For pseudomonas fluorescens, these chemicals, when incorporated according to these proportions, can bioremediate oil by over 50% in a period of one week.

2005 - EV074

DETERMINATION OF ANTIBIOTIC PRESENCE IN THE TENNESSEE RIVER AND INFLOWING WATERS

Jennifer Ann Taylor

Florence High School, Florence, Alabama, United States of America

Recently, attention has been drawn to the misuse of antibiotics in medicine and agriculture. Many details, such as the effect of low levels of antibiotics in the environment, are unknown. Last year, bacteria in the Tennessee River and the Florence wastewater treatment facility were tested for resistance to eleven commonly prescribed antibiotics. The high proportion of multiple resistances merited further research to determine both the concentrations of those antibiotics in the river and the contribution of suspected sources of antibiotics in the water. This year, POCIS were deployed in the river but were damaged by heavy rains and were unsalvageable. CowSide tests were adapted to detect antibiotics in water samples, but due to suspected interference of milk proteins, all results were negative. In the third procedure, one-liter water samples were filtered to remove particulate matter, and were then passed through solid phase extraction cartridges to sequester polar organic molecules. The analytes were removed from the cartridge with 5 mL of methanol, which was then evaporated to further concentrate the analytes. This was submitted for HPLC/MS analysis to determine the concentration of antibiotics present in the samples. Four antibiotics were detected, and quantitative data was obtained by comparing results with the peaks obtained from analysis of solutions with known concentrations of each antibiotic. None of the antibiotics were at levels above the minimum inhibitory concentrations for bacteria typically found in the river, but it is possible that the current antibiotic concentrations can have resistance-promoting effects, especially if the antibiotics work synergistically.

Awards won at the 2005 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2005 - EV075

METHODOLOGY OF PHYTOMINING BY GROWING AVENA SATIVA AND MEDICAGO SATIVA TO NUCLEATE GOLD NANOPARTICLES FOR NANOAPPLICATIONS PHASE II

Rachael Ann Scott

N.W.M.H.E.A. Como, MS USA

Mine tailings contaminate the environment. Gold ions remain in the tailings since they are too small to mine. Plants can phytoremediate the tailings and produce tailor made gold nanoparticles for nanoapplications.

 The objective of this study was to determine if pH affects the amount of gold bound in the Avena sativa and Medicago sativa. I experimented with the same plant cultivars, since I know they uptake gold and thrive in the gold chloride saturated soil from the previous experiment.

 All together, I grew 4 runs with 1,200 Avena sativa and 4,000 Medicago sativa at two week growth durations. I treated the plants with 30 mL of HAu(III)Cl 3H O solution every other day. This environment imitated gold ions from the tailings of a mine.

 I used silver staining enhancement reagent to increase the size of the gold 100 - 500 fold, then observed it with stereo and compound microscopes. I also used an environmental scanning electron microscope and determined exact amounts of gold by inductively coupled plasma.

 At pH 3 the plants nucleated more gold, and increased uniform particles, at pH 5 the results were less and at pH 7 it dramatically decreased . Overall, Avena sativa sequestered a higher

amount of gold than Medicago sativa.

 The by-product of gold mining produces tailings that are acidic. Consequently, it is an ideal location for phytomining. It would be an inexpensive, environmentally friendly method of producing gold nanoparticles from abandoned and active mine sites. The current method of reduction is expensive and produces waste.

Awards won at the 2005 ISEF

First Award of \$3,000 - Environmental Sciences - Presented by Ricoh

2005 - EV076

DYEING TO KEEP A SAFE ENVIRONMENT

Reya Jessica Das

Hamilton High School, Chandler, AZ, USA

The more commonly used dyes are vat dyes, direct dyes, and fiber reactive dyes. Natural and synthetic indigo vat dyes must undergo a chemical change from water-insoluble to water-soluble and then back to the water-insoluble state. Swollen fibers absorb the direct dye and physically trap it when the fiber dries. Fiber reactive dyes form covalent bonds with fibers. Frequently dyed fabrics include cotton and polyester. Excess dye that is disposed improperly often damages and contaminates the environment.

The purpose of this experiment was to determine the optimal dye and cloth combination, considering the colorfastness of the dyed fabric and environmental impact of the effluent. It was hypothesized that the best combination would be synthetic indigo dye on cotton.

Cotton, 50/50 cotton/polyester blend, and polyester were each dyed with natural indigo, synthetic indigo, direct, and fiber reactive dye. Each combination underwent five colorfastness tests and each dye was tested for environmental impact.

The results did not support the hypothesis, but indicated that the optimal combination was direct dye on cotton. The hypothesized indigo dyes displayed poor initial color and inferior colorfastness while containing oxidizer risks. Although the fiber reactive performed the best overall, it instantly killed the plants. Direct dyes allowed the plants to live, possessed no risks, and performed well on the colorfastness tests. Direct dyes should be developed to improve their colorfastness. The excess dye should be recycled and placed into the environment to water plants or reused to neutralize the acidic waste typically generated by manufacturing plants.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2005 - EV077

LAKE TRAVERSE WATERSHED ASSESSMENT

Neal Jerome Konda

Sisseton High School, Sisseton South Dakota, United States

Purpose: To determine whether or not the Lake Traverse Watershed Area is in optimum health. This is to be determined by the levels of nitrates, phosphates, dissolved oxygen, dissolved carbon dioxide, and E. coli bacteria present in the waters, along with clarity and pH. By conducting this research I hope to gain an understanding of how a watershed can be used to track where problem spots occur.

Procedure: Test sites were plotted and water samples were collected from the test sites on a bi-weekly basis. The samples were analyzed for nitrates, phosphates, dissolved oxygen, dissolved carbon dioxide, pH, and E. coli bacteria. The lake test sites were also analyzed for water clarity using a secchi disk.

Data: Lake surface waters were over the legal limit 73% and 43% of the time for nitrates and phosphates respectively. Lake bottom samples were over the legal limit 70% and 47% of the time for nitrates and phosphates respectively. All other data for lake samples were moderate.

Tributary samples revealed that 76% and 48% of the time samples were over the legal limit of nitrates and phosphates respectively. Dissolved oxygen was higher in the tributaries than in the lake as was the dissolved carbon dioxide. E. coli levels were much higher in tributaries than in the lake.

Conclusion: The watershed area is in need of intervention. The lake waters are not acceptable and the tributary waters are not diluting the lake down, rather they are adding to the problem.

2005 - EV078

AN ANALYSIS OF PERSONAL AND PHARMACEUTICAL CARE PRODUCTS (PPCPS) IN EFFLUENT WASTEWATER

Jaime Marie Weaver

Mercy Cross High School, Biloxi, MS, USA

This experiment tested for traces of personal and pharmaceutical drugs in the effluent wastewater of Harrison County. I obtained seven water samples and samples of the top ten prescribed over the counter and prescription drugs. The purpose of my project was to determine if traces of these drugs occurred in the water samples. I hypothesized that traces of the most commonly prescribed drugs would be found in the various water samples.

 To test the samples, I used a ToxiLab™ kit (Varian Incorporated, Irvine, CA) and followed the manufacturer's recommendations. To separate the compounds in each sample, thin layer chromatography was used. This system consisted of two different phases, the "stationary phase" and the "mobile phase."

 Five of the seven sights had detectable drugs in the effluents. The detection limit of ToxiLab™ is 10 mg in the sample. all samples had been diluted 10 times; therefore at least 100 mg were present.

 The results of this test prove that there are detectable amounts of the top ten prescribed drugs in the effluent wastewater of Harrison County. A further study would be to evaluate the samples using another method, such as gas chromatography to determine the concentrations of the drugs found in the samples

2005 - EV079

THE EFFECTS OF UNIOLA PANICULATA AND BITTER PANICA ON THE STABILIZATION OF SAND DUNES

Lindsey Marie Peresich

Mercy Cross High School, Biloxi, MS, USA

South Mississippi is a unique place to live because of its twenty-six mile long white, man-made beaches. The parallel current, Longshore Current, along the Gulf Coast causes erosion and has little deposition of sand. I have found the solution to a common problem in stabilizing Mississippi beaches. The purpose of my project is to determine which system best stabilizes Mississippi beaches: sand dunes or sand fences. Two procedures were conducted simulating the beach, the sand dune, and the wind at a constant velocity. After the first test, I found that the sand dune model with vegetation works more efficiently than the sand fence. The sand fence model allowed sand to go through and under, while the dune restricted movement. Next, I conducted a second experiment testing which two vegetations worked best, Uniola paniculata or Bitter panica. (These two plants are commonly used along the Gulf Coast.) I found that the Uniola paniculata blocks sand and allows very little movement. It forms the sand into a dune. I observed that the large roots of Bitter panica would not allow the plant to be as closely gathered as Uniola paniculata. This affects the outcome of beach stabilization. In my hypothesis, I stated that the sand dune would work more efficiently than the fence. Between the two types of vegetation, I believed that the Uniola paniculata would best protect the beaches. This long, thin rooted plant allows little movement and can be more closely gathered. I hypothesized correctly for both experiments.

2005 - EV080
SUSTAINABLE DEVELOPMENT IN AN UNSTABLE WORLD: HELPING ECONOMICALLY DISADVANTAGED FAMILIES PRODUCE THEIR OWN FOOD

Travis Lopez
Skyline Technical, 15220 South 50th Street, Suite 109, Phoenix, Arizona 85244

Purpose of this project is to test aquaponics systems for producing food using a sustainable method. This system will benefit families living in economically disadvantaged marginal arid land areas. The project research proved that one of the three systems tested could provide a family with protein from fish, carbohydrates, vitamins and minerals from vegetables, to supplement their diets. This research focused on determining the weight of vegetables produced from plants grown hydroponically in these systems. Also, weight of fish produced in the same systems was calculated. This system operated over a period of five months produced enough protein and vegetables for a family of five. In using tables developed by the USDA, in third world conditions, this family would need 44,500 grams of protein and 95,670 grams of carbohydrates for a period of six months. The most productive system tested contained two poly-tanks, 1136 Liters each, and four grow trays, each 4.88 meters long. If this aquaponics system is expanded by 50% it can produce 66,750 grams of protein and 143,500 grams of carbohydrates, providing nine months of nutrition. Expansion to 100% brings the totals to 89,000 grams of protein and 191,340 grams of carbohydrates, enough nutrition to feed a family of five for a full year. I would like to continue this research by converting the electrical power to solar power to run the pumps. In rural areas, electrical power is difficult to obtain, with solar power much more feasible and economically much less costly.

Awards won at the 2005 ISEF
DuPont's Center for Collaborative Research and Education, Office of Education recognizes individual and team winners in the categories that best exemplify DuPont's business-related interests: Biology, Chemistry, Engineering/Physics, Earth/Environmental Science and/or Computer Science. Each project is recognized with a Primary Award of \$1,000. - National Aeronautics and Space Administration
Honorable Mention Award of \$5,000 - Ricoh

2005 - EV081
THE PIPE DREAM?: AN ANALYSIS OF HALOACETIC ACIDS IN WASTEWATER EFFLUENT

Sky Breeden Vanderburg
Moberly High School, Moberly, Missouri, United States of America

This project is the result of experimentation to develop a new test method for haloacetic acids (HAAs) in wastewater effluent and a part of a two-year analysis of HAA formation, environmental effects, and prevention. The experimenter wanted to develop a new test method that would enable simpler and less expensive monitoring of HAA formation resulting from effluent chlorination. To accomplish this, the experimenter decided to test different volatilization methods. The effectiveness of the different volatilization methods were determined by using a HAA standard with known values of five HAAs, collectively called HAA5, and running the samples through a gas chromatographer/ mass spectrometer. If the HAAs are not volatilized, then detection is impossible. This research mainly concerned chlorine HAAs, because they are formed by the interaction between chlorine, in this case sodium hypochlorite, and wastewater organics. After experimentation, all of the esterification and amide formation methods failed to volatilize the HAAs; however, with some research, the experimenter decided to use acid to protonate the HAA standard samples, thus making the HAAs volatile and detectable. This method detected chloroacetic and bromoacetic acid; however, it was hypothesized that the pKa value of the other HAAs prevented protonation at safe levels for gas chromatography. Whenever this method was tested, it was found that the gas chromatography column was not suited for very acidic samples; however, the calibration curve was determined. With further experimentation, protonation could be adjusted to work at levels suitable for any GC column and therefore be an effective test method.

2005 - EV082
MUSKRATS AND WILD RICE- PHASE II

Aurelia Eugenia-Glory DeNasha
Fond du Lac Ojibwe School, Cloquet, Minnesota, USA

In the Ojibwe Creation story, the muskrat dove down into the seas to collect sediment to recreate the Earth after the great flood. Manoomin, wild rice, is the staple food for the Anishinaabe people. This project was done to observe and gather information about muskrat behavior and wild rice in a natural setting. The primary hypothesis is that muskrats help wild rice grow by eating and using plants that compete for space and nutrients with wild rice. This fieldwork will show that these competitive plants will make up a significant part of samples taken from dens of muskrats on Dead Fish and Cedar Lake. Wild rice plant material will

be non-existent or an insignificant part of the samples. Based on written research that looked at long-term studies of muskrat behavior, a secondary hypothesis was determined. Evidence of food storage behavior inside muskrat dens would indicate drought conditions within a two-year range, and increase the likelihood of wild rice plant material being used for den building. Samples of plant material from muskrat dens and their surrounding areas were collected from each of the two lakes that had been harvested for wild rice. The plants from all collection areas were sorted, identified and compared back at the lab. None of the samples contained wild rice plant material, or evidence of foods that are typically stored in time of hardship. These results supported the hypotheses.

Awards won at the 2005 ISEF

First Award of \$1,000 - American Veterinary Medical Association

2005 - EV083
M&M (METHYL MERCURY) WITH COLD VAPOR ATOMIC ABSORPTION

Jason C. Wu
North Quincy High School, Quincy, MA, USA

High levels of mercury in the body have been linked to neurological damage, coma, and death. Developing fetuses are particularly susceptible to nervous system damage by mercury. To better inform the public on how to maintain a "mercury-free" diet, this research explores mercury levels in different fish species, if canned fish has high mercury levels and if the canning processes play a role in contamination. It was hypothesized that canned fish, tuna, and swordfish would have high mercury levels. Weighted tissue samples were digested with trace metal acids at 95C followed by oxidation with potassium permanganate and potassium persulfate. Mercury in the digested sample was reduced with stannous chloride to elemental mercury and measured by cold vapor atomic absorption technique. A definite difference in mercury level among the fish species was evident. Swordfish was found to have the highest level of mercury because it eats large amounts of smaller fish thereby collecting their mercury. Canned fish was found to have a low mercury level because it consists of smaller tunas, leaner tissue, or cooked tissue, contradicting my hypothesis. By knowing the level of mercury, a fishery manager can better manage contaminants in fish and seafood. Future studies could include a wider variety of fish species and seafood such as mollusks or crustaceans. Another interesting possibility is the comparison for highest mercury in various parts of fish anatomy.

2005 - EV084
IT'S RAINING . . . CARBON?

Dustin George Harwood Hughes
Timmins High and Vocational School, Timmins ON, Canada

Several experiments were performed to demonstrate an innovative concept for the transformation of atmospheric energy into electricity and the conversion of fossil fuel waste carbon dioxide into a new energy cycle. A survey of annual energy consumption modes, habits and greenhouse gas generation was performed to determine the annual carbon output of an average citizen. Misted water, retrieved from the use of a water hammer pump, was sprayed over the opening of a "wind column," constructed from coffee cans. The air within the column, cooled by the misted vapour, generated a downdraft. Applying fluid dynamics, the column output was diffused over aqueous Ca(OH)2, sequestering atmospheric CO2. A Tesla type turbine was constructed and placed at the base of the column, powered by katabatic flow (applying Bernoulli's Principle). Electrical work of the turbine thermo-chemically regenerates CaCO3 to Ca(OH)2 and concentrated CO2. Finally, thermo-nuclear research calculations identified Americium-241, (the ionizing component in smoke detectors), could be used to radiolytically convert concentrated CO2 to C and CO, two potential fuels. The effectiveness of this innovative atmospheric carbon removal process over the next 100 years was also displayed in a simulation created using the iThink programming language. This simple process employs available resources (water, CO2) to power a Tesla turbine (generating electricity) and reduce the amount of atmospheric CO2, while creating two gaseous fuel sources in a continuous cycle. Simulation analysis, based on physical model measurements indicate that 26 Gt/year of atmospheric CO2 can be extracted and sequestered from the atmosphere, with a net energy transformation of 89 MWh/day, utilizing 55 tonnes of solid radioactive waste storage.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2005 - EV085
DO YOU REALLY KNOW WHAT IS IN YOUR DRINKING WATER?

Marissa Nichole Darvis
Plentywood High School, Plentywood Mt USA

I conducted this experiment because I am interested in water quality. One day, I hope to obtain a career testing water quality. This experiment will prove that many people do not realize the seriousness of water quality. The contaminants I tested for are nitrates, phosphates, iron, sulfides, coliforms, and total hardness. In my opinion, there are many wells in the Plentywood area that are infected with contaminants. In the tests that I will run, I will prove that some type of contaminant will be found in the water samples. Nitrates and phosphates are two contaminants found in fertilizer. These two compounds are hazardous to the environment and dangerous to humans. Iron and calcium are two minerals found in drinking water that can cause build up in pipes. Coliforms are dangerous when found in drinking water. The most commonly known form is E. Coli. E. coli is caused by human and animal waste. After deciding that I would test for water quality, I went around to farms in the surrounding area to collect water from their wells. I collected four different samples from each of the five wells to confirm my findings. I found that sample A had high levels of nitrates and sample D tested positive for E. coli. I was surprised to discover the number of contaminants in the water samples that I tested. Neither of the people knew their water had any level of nitrates or any form of E. coli. This experiment proves that people are not aware of the seriousness of water testing.

2005 - EV086

MULTIGENERATING ENERGY SYSTEM PHASE III

Gabriel Soto

Luis Muñoz Marín High School, Barranquitas, Puerto Rico

The objective of this project is to present a real and functional prototype that is environmental friendly and produces enough electric power to operate all home appliances.

 This functional prototype produces electricity using a combination of wind, solar and water energy. New components were added and changes were made in the existent original prototype. Additional solar panels (4) were installed (8 total) and two charge controllers (one for the solar panels and another for the generators). Additional batteries were added (12) to increase the storage capacity (16 total). Also the size of the watermill (hydraulic turbine) was increased from 1.52 meters to 2.8 meters, to obtain more motive power and it was relocated to a place where the water descent could be vertical, to increase the power of the flow. A stationary bicycle was modified by adding a generator, to produce electric power from human effort during daily exercises routine. The connecting rod between the hydraulic pump and the windmill was replaced by a lighter and thin one. The existing connection box was replaced by an electric safety box that has independent safety switches for each source and the electric cables were replaced by gauge 1/0 ones to increase the security level and the efficiency of the prototype. A functional prototype is in use providing enough electric power to operate all home appliances without contaminating the environment. These results confirm the hypothesis.

2005 - EV087

BIOENERGY PHASE II

Nataly Soto

Luis Muñoz Marín High School, Barranquitas, PR

The purpose of this project was to operate low energy consumption electric equipment with the implantation of electrodes in plants.

 Through the modification of an A/C current transformer and permitting the flow of a high energy electric current, the "cooking" time of the electrodes was reduced to 2.5 minutes, generating a uniformed cuprous oxide film. The cuprous oxide acts as a fertilizing agent and simultaneously makes it possible to obtain electrical energy from the plant with the complementary use of galvanized wire. These electrodes are injected between the plant bark and the xylem. Plant fluids act as electrolytes permitting this living battery to work. Through the use of waxed tape, the electrodes were covered and sealed, avoiding contamination and maintaining moisture. Using different tree stems permitted the injection of more than one pair of electrodes which provided more the on one connection per plant. The more pairs of electrodes connected in series the greater the amount of electric energy than was generated.

The operation of the digital clock, for a 48 hour period, was achieved through the insertion of three pairs of electrodes in a Schefflera Actinophylla (Brassaia actinophylla) tree. This confirmed the hypothesis postulated in this study.

2005 - EV088

GROWTH OF FUNGUS IN THE AIR CONDITIONERS OF AN EDUCATIONAL FACILITY

Angelina Marie Estela

S.U. Macaná, Guayanilla, P.R.

nvestigation presents the study of how the lack of maintenance of the air conditioner units in an educational facility can provoke the development of conta minating fungus. To be able to carry out this study each of ten petri dishes with PDA was placed uncovered for fifteen minutes in one of the ten class rooms of the school. Nine classrooms had air conditioner units and one classroom didn't. Then they were taken to the laboratory of the university to be incub ated at 25° C for seven days. The counting of the colonies was done visually. For the identification of the fungus a sample of the colonies was taken using an inoculation needle sterilized with heat. The samples were placed on a microscope slide that contained a drop of lactophenol with blue color and were observed under the microscope. Fungus that developed in air conditioned classrooms were Cladosporium, Fusarium, Mycelia sterilia, Mucor, Trichoderma and Aspergillus. On the petri dishes from the classrooms without air conditioner units the following fungus developed: Cladosporium, Fusarium and Yeast, but the quantity of each colony was not significant. On all of the petri dishes the following fungus developed: Cladosporium and Fusarium. All of the fungus that developed in the petri dishes are contaminants of the environment and can cause health problems. The contribution of this project is to demonstrate the importance of an adequate maintenance of the air conditioner units to avoid the proliferation of contaminant fungus and the development of a sick building.

2005 - EV089

ENVIROMENTAL PROBLEMS THAT AFFECT THE QUALITY OF PUNTA SALINAS ESTUARY IN P. R. AND THE EFFECTS IN THE PRODUCTIVITY OF THE BENTHICS COMMUNITY, MARINE LIFE AND HUMAN HEALTH.

Alexis Colón

Jose Santos Alegría, Dorado, Puerto Rico

The purpose of this investigation was to study some of the environmental problems that affect the natural balance of the Punta Salinas estuary in Toa Baja PR. Some water samples were collected in nine estuary stations to analyze the presence of bacteria. Water samples were also analyzed for pH, temperature, salinity, dissolved oxygen, nitrates, phosphates, electric conductivity and for inorganic minerals. Water samples were collected between the months of March and December. The seawater flow and its effects in how the nutrients are mixed were studied for one year. It was found that during springtime there were many colonies of a great variety of pathogenous bacteria including bacillus sp, Klebsiella Neumonia, and Aeromonas among others. Also the level of dissolved oxygen in water was lower while the levels of nitrates and phosphates were higher. During springtime the water flow in the estuary is slow and a fewer number of marine species come into it. From the survey among community people it was found that during the springtime there's a high incidence of diseases from the consumption of seafood from the estuary. It was observed that there is an obstruction at the entrance of the estuary that affects the life cycle of the marine species, reducing the production and reproduction of the benthic community. The excess of fishing and the dragging technique have altered the life cycle of the

benthic communities. The invasion of lizards has also affected the marine life in the estuary. These results help to accept the hypothesis.

2005 - EV090
AMMONIA EMISSIONS FROM AGRICULTURAL WASTE
Tara Ellen Gloyna
Temple High School, Temple, Texas, USA

As the number of agricultural operations increase near urban areas, there is a pressing need for understanding how these facilities affect the air we breathe. Ammonia gas released from cattle urine contributes to the smog and ozone formations near ground level. The purpose of this research was to determine if there was a measurable difference in the amount of ammonia released from cow urine deposited on different surfaces with different moisture contents. It was originally thought that dry grass, as compared to other surfaces, would be most beneficial in reducing ammonia releases. The impact of ammonia releases was evaluated by placing test samples in a glass container that was surrounded by a larger temperature (35 C) chamber. Data were collected at one-minute intervals for a six-hour period. Two sets of data were collected: the first set was determined by using 100 mLs of urine on 200g samples, and the second by using 50 mLs of urine on 236 mL samples. Similar results were obtained with both sets of data. This experiment involving soil, grass, and concrete surfaces concluded that dry grass was the most beneficial in preventing the volatilization of ammonia gas into the atmosphere. It appears that the bacteria responsible for degrading urea into fixed nitrogen for the plant were present and the lack of moisture prevented the reaction of the urea to form ammonia gas. This study demonstrated the importance of surface composition in evaluating the impact of ammonia gas released from cattle urine.

Awards won at the 2005 ISEF
Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh
Student Membership in SETAC - Society of Environmental Toxicology and Chemistry

2005 - EV091
LADYBUGS DON'T FLY AWAY; LIVE IN ORGANIC SPRAY THE EFFECTIVENESS OF ORGANIC PESTICIDES ON LADYBUGS
Eboni-Shanielle LaDion Wafford
Gaffney Senior High School Gaffney, South Carolina United States of America

The purpose of my experiment is to determine the effect of organic pesticides on ladybugs. The information gathered will help farmers choose organic pesticides that will not harm ladybugs while trying to kill aphids and mosquito mites. The project was derived from research gathered at Cornell University. To perform the experiment, I infused four different substances with 100 ml of boiling water and placed each in its own spray bottle. These substances included: 15 grams of minced dill leaves, 15 grams of pyrethrum powder, 15 grams of jalapeno pepper, and 15 grams of garlic. Next, I placed 25 ladybugs in five different containers along with 100 grams of sliced potato. I covered each container and labeled it to correspond with a mixture. The fifth container was used as a control group and only received water. I sprayed each container three times with its corresponding mixture and waited three hours to record the data of how many ladybugs were still alive. I repeated this step six times; recording data each time. After the test was complete, I compared the number of living ladybugs to determine which organic pesticide had the least effect on the insect. In trial #1 the dill leaves killed 5 out of 25 insects; garlic killed 10, jalapeno peppers killed 17; pyrethrum killed all 25; the control control only lost one insect. In trial #2 the dill leaves killed 4 out of 25 insects; garlic killed 12; jalapeno pepper killed 15; pyrethrum killed all the insects; the control group lost none. On the average, the number insects that survived: dill weed had 20.5; garlic had 12; jalapeno pepper had 9; pyrethrum had none; the control group had 24.5. Pyrethrum proved to be most deadly on ladybugs. The dill leaves mixture proved to be the most effective organic pesticide because the research at Cornell University showed that this mixture killed harmful insects such as aphids and mosquito mites; yet, it showed the least harmful effect on ladybugs.

2005 - EV092
EFFICIENT AND ENVIRONMENTALLY SAFE REMOVAL OF TOXIC AMMONIA USING AQUATIC PLANTS
Catharina Rose Grubaugh
White Station High School, Memphis, Tennessee, USA

When fish are housed in confined spaces such as in aquaculture or the aquarium trade, the build-up of toxic ammonia is a major problem. Through the nitrification process, biofiltering bacteria are used to convert ammonia into nitrite, which is in turn converted into nitrate. However, nitrite is also toxic to fish, and nitrates can cause eutrophication in receiving waters. Duckweed, a floating plant, can remove ammonia directly from water. The purpose of this study was to determine if duckweed can be used as a more efficient method than bacterial biofiltration to reduce toxic concentrations of ammonia from water.

 Fifteen aquaria were divided into three groups which contained: 1) duckweed alone, 2) biofilter media colonized with nitrifying bacteria, and 3) duckweed and biofilter media together. Ammonia, nitrite, and nitrate concentrations were sampled periodically over a 216-hour period.

 Ammonia concentrations decreased significantly faster in aquaria with duckweed than with biofilters alone. Nitrite concentrations remained low in aquaria with duckweed but rose to concentrations ten times greater than published lethal concentrations in aquaria with biofilters alone. No significant increases in nitrate concentrations were found in aquaria that contained duckweed, but aquaria with biofilters alone showed significant increases in nitrate. These results suggest that duckweed removes toxic ammonia from water more efficiently than standard bacterial biofiltration does, and methods using duckweed may be a valuable tool in aquaculture and the aquarium trade.

Awards won at the 2005 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV093

THE EFFECTS OF TEMPERATURE ON THE DEGRADATION OF PETROLEUM

Stephanie Robyn Seman

Burkburnett High School, Burkburnett, Texas, United States

The purpose of this experiment was to determine whether temperature would affect the rate at which petroleum degrades. Oil is important to this area, Texas, yet it causes many problems when used incorrectly. There are several hazards when an oil spill occurs. My hypothesis was that petroleum would degrade at a faster rate when it was in a colder environment.

 Petroleum degradation was tested by changing the environment of three identical solutions. The three vials of non-pathogenic bacteria culture and refined motor oil were kept in a closed container and the temperatures were changed through the use of ice packs and a heat lamp. During a period of five days, the vials were observed and notes were taken on top layer depth, color, turbidity and overall observations. Also, the temperature of each environment was recorded.

 The temperatures remained nearly constant through out the trials. After only one day in the container, the vials began to show signs of degradation. The petroleum began to form globs and break apart from the layer. Also, color changes occurred almost immediately. By the fifth day, it was obvious that Vial A, the warmest vial, was the most degraded at that point.

 My initial hypothesis, that lower temperature would increase degradation was incorrect. The turbidity and other observations of Vial A showed that it had degraded more than the other vials. For further study, I would use a more stable temperature environment. Also, advanced equipment for specific measurements about the degrading petroleum would be useful.

2005 - EV094

THE EFFECTS OF NITROGEN INPUTS ON MICROBIAL ACTIVITY IN BARK BEETLE INFESTED FORESTS: IMPLICATIONS FOR GLOBAL CARBON CYCLING

Kevan Lew Christensen

Corona del Sol High School; Tempe, Arizona; United States

Bark beetle infestations pose a mounting risk to Ponderosa pine forests throughout Arizona and the southwestern United States. Infestations cause widespread mortality of Ponderosa pines and have been occurring at a higher frequency due to droughts and an increased forest density resulting from fire suppression practices. Prior studies have shown that increased nitrogen levels in fallen pine needles are among several ecosystem changes that occur in areas affected by bark beetle outbreaks. This project aims to determine what effect bark beetle infestations, and particularly nitrogen increases, have on the soil respiration of affected forests. Soil samples were collected from the Sierra Ancha Experimental Forest from three pairs of infested and healthy plots. During experimentation, nitrogen was added to some of the samples in amounts equivalent to 7.5 kg per ha and 750 kg per ha while the remaining samples served as controls. All samples were wetted to field capacity to simulate monsoon rains and stimulate microbial activity and were monitored for approximately one month. During this time, an Infrared Gas Analyzer was used to measure carbon dioxide flux from the soil at varied intervals. While no statistically significant difference was found between the nitrogen enriched and control soils, a significant difference was observed between the healthy and infested soil samples. The observed increase in carbon flux for infested plots in a laboratory setting is evidence that bark beetle infestations may in fact affect the Ponderosa pine ecosystems in a way that alters carbon cycles and could exacerbate global warming.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV095

TOXIC NANOPARTICLES?

Annick Michelle McIntosh

The Academy of Science and Technology, Conroe, Texas, USA

<p> In this experiment, the small crustacean, Daphnia magna, was used as the biomonitoring organism to test the possibly toxic effects of exposure to nanoparticles of Titanium Dioxide, Silicon Dioxide, Zinc Oxide, and Carbon60. Since these materials possess such potential and may eventually be used on a large scale, one concern is their possible effects on the environment, which are largely unknown.

 Nanoparticles for this experiment were obtained from Rice University in solution form at .02g/mL. Through serial dilution techniques, the initial concentration of 1 part per million was achieved for all nanoparticle solutions. Ten daphnia were placed in each container and all experimentation was performed in triplicate, including the control group (700 mL of spring water). For all compounds with high toxicities at 1 ppm (ZnO and C60 had 100 percent Daphnia mortality), subsequent experiments were conducted with lower concentrations (200 ppb and 500 ppb). Because SiO2 and TiO2 did not effect the Daphnia nearly as much at 1 ppm, concentrations were increased to 10 ppm and 20 ppm in later trials to establish toxic thresholds. Mortality was recorded over an eight day period in all experiments.

 These experiments demonstrate the extremely toxic effects on Daphnia magna of exposure to ZnO and C60 at all tested concentrations. Although TiO2 and SiO2 had limited toxicity at 1 ppm, toxic effects increased significantly at 10 and 20 ppm. As we look towards the coming nanotechnology revolution, realistic assessments of the potential toxicities of these materials are essential to the development of appropriate safeguards.

Awards won at the 2005 ISEF

First Award of \$500 - Society of Environmental Toxicology and Chemistry

2005 - EV096

INHIBITION OF SPAWNING OF THE CORBICULA FLUMINEA BY 5-HYDROXYTRYPTAMINE

Ellen Ruth Owen

Gleason School, Gleason, Tennessee, United States

This project was the result of experimentation to determine if 5-hydroxytryptamine will inhibit the spawning of Corbicula fluminea.

 Six thirty-eight liter aquaria were filled with twenty-six liters of pond water. Sixty Corbicula fluminea were acquired from a nearby lake. Ten Corbicula fluminea were placed into each aquarium. Four large rocks were placed in all six aquaria for Corbicula fluminea to attach. There was an aerator system set up to each aquarium. The room temperature was set between 18 degrees Celsius and 22 degrees Celsius for all three months. They were fed every thirty-two hours with dry dog food. Every two weeks, thirteen liters of the pond water was removed from each aquarium and replaced with fresh pond water. Three of these aquaria were used as the control, in which there was no chemical added. The other three aquaria had an external application of 5-hydroxytryptamine (5-HT). Every week 4 mg of 5-HT were placed in the last three aquaria by dropping it into the aquarium. Every week the Corbicula fluminea were counted in all six aquaria, and the data was recorded.

 The average reproduction of Corbicula fluminea for the aquaria with an application of 5-HT was 0.67 Corbicula fluminea per week. The average reproduction of Corbicula fluminea for the control was 3.29 Corbicula fluminea per week. This confirms the hypothesis that 5-HT will inhibit the spawning of Corbicula fluminea.

2005 - EV097

HYDROPONIC PHYTOFILTRATION OF ARSENIC IN DRINKING WATER

Stephen Goodwin Honan
W.T. Woodson, Fairfax, Virginia, USA

This project concerns phytoremediation of arsenic in drinking water and attaining the stricter (2006) U.S. water quality requirements. There's a global need to limit the cumulative and carcinogenic effect of arsenic on people and animals.

 Pteris mayii and Arachniodes simplicior were monitored daily for six months while hydroponically cultivating their roots. A 1:50 ratio (root displacement to water) was used in this experiment. The plants were suspended in a gravitational flow system, circulating 90 liters of water per hour.

 275 water samples were analyzed. Water samples, from the control and water filtered through Pteris mayii and Arachniodes simplicior roots, were tested. Using plants to filter water significantly reduced arsenic's presence. Pteris mayii decreased arsenic levels by 96%.

 Toxicity of arsenic in the water, filtered and unfiltered, was determined by isolating and converting the arsenic in the samples into gas, arsine. Water samples were combined with Tartaric Acid to create acidity; and oxidizer was added to prevent hydrogen sulfide from interfering with the results; and, zinc was added to convert arsenic in the water into arsine gas. A Mercuric Bromide indicator test strip measured the concentration of arsenic through the bottled samples' lids. After ten minutes, the reactions on the strip were compared with a calibrated color chart to measure arsenic for each sample.

 Arsenic is prevalent in water sources worldwide. Phytofiltration is an effective method to improve health and environmental issues involving exposure to inorganic arsenic in drinking water. Minimizing arsenic-related illnesses will positively impact millions, globally.

Awards won at the 2005 ISEF

Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by Ricoh

2005 - EV098

ALLELOPATHIC KINETICS: A NOVEL APPROACH DEVELOPING HERBICIDES USING NATURAL PLANT TOXINS

Ana Luisa Cisneros
Uniondale High School, Uniondale NY , United States

Synthetic herbicides have shown to be efficient in eliminating unwanted weeds, but studies have concluded that exposure to these chemicals can lead to several health hazards. As it becomes a global issue, the science of Allelopathy (the negative or beneficial effect of plant-plant interaction) is being analyzed to create an "environmental friendly" weed management alternative. In this analysis, the focus was centralized in the allelopathic effects of allelochemicals on agricultural crops that included Lolium perenne, Raphanus sativa and Glycine max. Juglone (an allelochemical whose potency is known) was used as a standard to compare the natural herbicidal tendencies of chlorogenic acid, pelargonidin chloride and rutin hydrate. With a future goal to ultimately make a natural herbicide using the most effective allelochemicals, the first stage focused of the chemical nature and inhibition potential of the allelochemicals. In the analysis of the chemical nature, signature fingerprints were obtained of juglone through Infrared Spectroscopy to understand its structure. To test the inhibition potential of the chemicals, a bioassay experiment was arranged where all 4 allelochemicals were tested on the mentioned agricultural crops in four different concentrations. After growth period, physical measurements were taken and the determination that chlorogenic acid and pelargonidin chloride were the most effect allelochemicals was made. In the second phase, biological testing was performed on plants inoculated with the two chemicals through photosynthetic analysis. Also a degradation test was held comparing the degradability of the two allelochemicals against RoundUp, concluding that these chemicals effectively substitute the synthetic ones used today.

2005 - EV099

DESIGN FOR BIODEGRADATION: HARNESSING NATURAL DECAY BY MANAGING PHYSICAL AND CHEMICAL DYNAMICS

David I. Marash-Whitman
Kehillah Jewish High School, San Jose, California, USA

This project's motivation was to determine how key physical and chemical parameters affect biodegradation efficiency and decomposition rates, impacting our ability to harness natural decay to our advantage so that we can keep organic material out of landfills. To assess biodegradation efficiency, small bioreactors were constructed for composting samples with varying carbon:nitrogen ratio, moisture, and aeration design (9 variations with duplicates, replicate runs). Temperatures produced were measured by probing bioreactor samples 3-5 times daily. To look at decomposition rate of organic samples, oxygen uptake and therefore CO2 emission was measured by monitoring liquid displacement in custom-built constant pressure respirometers.

The optimum carbon:nitrogen ratio was found to be about 30:1, reducing it to 20:1 (increased nitrogen) resulted in a 41% drop in averaged net temperature produced over 80 hours, and increasing it to 40:1 (increased carbon) resulted in an even greater drop of 51%. Measured CO2 emission rates were up to 8 times higher for

organics high in nitrogen during initial decomposition, consistent with a steeper initial ramp up to peak temperature observed for samples with low carbon:nitrogen ratios, which were subsequently unable to maintain their high temperature probably because not enough carbon was available to support rapid bacteria growth. Varying sample moisture produced optimum average temperatures for samples with 55% initial moisture content. Low to medium aeration design yielded optimum results.

This project derived optimum carbon:nitrogen, moisture, and aeration values for efficient biodegradation, and stressed the need to design for biodegradation by showing the impact of managing key parameters.

Awards won at the 2005 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2005 - EV100
COMPARISON OF ZEBRA AND QUAGGA MUSSEL FEEDING
Tim Walter Wilke
Liverpool High School, Liverpool, New York, USA

Ever since the introduction of the Zebra Mussel from European ships in 1988, the ecosystems of North American lakes and rivers have changed dramatically. The water clarity has greatly increased causing more weed growth in lakes, and a change in the feeding patterns of fish. The Zebra Mussel has also affected humans in several negative ways, such as the clogging of water intake pipes and the cutting of swimmers feet. Recently the Quagga Mussel, a relative of the Zebra Mussel, has been discovered in many areas already populated with Zebra Mussels. After introduction of the Quaggas, they take over and displace the Zebra population. The Quagga's feeding efficiency might be a cause of their success as well as their ability to grow larger, and survive in colder waters. In this study, the feeding rate of Zebra and Quagga Mussels was compared, for three different size groups. The results indicated that the Quagga Mussels fed slower than Zebra Mussels. Also, the results indicated that the size of the Zebra Mussels did not have much effect on feeding rate. Additionally, the larger Quaggas fed slower than smaller Quaggas. The slower feeding rate of Quaggas, combined with the fact that Quaggas consume a wider diet of microorganisms than Zebras, may help explain why the Quagga Mussels have a survival advantage.

2005 - EV101
THAT IS THE SMELL OF INSPIRATION
Andrew David Hix
Maryville High School, Maryville, TN, USA

The purpose of this project was to determine which of the three organic compounds (carbohydrate, protein, or lipid), fuels of anaerobic digestion, would be used by methanogens to produce the highest concentration of methane, a renewable and cleaner fuel than coal.

 The researcher hypothesized that since nitrogen is an essential nutrient for methanogens, and protein is rich in nitrogen, that protein would produce the most methane.

 One liter of sewage sludge was mixed with one liter of either dog food (protein), sugar (carbohydrate), corn oil (lipid), or a liter of all three compounds mixed in equal amounts (control). The mixtures were placed in two-liter, airtight containers equipped with gas collection systems for checking gas content and sampling valves for checking pH. The containers were placed in a 35 degree Celsius water bath, shaken and stirred at 60 rpm daily for two weeks. Gas volumes and visual observations of the digestion process were recorded every day. Methane contents and pH of sludge were measured every other day.

 In conclusion, the hypothesis was proven correct. The protein had

the largest, most constant output of methane of all three compounds. The protein-sludge mixture's pH changed little while the pH decreased with other additives. These results suggest that nitrogen is a very crucial nutrient for methanogens and possibly should be added to digesters to increase gas production while safely disposing of animal and human wastes.

2005 - EV102
PHYTOREMEDIATION: THE SECTION STREET SPRING
Jessica Marie McEnaney
Northwestern High School Springfield Ohio USA

Phytoremediation is the process by which trees and other vegetation remove, or degrade toxic waste and pollution in the environment. Plants remove harmful chemicals, metals, pesticides, and other contaminants when their roots take in water and nutrients. This form of remediation is used to clean up polluted soil and ground water. The Section Street Spring is a site contaminated with tetrachloroethylene (PCE) which has a Clean Water Act limit of 5 ppb. Since the contamination levels at the Section Street Spring are greater than 5 ppb this location is on the EPA's Master Site List (MSL).

To remediate a spring, The best place to start is in the water. Among the water plants chosen for the removal of the contamination were Anacharis, Banana Plant, and Red Myrio. Anacharis is a rapid growing plant which takes in a large amount of water and nutrients. Banana Plants have banana like roots that penetrate into the ground allowing the plant to absorb contaminates resting upon the bed of the spring's pond. Myrio grows rapidly and is adaptable to a wide variety of water conditions. Between the three plants Anacharis is the most adsorbent. The more water intake, the more chemical intake, therefore Anacharis will be the best remediate for the Section Street Spring.

When moving away from a controlled environment and into a contaminated site in society, there is a greater chance for error. Anacharis removed the greatest amount of tetrachloroethylene, according to the data collected. Tetrachloroethylene is a highly volatile chemical and the samples grew for eight weeks which could have been the main reason for lower results after being remediated. Tests on the plant tissue should be implemented to determine whether or not any of the three plants can truly remove tetrachloroethylene. Through this experiment a set clean-up plan was not reached but a good base for future research was obtained.

2005 - EV103
ANALYSIS OF MACROINVERTEBRATE POPULATION AND DIVERSITY WITH HYDROLOGICAL PARAMETERS AND THEIR INFLUENCE ON WATER

QUALITY - PHASE 3 - A WATERSHED STUDY

Christine Weizer Li
Cookeville High School, Cookeville, TN, United States

This year's study was designed to employ techniques and field and lab methods not only used in research Phases 1 and 2, but also to incorporate them with an expanded agenda to compare the water quality of urban and rural watersheds. Data sampling sites included Spring Creek, Blackburn Creek, and Pigeon Roost Creek, which represent three watersheds with different characteristics. Tests performed consist of turbidity measurements, Total Suspended Solids (TSS), flowrate, and biological indicators, the major component of this study. Macroinvertebrate samples were identified and given a Bioregion Index Score (BIS), which is comprised of each species' North Carolina Biotic Index (NCBI) and other water quality indicators.

After data analysis, I further confirmed water quality difference between the three sites: 1) Surprisingly, Blackburn Creek holds a slightly higher non-impaired BIS rating (38) as opposed to Spring Creek's (36), which is Tennessee's reference stream for this bioregion. The lowest BIS was found in the Pigeon Roost (20), an urban watershed. The study suggests that, in the future, Tennessee Department of Environment and Conservation may have two reference streams in this region. 2) Habitat assessment shows that a less diverse habitat (like the one found at Pigeon Roost) contributes to a lower BIS than a stream with a more diverse habitat. 3) Turbidity and TSS were proven to have a positive correlation using the student t-test proving that turbidity can provide rapid assessment in the field. 4) TSS and BIS display no significant correlation. 5) A higher percentage of urbanization contributes to a lower BIS value. 6) Watershed flowrates have no significant correlation with BIS value. 7) Proposed Best Management Plans were discussed to alleviate the water quality problem faced by small urban watersheds.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh
Honorable Mention Award - North American Benthological Society

2005 - EV104

A COMPARATIVE STUDY OF NITRATES AND PHOSPHATES DUE TO BLUE RIVER WATERSHED RUNOFF

Angie Marie Sells
Eastern High School, Pekin, Indiana, USA

There has been an obvious decline in the mussel population in Blue River in Indiana. This research was designed to possibly find a reason for the decline. It was hypothesized that if the nitrate and phosphate levels of various locations, including forested, fielded, and urban areas, along the Blue River were tested, then both levels would be highest in the urban area. Five sites on the Blue River were tested. Samples were taken every week for three weeks. A Vernier LabPro, a TI-83 Plus Calculator, and a Vernier colorimeter were used to analyze the nitrate and phosphate levels. After experimentation, totals and averages were figured and compared to healthy nitrate and phosphate levels for rivers. Even the lowest phosphate average, 0.3 mg/L, means that the levels in all sites were very high. This suggests poor water quality at the time. However, the nitrate levels were all well below the EPA Maximum Contamination Level of 10 mg/L NO3-N. Site four, which was in a wooded area with many homes, had the highest orthophosphate concentration. Site five, in an urban area had the highest nitrate concentration. An Anova statistical analysis was used to determine if there was a significant difference between the highest levels for urban to rural areas. There were no significant differences, however this shows that high phosphate levels and healthy nitrate levels were consistent throughout the course of the river. Based on the data collected, it was concluded that the hypothesis was supported.

Awards won at the 2005 ISEF

Tuition Scholarship Award of \$5,000 per year for 4 years for a total value of \$20,000 - Indiana University

2005 - EV105

THE ABILITY OF CERATOPTERIS RICHARDII TO TOLERATE AND ACCUMULATE CHROMIUM

Alina Yinan Lou
MOISD MSTC, Big Rapids, MI, USA

The purpose of this experiment was to determine if Ceratopteris richardii (more commonly the C-fern) was able to tolerate and accumulate varying concentrations of chromium into its biomass. A recent study had tested to see if the C-fern possessed the ability to tolerate and accumulate lead, and chromium was chosen for this experiment because of the growing chromium contamination in Michigan waters. My hypothesis was:

H0: Ceratopteris richardii will not be able to tolerate chromium.

H1: If Ceratopteris richardii is able to tolerate chromium in different concentrations, then as the concentration increases, so will the metal uptake in the leaves of the plants.

The plants were grown from spores and once they had sprouted 1 or 2 small leaves, they were transplanted to new mediums containing the following concentrations of chromium: 0 ppm, 10 ppm, 50 ppm, 100 ppm, 200 ppm, and 500 ppm. This was done initially to see if the C-ferns could tolerate growing in chromium.

All the plants except the controls died within two weeks, so the only statistical analysis done was a death percentage. Thus, it was found that C-ferns are unable to tolerate chromium due to the high toxicity of the heavy metal. Chromium accumulation could not be determined because there wasn't enough plant mass available. The amount of metal uptake would otherwise have been found by means of an Atomic Absorption Spectrometer. The results failed to reject the null hypothesis, and for that reason, they did not support the alternative hypothesis.

2005 - EV106

BIO-ELECTROMAGNETISM: SUSTAINABLE ELECTRICITY PRODUCTION USING A MAGNETIC FIELD GENERATED BY MAGNETOTACTIC BACTERIA IN A MICROBIAL GENERATOR

Kartik Madiraju
Centennial Regional High School, Greenfield Park, Quebec, CANADA

Bio-resources are considered as alternatives for present non-renewable energy resources. The hypothesis is if magnetic bacteria, *Magnetospirillum*, were immobilized by their flagella, using anti-flagellin antibody, they spin on their central axis, resulting in a bio-dynamo. In this project, a distinct method to produce electricity biologically is outlined.

The project's focus was to construct a generator cell, in which magnetic bacteria could be immobilized to spin, generating a magnetic field as in dynamos. In dynamos, electricity is produced electromagnetically.

A 0.7 cm³ cell was built with aluminum and polystyrene walls, coated with anti-flagellin antibody. The cell was connected to a voltmeter and bacterial culture was inoculated in the generator.

In a control generator with only growth medium, maximum voltage of 14 mV was achieved. In the cell with magnetic bacteria, a voltage peak of 78 mV was achieved within 50 minutes. Voltage remained above 65 mV for 2 hours. Preliminary results show electricity output even without bacterial immobilization. There was no noticeable electricity production with *E. coli*.

Theoretically, a D-sized bacterial battery, would have an output of 16 V. Sustainability of this energy source can be increased substantially by harnessing electricity from the bacterial environment and preventing bacterial cell sedimentation. Simulations predicted that in future, 1000 L tankers with magnetic bacteria could theoretically yield 170 kV of electricity. In conclusion, the presence of magnetic bacteria causes electricity production in a generator. This is a unique procedure to generate electricity in bio-dynamos, without production of pollutants and has the potential for scale-up.

Awards won at the 2005 ISEF

First Award of \$3,000 - Environmental Sciences - Presented by Ricoh
Grand Award of \$1,000 - Patent and Trademark Office Society

2005 - EV107

ESTABLISHMENT OF A NEW CULTIVATION METHOD USING DEEP OCEAN WATER AND SLIGHTLY ACIDIC ELECTROLYZED WATER

Tomoyuki Suzuki

Kanagawa Prefecture Hiratsuka Senior High School, Kanagawa, Japan

Miura peninsula where I live is one of the leading areas for cabbage cultivation in Japan. The amount of agricultural chemicals used for cabbage production has been increasing. Therefore, I started to research ways to reduce dependence on agricultural chemicals. As a result, a major cultivation method was discovered.

Drawing on the salty sea breeze that blows in Miura, a series of cabbage cultivation trial using deep ocean water were begun. Several positive results were obtained by spraying ocean water on cabbages. Then, I conducted experiments assessing the effects of the concentration of ocean water on cabbage growth. The highest concentration in this experiment, 300x resulted in the best growth.

As an alternative method for disease control, slightly acidic electrolyzed water was also tested. This has been used as an environmentally friendly method to sterilize cut vegetables. I conducted two experiments with cyclamen seeds and cutting dried Japanese radish, and consistently obtained a sterilizing effect. Then, its effect of spraying electrolyzed water on cabbage plants was tested in an open commercial field. In this experiment, electrolyzed water application and monitoring of cabbage plants were carried out once a week. The effects on cabbage growth were so good.

By doing these experiments, I developed a natural, environmentally friendly cultivation method.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV108

WHERE HAS ALL THE WATER GONE?- ANALYTICAL COMPARISON OF NON-NATIVE TAMARISK AND NATIVE WILLOW.

Sammia Renee Largo

Ft. Wingate High School, Ft. Wingate, NM, United States

The purpose of this project was to investigate whether the invasive Tamarisk transpired more water than the Native Willow in riparian areas. This was determined by the comparison of both tree species. The experimentation would either deny or confirm the hypothesis that the transpiration rate of the Tamarisk would be greater than the Willow. The first step of experimentation was the preparation of the beaker of water with its secure cling wrap to prevent evaporation. The stems were then weighed and recorded. The Tamarisk or Willow was then put through the cling wrap. It was then placed under a lamp for a total of 48 hours. The remaining water volume was measured, and then subtracted from the initial water volume of 400mL. That gave us the amount of water that had transpired. Observations were made within the 48 hours of transpiration. Five trials were conducted for each tree species. The mean of the five trials were calculated and recorded for both the Willow and Tamarisk. Results indicated that Tamarisk does transpire twice as much water than the Native Willow.

2005 - EV109

SAMPLING AND ANALYSIS OF AGRICULTURE RELATED CHEMICALS IN BULLOCH COUNTY FARM PONDS AS INDICATORS OF ACCUMULATION FROM RUNOFF PHASE II

Abby C. Blocker-Joyner

Statesboro High School, Statesboro, Georgia, United States

My project is a study of the environmental conditions of farm ponds. This is a two year study of 10 selected ponds within a 5 mile radius of my home in rural Bulloch County, Georgia, USA. Phase One, 2004, produced baseline data to see that the selected variables could be measured. My Phase Two, 2005, research was to monitor these 10 ponds, on 15 dates between June and December 2004. I did sampling and analyses of 7 variables on each of the 10 ponds over the 7 month testing period. The chemicals selected for testing were nitrate-nitrogen, nitrates, phosphates, and elemental phosphorus because when accumulation is high these relate directly to pond eutrophication. These compounds are found in both organic and inorganic fertilizers therefore are frequently carried into surface waters by runoff. The other variables tested were pH level, air temperature, and water temperature. Turbidity was tested but did not become an influencing factor. Dissolved Oxygen was tested and found to be highly consistent so not included in every sampling. Testing detected all the chemicals

studied at varying amounts yet none were found to be exceptionally high. PROCEDURES were to take water samples from the 10 ponds then complete chemical analyses using the HACH Surface Water Test kit. The pond locations and all mapping data were produced using the ARC-VIEW program and GPS data. My maps include aerial land use maps, topographic maps, and drainage area maps. After gathering and organizing my extensive data I then ran statistical analyses using the SPSS and Excel computer programs. My correlational research produced descriptive statistics, regressions, and r values from Pearson's correlation. In CONCLUSION I was able to support my HYPOTHESIS. The variables measured indicated changing amounts of chemicals monitored over the test period. Correlations were shown relating the variables to the rainfall in the statistical analyses.

Awards won at the 2005 ISEF

Scholarship Award of \$10,000 per year, renewable annually - Florida Institute of Technology

2005 - EV110

GROWING ENERGY: THE PRODUCTION OF HYDROGEN FROM THE GREEN ALGAE CHLAMYDOMONAS REINHARDTII

Radha Ramjeawan

Uniondale High School, Uniondale, NY, United States

en gas is the ideal fuel for a world in which air pollution has been alleviated, global warming has been confined, and the environment has been protected in an efficiently sustainable manner. Since the revolutionary breakthrough by Gaffron and coworkers over sixty years ago, the ability of unicellular green algae to produce hydrogen gas has been mostly a biological interest. Chlamydomonas reinhardtii are unicellular green algae that are capable of hydrogen production when grown under anaerobic conditions. This ability is owed to the inhibition of photosynthetic O₂ – evolution. As a result, an anaerobic environment is formed under constant illumination. Chlamydomonas reinhardtii then produces reversible hydrogenase (the activation enzyme that transports electrons to protons, thus synthesizing H₂) and begin to develop H₂ in light (Melis 1217). This project expanded on this biological reaction and produced significant amounts of H₂. When this study was conducted, it was noticed that hydrogen production occurred in these phases: the aerobic phase, an O₂ consumption phase, an anaerobic phase, and the H₂ production phase

 The second and most important aspect of this study involved channeling hydrogen yields into a fuel cell. This process proved to be more cost-effective than a 200 year old technique known as electrolysis. The future of hydrogen production as a fuel is extremely promising and economical. Could green algae provide hydrogen for a hydrogen fuel cell commercially? This remains to be seen but it is clear that the launch of this renewable energy carrier will have important economic implications.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

Honorable Mention Award of \$5,000 - Ricoh

2005 - EV111

IMPACTS OF ACCIDENTAL AQUACULTURE RELEASE ON THE HABITAT UTILIZATION OF NATIVE SPECIES: ENVIRONMENTAL MANAGEMENT CONSIDERATIONS

Marla Maxine Valentine

Murphy High School, Mobile, Alabama, USA

While the impacts of exotic species are known in terrestrial and freshwater ecosystems, their impacts on estuaries remain unstudied. Aquaculture commonly uses fast growing exotic species such as Nile tilapia (*Oreochromis niloticus*). Until recently, it was assumed Nile Tilapia escapes were unimportant since they could not survive winter temperatures. Recent surveys, however have found established populations of Nile Tilapia in the waters of Mississippi and Florida. The impacts of these populations on native species in rivers and estuaries of the Gulf of Mexico are unknown.

 The goal of this research was to determine if accidental release of the Nile Tilapia could lead to changes in habitat preferences of selected native fishes in the Mobile Tensaw Delta. In this study, varying densities of Nile Tilapia, and two native species (the Green Sunfish (*Lepomis cyanellus*), and the fathead minnow (*Pimephales promelas*), were offered choices between vegetated (*Valisneria americana*) and unvegetated gravel habitats. A second experiment tested Nile Tilapia impacts on native species habitat preferences. In single species experiments, regardless of density, all preferred the vegetated habitat. When Nile Tilapia was present, the native species were unable to consistently occupy their preferred habitat. The results of the preference tests and the interspecific competition experiments show that Nile Tilapia can have important negative impacts on the habitat preferences of native fish species. This suggests a need for management agencies to place more stringent requirements on the aquaculture industry to reduce releases of Nile Tilapia into coastal environments.

2005 - EV112

UV AND H₂O₂ REMEDIATION OF STRONG ORANGE-CONTAMINATED WASTEWATER

Adria Katrin Schwarber

Notre Dame Academy, Covington, KY, United States of America

The most commonly found pollutants in natural waters are dyes used by the textile industries. The current methods of disposing of these dyes are inadequate. The purpose of this experiment was to study whether the rate of degradation of a reactive dye would be increased by the addition of oxidizing agents such as hydrogen peroxide to the wastewater. Procion Strong Orange dye at concentration 0.05 g/L served as simulated wastewater. The concentration was measured using a spectrophotometer. Through three different runs degradation of the dyes in the presence of H₂O₂ and UV light was studied. UV acting alone was completely ineffective. H₂O₂, when acting alone, had some degrading effects. Surprisingly, it was found that the solutions containing 10 drops of H₂O₂ showed slower degradation than those solutions containing 5 drops of H₂O₂ (0.000149 g/L per minute for 5 drops and 0.0000560 g/L per minute with 10 drops). Although this was a surprise, this finding was constant throughout the experiment. With the addition of UV light, the solutions had a great increase in the degradation rates. The solution treated with 5 drops of H₂O₂ and UV light had nearly double the degradation rate of the solution that was not under UV light.

The solutions treated with 10 drops of H2O2 and UV light had four times the degradation rates of the solution that was not irradiated.

2005 - EV113

THE EFFECTS OF D-LIMONENE ON SOLENOPSIS INVICTA

Amarette Hope Aube'

Semianry Attendance Center, Seminary, Mississippi, U.S.

In this year's experiment I hoped to use D-Limonene to kill Solenopsis Invicta. In Phase I, I marked 6 large circles in my pasture. Two of these circles were sprayed with D-Limonene and Easy-Mulse, an emulsifier, two more were sprayed with Easy-Mulse to make sure it didn't kill the fire ants, and the final two circles were controls. The circles with D-Limonene and Easy-Mulse killed the ants but it killed the grass too. The Easy-Mulse circles didn't kill the ants, but it also killed the grass. I needed an environmentally safe emulsifier so in Phase II, I mixed Joy! with D-Limonene and water. They combined perfectly. In Phase III, I took four pans with baby powder along the edges, and put approximately 63 ants in each. The 1st pan contained half D-Limonene and half Joy!, the 2nd contained equal amounts of Joy!, D-Limonene, and water and the 4th more. All of the ants were dead the next day, but none were touching the substance. In Phase IV, I soaked a cotton ball in D-Limonene, put the cotton ball on a paper clip, and stuck both in an Erlenmeyer flask with 15 ants at the bottom. The fumes killed the ants in a day. In Phase V, I did four of Phase IV flasks, but with Florence flasks and with the concentrations in Phase III. This killed all of the ants, but I repeated the experiment in Phase VI to get more accurate results.

2005 - EV114

A SUCCESSION STUDY OF SOILS INVOLVING MICRO INVERTEBRATE POPULATIONS FOR WETLANDS RESTORATION

Jaime L. Jensen

Homeschool, Devils Lake, North Dakota, United States

Purpose: To observe the succession of soil cultures over a six-month period, to find which soil type is most conducive to the production of micro invertebrates in a simulated wetland environment, and to quantify the relationships between the protozoa and rotifer succession and concentration, and the water quality parameters over a six-month period. Establish which soil type would be the best medium for a wetland restoration.

Procedure: Five different soils samples were collected. The soil was sent to the NDSU Soil Testing Lab for analysis. The soil was allowed to dry out for two weeks, and 350 grams of one soil and 3.5 liters of spring water were placed in a one-gallon jar. This was repeated for all soil samples. After two weeks, 500 milliliters of water was removed from each jar and tested for pH, temperature, dissolved oxygen, orthophosphates, total phosphates, ammonia nitrogen, iron, sulfates, nitrates, nitrites, TDS, and conductivity. Water samples were taken and prepared for microscopic observation. Bacteria cultures were prepared using the spread plate method. After 24 hours of incubation, the bacteria were counted. This process was repeated every two weeks for six months.

Conclusion: Direct correlations were found between the pH, oxygen, ammonia nitrogen, total phosphate, iron, TDS, and sulfate levels and the algal and protozoa diversity and the rotifer populations. Practical conclusions could not be drawn as to a correlation between the bacteria numbers and the other considered factors because specific bacteria were not identified and their numbers did not show a great fluctuation. The Fargo soil series showed the greatest variety of algae and protozoa and the greatest population of rotifers over the six-month period, and would appear to be the best tested soil for a wetlands restoration project.

2005 - EV115

THE EFFECT OF THE MASS PERCENTAGE OF WATER TREATMENT RESIDUES ON THE PHOSPHOROURS LEVELS AND GREEN BEAN GROWTH

Casey Lynn Smith

Blssfield High School, Blissfield, MI, US

The purpose of this project was to determine the effect of the mass percentage of water treatment residue on the soil phosphorous levels when using bean plants. The hypothesis of this research study was that if the mass percentage of water treatment residues is increased then the amount of phosphorous maintained in the soil would also increase because of the binding capacity of the water treatment residues. In Phase I of this study, 0%-22.5% WTRs soils mixtures were set up using three groups fro each mixture. In Phase II of this study, 0%-12.5% WTRs soil mixtures were used with three groups each. The control sample in Phase II had a phosphorous level of 30.5 PPM, this was the highest result reported in the study. The 22.5% water treatment sample averaged a 5.3 PPM phosphorous level. This was a significant decrease when compared to the control. The largest declined were found with the 2.5% to the 5% with a decline of 6.3% PPM. The 10% and the 12.5% water treatment residues samples declined 6.3 % as well. The plants grown in the water treatment residues between 2.5% and 17.5% indicated a better growth rate with growths between 2.25 inches to 4.4 inches. The plants grown in the water treatment residue between 20% and 22.5% did not grow as well as the control plants. These results indicated that the water treatment residue does not affect the overall growth of the plants below the 22.5% water treatment. When the percentage of water treatment residue was increased the phosphorous levels in the soil decreased 20.5 PPM. When the percentage of water treatment residue was increased the growths of the plants show no significant change.

2005 - EV116

SCORCHED EARTH - TOXIC WATER AN INVESTIGATION OF ATMOSPHERIC MERCURY DEPOSITION AND WILDFIRES

Kyle Nathan Jaffa

Sandia High School, Albuquerque, New Mexico, USA

Atmospheric mercury deposition into water sources from anthropogenic sources is currently being investigated by the USEPA. Natural sources of mercury emissions not currently being modeled may also contaminate water. I hypothesized that if emission sources other than power plants are causing modeling aberrations in mercury deposition studies then wildfires may be identified as an under-recognized contributor to mercury deposition because wildfire smoke is known to contain mercury which is released during a fire. It was also hoped to identify geographical areas of greater possible release through soil analysis.

 Statistics were obtained for large wildfires from 2001-2004. Acres burned, seasonal trending, mercury deposition averages, and regional data were all analyzed and graphed. Locations of several fires were mapped along with Mercury Deposition Network sites. Deposition rates were graphed over distance and time following a fire. Soil samples were collected from forested areas and analyzed for stored mercury using a plasma spectrometer. Soil sample experimentation was unsuccessful as all collected samples were below the detectable limit of the spectrometer. Results of the atmospheric deposition analysis however did reveal increased mercury deposition in the first week following a fire's ignition within a 0-500 km radius of the location. There was also strong compatibility between seasonal and regional comparisons of mercury deposition data and fire data. Recognition of regional mercury deposition from a fire might help to identify water sources at risk for mercury alerts. Long term research may also lead to more understanding of elemental and divalent mercury in the global mercury budget.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV117

ABSTRACT WATER PURIFICATION SYSTEM FOR RURAL AREAS

Sarah DeWitt Nagel

MSTC-MOISD, Big Rapids Michigan, United States of America

The need for clean drinkable water is great, especially in developing countries. The plan of this research was to create a machine that could purify water in rural areas, using local materials that are inexpensive. The water purification system had to be able to clean polluted water to safe drinking levels (nitrate levels at 10ppm or less, no bacteria, no lead, and no pesticides).

 A box was made out of strand board, and the inside was painted black. Next, tubing was attached to the inside bottom. The tubing from inside the box was attached to a funnel that collected water after it had drained through a sand filled 5-gallon plastic bucket. A funnel stand and bucket stand were set up in the box and then translucent plastic sheeting was attached. Next, tests were conducted to see if the machine was able to heat the water in the tubing to the minimum needed temperature of 70°C. The water was tested for bacteria, nitrates, lead, and pesticides. It was found that the machine cleaned the water. The machine that was built worked, and was found to be an effective and efficient way to clean the contaminated water.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV118

A STUDY OF THE EFFECTS OF SELECTED TREATMENTS OF OILFIELD WATER ON THE VASCULAR CONTRACTIONS AND BEHAVIOR OF CALIFORNIA BLACKWORMS

Kari Lynn Gillespie

North Toole County High School, Sunburst, MT, USA

The purpose was to determine the effects of oilfield water on the vascular contraction rates, death rates, and behavior of California Blackworms and to test a commercial filter, a filter consisting of only filter paper, and a filter created from filter paper and activated charcoal.

 It was hypothesized that oilfield water would negatively affect the vascular contractions and behavior of California Blackworms and increase the mortality rates. Filtered water would be closer to levels safe for cattle drinking water and vascular contraction rates, behavior, and death rates would be improved in comparison to the oilfield water group.

 Oilfield water was collected and analyzed at Energy Laboratories. Water was filtered using a Brita™ filter, filter paper, and activated charcoal. Ten worms were exposed to each type of filtered water, spring water (control), and oilfield water for five minutes at a time and vascular contraction rates were counted. 25 worms were placed in a culture dish filled with each water type and death rates were recorded daily for five days. Samples of the filtered water were analyzed and the degree to which inorganic, metals, and physical properties were affected varied between filtration methods.

 Vascular contraction rates were significantly decreased and mortality rates increased in the worms exposed to oilfield water, Brita™ filtered water, and filter paper filtered water in comparison to the control. There was not a significant difference in the vascular contraction rates or death rates of the worms exposed to activated charcoal filtered water in comparison to the control.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV119

THE EFFECTS OF FLUORESCENT LIGHT ON WATER QUALITY

Sarah Jo Moquist

Valley High School, Hoople, North Dakota, USA

The purpose of this experiment was to determine whether levels of lead, cadmium, and bacteria in bottled water were affected by exposure to light at various amounts. The hypothesis was that lead, cadmium, and bacteria will be highest when exposed to 100% fluorescent light for the longest period of time.

 Tests were conducted on sealed bottled water stored in polyethylene terephthalate plastic. The water was initially tested for lead, cadmium and bacteria, then contaminated with human flora. The water bottles were stored in Styrofoam coolers to control the amount of light exposure. Each cooler was wrapped in aluminum foil to avoid indirect light. Individual coolers had various numbers of holes cut in the cover to obtain 0%, 33%, 67%, and 100% light exposure, which was tested using a light intensity meter. The coolers were maintained at room temperature and stored under fluorescent light for four weeks. Water was tested weekly for lead and cadmium using colorimetric analysis. Bacteria counts were taken using blood agar plates initially, and at varying intervals. The temperature

was read in each cooler using a temperature probe at four weeks.

The conclusions of this project are as follows: As light intensity increased, the temperature at which the water was stored increased. The highest lead readings were found in partial light. The lead readings showed a fluctuation over time. Cadmium levels fluctuated in a similar manner from week to week. All cadmium readings were over the EPA limit with the initial readings being the highest. Bacterial growth was limited during the study. Maximum bacterial growth was achieved at higher light intensities and at 48 hours.

2005 - EV120

CORRELATION BETWEEN COLORS OF GLOW AND DEGREES OF AIR POLLUTION

Han-Ki Oh

Daejeon science High School , Daejeon city, Korea

Abstract

 This paper is intended to investigate the average colors of sky glow and correlation between colors of sky glow and degree of air pollution. To do this, we recreated the colors in our lab by the computer program that verifies the colors of the sky glow. The result indicates that PM10 and the saturation of colors of sky glow are inversely proportional; $PM10 = 0.7746 \frac{1}{\text{saturation}} - 13.972 \frac{1}{\text{saturation}} + 104.39$. This result also presents that in days with heavy cloud, sky glow has light colors, in ones with high relative humidity, it has thick colors and in ones with high visibility it has reddish clear colors.

 Finally, the conclusion is that the more SO2 in the atmosphere is, the brighter colors sky glow has, the more O3 and NO2, the clearer colors it has, and the less CO, the redder colors it has.

 During the lab experiment for the recreation of colors of sky glow, it is realized that when the concentration of the scattering substances is changed, only the saturation is changed and the tone of the color isn't. That is why the sizes of the scattering substances are all the same. Through this experiment, a program that can recreate the colors of sky glow with pollutant variables is constructed.

2005 - EV121

BIOLOGICAL OXYGEN DEMAND AT INTERNATIONAL PAPER'S POINT SOURCE DISCHARGE

Lauren Wooten Smith

John S. Davidson Fine Arts School, Augusta, GA, USA

I became interested in conducting experiments on the Savannah River several years ago, after it was rated the seventh most polluted river in the United States. Augusta has a history of fluctuations in compliance with the Environmental Protection Division and struggles with consent orders. My 2003-2004 data summarized that the DO levels of the Savannah were really quite healthy except for the "at or near zero" level of DO at one of Augusta's paper manufacturing sites. DO levels less than 1-2 ppm will not support fish. Expanding on my previous project, I further studied this paper manufacturing site, to determine if the decrease in dissolved oxygen continued, if the dissolved oxygen equilibrated downstream, and to test the Biological Oxygen Demand (BOD). BOD is a measure of the oxygen used by microorganisms to decompose waste and is a measure of organic load like dead plants/wood pulp and sewage. DO levels in the Savannah River were healthy above and 0.5 miles below this paper manufacturing site (8.4 to 11 ppm) while levels at the paper manufacturing discharge measured 0.0 to 2.7. BOD levels above and below the paper manufacturing site were primarily very low < 2.7 ppm. BOD levels at the paper manufacturing site were 46 ppm. This site is permitted to discharge an average of 68 ppm of BOD. Its allowable discharge is in excess of acceptable BOD limits for ecologically healthy waters. This discharge is designed using the Savannah River as a mixing zone for dilution of BOD.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2005 - EV122

EFFECTS OF TEMPERATURE ON DIETARY ACCUMULATION AND TOXIC EFFECTS OF METHYLMERCURY IN RED SWAMP CRAYFISH (PROCAMBARUS CLARKII)

William Patrick Jagoe

AR Johnson Health Sciences and Engineering High School, Augusta, GA, USA

Global warming may increase temperatures in lakes, streams and wetlands. Metabolism and food consumption increase with temperature in poikilotherms, so exposure to contaminants in the diet may also increase with temperature. Mercury released into the atmosphere by industry and fossil fuel combustion is deposited to soils and waters and methylated in these environments. Crayfish are opportunistic omnivores that live in wetland environments where they can accumulate methylmercury from their foods. If metabolism and feeding increase with environmental temperature, mercury content in tissues might also increase. Methylmercury causes disorientation, and loss of sensory perception and coordination. Such neurotoxic effects could influence abilities to find food or shelter, defend territories, find mates, and avoid predators. These effects might be increased at higher temperatures, if more methylmercury is accumulated from the diet. I fed *Procambarus clarkii* (n=96) diets with high or low methylmercury (< 0.1 and > 1 ppm) while keeping them at two different temperatures (15 and 20 C). I measured tissue mercury concentrations and ecologically-relevant behaviors (foraging, ability to find shelter and food detection) after one, two and three months of exposure. Crayfish fed a high mercury diet accumulated more mercury than those fed a reference diet. Crayfish also consumed more food and accumulated more mercury in muscle at the higher temperature. Muscle mercury concentrations were higher than carapace concentrations. This supports the idea that global climate change could increase accumulation of some pollutants in poikilotherms. The results of the behavioral experiments were inconclusive. Differences among treatments were not statistically significant so hypotheses about effects of mercury on behavior cannot be rejected at this time. It is possible that longer exposure would result in greater mercury accumulation and more marked behavioral differences.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

Third Award of \$100 - Society of Environmental Toxicology and Chemistry

2005 - EV123
RADON- GUAM'S UNKNOWN THREAT

Kim Tae Hun
Father Duenas Memorial School, Mangilao, Guam

The project in its present form serves the purpose of helping people to be aware of Radon effects and of determining if simple acts like placing plants in rooms can reduce Radon levels.

 After research, plants were hypothesized to help reduce radon levels because plants help circulate the air through their process of photosynthesis. The element Radon concentrates in homes or places that have poor ventilation.

 In order to find out if plants reduce Radon levels the approach of before and after was used. Testing the homes with two canisters gave the initial results. One canister tested the living, and the other canister tested the bedroom. After testing, a plant was placed in the living room for a week. A week was sufficient time because Radon takes less than a week to equilibrate its level. While the living room had a plant during this one-week period the bedroom did not have a plant. Thus it was the experiment's control while the living room serves as my experimental factor. Once the week was over, radon canisters tested both rooms.

 Comparing radon readings from both testing showed the experiment's conclusion. The recommended level for Radon is 4.0 pCi/L, and most of the results were under the recommended level and showed that Radon did help reduce levels. One sample that showed the experiment's conclusion was a testing from .89 pCi/L to .72 pCi/L while the levels in the control group remained almost the same from .91 pCi/L to .96 pCi/L.

Awards won at the 2005 ISEF
Award of \$3,000 in savings bonds, a certificate of achievement and a gold medalion - U.S. Army

2005 - EV301
A PESTICIDAL SURVEY OF THE WEST ST. JAMES WATERWAYS

Ciara M. Sutherland, Jahara I. Pierre
St. James High School, St. James, LA, USA

The purpose of our experiment was to find out any pesticides that may be found in waterways in West St. James Parish and establish if they are harmful to West St. James residents. In order fulfill the purpose of our experiment, we had to collect samples gathered from West St. James waterways. After we collected the samples, we then proceeded to test them for any pesticides that appeared to be abundant in West St. James. We organized data such as the location of the samples and the time the samples were collected. We came to the conclusion that only three non-harmful pesticides were found. We also found out that the three pesticides found were extremely minute. In the future, we hope to conduct studies documenting the waterways of East St. James, West St. John and East St. John. All of which are surrounded by sugarcane crops.

2005 - EV302
ASSESSMENT AND ANALYSIS OF WATER QUALITY IN THE CHAIN OF LAKES IN MINNEAPOLIS, MINNESOTA

Kalia Her , Erik Michael Halvorson
John A. Johnson Senior High, Como Park Senior High, St. Paul, Minnesota, USA

The Chain of Lakes in Minneapolis, Minnesota, provides many recreational activities for local residents and visitors. The Chain of Lakes has many attractions and it's becoming vulnerable to ecologic disturbance from a wide variety of human activities. The quality of water is now an issue of concern to many of the local communities and the DNR and MPCA. Our experiment was to determine if there were any specific disturbances ecologically in the Chain of Lakes. The Chain of Lakes included: Cedar Lake, Lake of the Isles, Lake Harriet, Lake Calhoun, Minnehaha and Minnetonka confluence, Lake Nokomis, and the Minnehaha Creek and Mississippi River. Our experiment extended from April to August of 2004. Over the five month period we tested for nitrate, phosphate, dissolved oxygen, carbon dioxide, pH, temperature, conductivity and hardness to determine the water quality. We hypothesized that Cedar Lake was going to have the least ecological disturbance and have the highest water quality because it is the beginning of the chain and is spring fed. Lake Harriet and Lake Calhoun were hypothesized to be the most affected lakes because of their commercial locations and the unlimited number of events and interest within the area. In conclusion our data revealed that by the end of the summer the pH levels have increased in almost all of the lakes. There was a negative association between the results of CO2 and DO2 in almost all of the lakes. And by August the clarity of water increased and algae decreased.

2005 - EV303
ARE THERE OXYGEN DEFICITS IN LAKE PANASOFFKEE

Russell Wayne Swartzfager, David W. Swartzfager
Wildwood high School, Wildwood, Florida

In part, dissolved oxygen levels collected and compared can be used to recommend dredging used for lake restoration. Fish and wildlife will benefit from the higher dissolved oxygen levels that occur after dredging.

Are there dissolved oxygen defecits in Lake Panasoffkee? If there are dissolved oxygen defecits in the water of Lake Panasoffkee then the mapping and data collection will identify the specific areas deficient in dissolved oxygen.

The study presented lower dissolved oxygen levels at the northern most and southern most points of the oblong lake. Dissolved oxygen(DO) ranging between 1.88ppm and 5.04ppm at the north end of the lake and at the south end of the DO ranged from 2.10ppm to 5.40ppm. The highest level of dissolved oxygen was found in a test area that had been dredged a little over a year ago (site 5 on the southwest side). The range of DO recorded here was 8.30ppm to 10.10ppm. This spike in dissolved oxygen was caused by the experimental projectof dredging and the removal of vegetation. As silt and vegetation are removed, the water can flow more freely through the area. The more movement in a body of water the higher the dissolved oxygen increases.

When data is graphed, oxygen defecits appear pronounced. Defecits were found at the southern most and northern most areas of the lake and among vegetation, thes defecits were recorded at site numbers 11, 12, and 13. Therefore Lake Panasoffkee has specific mapped sites that show dissolved oxygen defecits.

2005 - EV304

STUDIES ON WATER QUALITY PROFILES OF ESTUARINE SYSTEMS IN PUERTO RICO

Loipa Ramos, Angela Figueroa

Academia Nuestra Señora de la Providencia, San Juan, Puerto Rico

Water quality has been decreasing for the past decade in different water bodies of Puerto Rico. This is why this research intends to investigate how much pollution has increased on the water of The San Juan Bay Estuary in Puerto Rico. If the water quality has decreased at The San Juan Bay Estuary in Puerto Rico, its use will be affected for primary and secondary contact recreation and the propagation of endangered species will be reduced.

 The San Juan Bay Estuary was divided into seven stations. Each station was visited and observations were done concerning color, smell and temperature of the water, wind, climate, air temperature and nearby activities. A water sample was taken from each site using gloves and sterilized 250mL flasks. The water samples were taken to an environmental laboratory to be analyzed for: coliform bacteria, dissolved Oxygen, biochemical demand of Oxygen, pH level, total residual Iron level, total residual Chlorine, fat, oils and turbidity percentage.

 Results confirm that there is a bigger degree level of pollution that affects the use of this water for primary and second contact and for the propagation of endangered species.

2005 - EV305

A NUTRITIONAL COMPARISON OF HISTORIC LESSER SCAUP FOODS TO THE ZEBRA MUSSEL

Mitch Dale Weegman, Matt Moraco Weegman

Winona Senior High School, Winona, Minnesota, United States of America

The lesser scaup population has steadily declined from 7.5 million breeding birds in the 1970's to 3.5 million in 2003. The purpose for this project was to compare the nutritional value of traditional scaup foods (fingernail clams, freshwater shrimp, snails, and wild celery) to the zebra mussel. It was hypothesized that the nutritional value of the zebra mussel would be less than traditional foods, with the exception of wild celery. Freshwater shrimp should have the highest nutritional value, while wild celery would contain the highest concentrations of moisture. The invertebrate collection took place at Lake Onalaska, WI. The petite ponar dredge technique was used for invertebrate collection. This process was repeated 6 times from May-August, 2004. Lipid and moisture analyses were conducted at Viterbo University, LaCrosse, WI, using procedures from Covance Laboratories. A standard Bradford assay was used for the protein analysis. Overall, freshwater shrimp contained the highest nutritional value, while the zebra mussel contained the lowest nutritional value. Low fat concentration in zebra mussels may be due to the materials that are filtered having low fat content. The zebra mussel is the least nutritionally fit of all of the species tested, while the freshwater shrimp is the healthiest for lesser scaup to consume. Overall, the data supported the original hypotheses.

Awards won at the 2005 ISEF

Second Award of \$1,500 - Team Projects - Presented by Ricoh
Honorable Mention Award - North American Benthological Society

2005 - EV306

AN INFERENTIAL STUDY OF THE EFFICIENCY OF THE NATURAL FILTRATION PROCESS OF THE OES WETLANDS AS DETERMINED BY THE BIOLUMINESCENT CAPABILITIES OF THE DINOFLAGELLATE P. NOCTILUCA

Cole Thomas Streiff, Matt Mckinney

Oregon Episcopal School, Portland Oregon, USA

Marine dinoflagellates bioluminesce when the chemical luciferin is oxidized, releasing a large amount of energy in the form of light. Bioluminescent dinoflagellates are ideal for indicating toxins because they are very sensitive, the amount of light they produce is directly proportional to their health, and therefore, the health of an ecosystem. This project aimed to determine whether the dinoflagellate, Pyrocystis noctiluca, could be used successfully as an indicator of ecologic toxins over a period of time. Multiple cultures of Pyrocystis noctiluca were grown, allowed to reproduce, and then divided into two groups. The control group remained untreated, except for the addition of more growth medium to keep the volumes of the cultures constant. Each of the other three groups were administered either distilled water, parking lot run-off water, or wetlands treated water; the later two contained ecologic toxins. The light intensity of each culture was measured and recorded. Both the ES-Enriched medium and the distilled water increased in brightness by 24.25% and 15.1% respectively while the parking lot run-off water and the wetlands treated water decreased by 26.95% and 19.35%. The data suggests that Pyrocystis noctiluca can be used effectively as a bioluminescent indicator for various ecologic toxins present in the environment. This discovery is encouraging because this process provides a convenient new method which can be used to determine the general health of an oceanic ecosystem.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Team Projects - Presented by Ricoh

2005 - EV307

EVALUATION OF INNOVATIVE NITRIFICATION INHIBITORS

David Day Song, John Daniels Ruzic

Ballard High School, Louisville, KY USA

A. Ammonia-oxidizing bacteria (AOB) are known to nitrify the ammonia in chloramine, thereby breaking down the molecules of chloramine, resulting in the exposure of drinking water to biological contamination. Thirty percent of the water utilities in the United States use chloramines as an alternative disinfectant.

Out of these utilities, 63% of them have experienced nitrification.

B. Nitrification inhibitors (NIs), are chemicals that “disrupt” the activities of the AOBs, resulting in the inhibition of nitrification.

C. There are two processes occur that during nitrification: 1) The process of oxidation of NH3 (ammonia) to NO2- (nitrite) by ammonia oxidizing bacteria. 2) The NO2- produced from the first process is then oxidized to NO3- (nitrate) by nitrite-oxidizing bacteria (NOB).

D. The study is comprised of two phases. In phase one, certain NIs are selected for testing after an extensive literature review. These chemicals are screened for their ability in nitrification inhibition. After selecting the most effective NI, the chemical is further tested at various levels.

2005 - EV308
THE EFFECTS OF SOURCES OF INNOCULEMS ON METHANE PRODUCTION

Berhanemeskel Alemu Nida , Nathan Abay Kebede
Piney Woods School, Piney Woods, MS, United States

This project studies two main things that go hand in hand. First, we compared the amount of methane from different sources and selected the most efficient one. Second, we designed our own unique apparatus that could produce energy for domestic uses consuming the efficient source of methane that we have selected earlier.

Pig waste, rumen fluid, lagoon water and fresh water were used for the experiment. Pig waste was mixed with rumen fluid; lagoon water and fresh water were mixed each in separate flasks. The delivery tubes connected these flasks with another pair of flasks that contain alcohol. The alcohol was sent to research center to find the amount of methane in the alcohol. Our result showed that the mixture of the rumen fluid and the pig waste can produce 2.8 cubic feet of methane gas from the waste obtained by one pig per day while the other only produce 1.4 to 2.1 cubic feet of methane.

The apparatus we designed contains about four to five tanks; acid forming bacteria and methanogens, compressor, generator, heater and other electronic equipment. Our apparatus is very economical and according to our study just form wastes of twelve pigs and three cows we can save up to \$324 per week and \$ 16,000 per year. In comparison with the bigger biomass plants, this machine will not cost nearly as much but still produce enough methane to be used locally. Once in use it will provide heat, gas for cooking, electricity for other uses.

2005 - EV309
EFFECTS OF PHOSPHATE ON CRAWFISH

Shanee Tranise Turner, Alisha M Bailey
St. James High School, St. James, LA, USA

See Alisha Bailey's Abstract

2005 - EV309
EFFECTS OF PHOSHATE ON CRAWFISH

Alisha Marie Bailey, Shanee` Turner
St. James High, St.James,Louisiana , USA

The purpose of our project is to test the effect of phosphate levels in water on crawfish's growth. We all know that phosphate is an essential nutrient for all aquatic plants and algae, however, excess phosphorous can cause pollution and lead to eutrophication (a condition where an over abundance of nutrients, such as phosphorus, causes increased plant and algae growth). Eutrophication is known for lowering levels of dissolved oxygen in water, which causes a decrease in fish population. An experiment was developed to test the response of crawfish to various levels of phosphate concentrations. Five crawfish were placed in three gallon aquariums. Different concentrations of phosphate solutions were added to two of the tanks and tap water was added to the third. The same nutrients were placed in all three tanks. Crawfish were observed for one week. Results confirmed our hypothesis that the higher the concentration of phosphate (0.7ppm) resulted in the death of three of the five crawfish in the first tank. Crawfish in the 0.1ppm phosphate concentration were all still alive after one week. There was no observable algae in the tanks, so we could hypothesize that the phosphate had direct effects on the crawfish.

2005 - EV310
AIR QUALITY IN PORT HURON AND ITS EFFECTS ON THE POPULAITON

Rachna Beeravolu Reddy, Elizabeth Wells Busdicker
Port Huron Northern High School, Port Huron, MI 48060

Our objective was to determine if a correlation existed between the daily Air Quality Index(AQI)levels, emergency room(ER) visits for respiratory problems and school absences over a period of 90 days in Port Huron, Michigan. Our hypothesis was that we would see a correlation on that day or two days after.

AQI documents the quality of air. It measures five pollutants. The AQI levels range from 0-500 with 500 being the worst possible air quality and 0 being the best.

We obtained data from October 17th, 2004 to January 15th, 2005. The school absence data was collected from St. Clair County Regional Educational Service Agency for all public schools in Port Huron. The ER data was collected from our area hospitals. The diagnoses classified as respiratory were pneumonia, bronchitis, asthma, pharyngitis, sinusitis, emphysema, and upper respiratory infection (common cold).

A Pearson Coefficient of Correlation test was performed on the data gathered. No direct correlation was found. The data from the two-day lag was separated into quartiles by AQI levels. There was a trend towards increased number of ER visits in the highest AQI quartile (20.5 visits) as compared to the lowest quartile (12.8 visits). School absences did not show a significant difference.

In conclusion, there was no direct correlation between AQI values, school absences, and ER visits. We did observe a trend for the number of ER visits to be greater in the highest AQI quartile versus the lowest AQI quartile.

2005 - EV311
THE RELATIONSHIP OF THE BEHAVIOR OF TADPOLE OF RANA OMEIMONTIS WITH THE CONCENTRATIONS OF THE WATER IN RICE PADDY

Yi Wang, Xiang Shi, Fei Duan
Chendu Number 7 High School, Chendu Sichuan, China

There are fewer tadpoles in rice paddy compared with them in stream and pond in the Emei areas. For delving the cause we compared the behavior (including distribution) of Rana omeimontis tadpoles in different concentrations of water of rice paddy and stream. It is showed that (1) The behavior patterns of tadpoles between the blank and experimental groups are quite different ($p<0.05$); (2) The correlation of index of crowding (P) of tadpoles is positive ($y = 0.2316x + 2.7348$; $R = 0.8862$) and the index of gathering (k) is negative ($y = -0.026x + 0.5662$; $R = 0.8122$) as the concentration of the water of rice paddy increases; (3) Tadpoles' distribution patterns are obviously different between water of rice paddy and stream ($p<0.05$). According to the data, it is deduced that: (1) Water in rice paddy has influenced tadpoles' living and (2) The behavior (including the patterns of distribution) of Rana omeimontis tadpoles is sensitive to variation of habitats.

Awards won at the 2005 ISEF
Fourth Award of \$500 - Team Projects - Presented by Ricoh

2005 - EV312
BARREN LAND

Casey Eugene Hunewill, Tyler Hunewill Elliott
Smith Valley High School, Smith, Nevada, United States

As the amount of farm land decreases, it's pertinent that our crop lands are producing feed on every square foot in order to support our food demand. The title of our project is "Barren Land". The purpose of our experiment was to find out if bloat/mineral blocks were ruining farmers and ranchers land when they placed them on the soil in their fields.

 In the first part of our experiment, we planted corns seeds in an artificial environment. The second part was done in a natural environment. The variable was the block that was added to the soil surface. Erosion of these blocks occurred by natural elements and the watering of these plants. The soil was tested for various elements before and after experimentation. The plants were measured daily, observed and then preserved after the project time expired.

 Our results concluded that the bloat/mineral blocks don't kill everything in its area, but the growth was very poor. The seeds in the control soil grew 100% faster. With the high price of retail cuts, a rancher needs to be aware of their soil fertility rate so they can maximize production and profit.

2005 - EV313
LEAD ... INADVERTENT POLLUTING AGENT

José Eduardo Bogado Mercado, Eisis Maria del Carmen Cabrera Chavez , Fatima Aidee Chavez Lazcano
Colegio Tecnico Nacional , Encarnacion, Paraguay

One of the factors that contribute in great measure to the atmospheric contamination is the toxic gas discharge on the part of the automobiles. In order to eliminate oxides of nitrogen and of carbon that take place during the combustion of the gasoline, the governments of almost all the countries, have begun to demand to the automotive industries the installation of catalytic converters which consist of filters which are placed in the part previous of the escapes sewers, in order to oxidize to carbon dioxide compounds and to reduce to nitrogen, nitrogen oxides. These compounds are those that are generally considered in the study of the environmental contamination. In our city. Encarnación, is of frequent use the gasoline of low octane that contains the additive and tetraethyl. Worried by the harmful effects that it can cause the lead in the alive beings, in chronic form, happening like an inadvertent pollutant agent, we chose to make a detailed study more of the same one in the environment. Considering that the lead released in gases emanated by the vehicles, adheres to the leaves of the trees. We decided to determin espectrophotometrically the lead that Could be accumulated in the same ones, in zones of the City, with different characteristics and to compare the obtained results. The dates successfully obtained data demonstrate that to considerable quantity of lead accumulated on lthe leaves exists, and when comparing the results, we confirm the lead presence in the atmosphere and that the contamination is greater in zones surrounded by buildings and with little vegetation; reason why we think that is convenient to present the results, to the pertinent authorities and the community, through char them educative, conferences to object of make conciens on the necessity of diminish the uses of fuel of smaller octane, in safeguard of our health.

2005 - EV314
WAT'R YOU FILTERING?

Perry Emerson Mullins, Eric James Kauffman, Brian Thomas Stelly
Williams High School, Plano, TX, USA

With pollution becoming a greater problem in our society, water treatment is a growing concern to many people. There have been many innovations in the field of water treatment so that clean and contaminant free water can be made available to the public. Water treatment plants incorporate several different steps in the water purification process. One key step is the filtration of water through soil. This experiment answers the question of which type of soil would be most useful and efficient with this method of filtration. In this experiment, the dye solution that is poured through the soil represents the polluted water processed through the treatment plants. As the water flows through the soil, the dye is removed. The remaining filtrate, along with the water, eventually drips out the bottom of the funnel and into the beaker below. After the experiment, there will be twelve beakers with various concentrations of blue dye remaining. By comparing the amount of methylene blue present in the beakers to a control, it becomes apparent which of the three soils is the most efficient at filtering the pollutants. This information can be very useful in the efficient filtering of the public water supply in cities around the world.

2005 - EV315

THE SOLUTION TO PHOSPHORUS POLLUTION

Johrdashe Journey Walsh, Bernard Nguyen
Sumner High School, Sumner WA, USA

In our experiment, we wanted to see if using Struvite for a fertilizer affected plant phosphorus levels. To accomplish this, we worked with scientists at WSU Extension in Puyallup, who took us to Werkhoven Dairy in Monroe, WA, where we observed the process of Struvite extraction. We predicted that Struvite would produce healthier plants and higher phosphorus levels than 11-52-0 commercial fertilizer. On January 31, we planted corn and triticale seeds, the purposes of which to assess Struvite's effect on a stalk and a grass. Our 24 pots were fertilized with one type of fertilizer at one of three application rates. The plants grew for approximately 35 days, during which time we watered and recorded observations four times a week. Before conducting phosphorus analysis, we measured final plant height and weight. After this, we dried our plants and sent them to Custom Dairy Services, for phosphorus analysis. Four days later, the results showed that corn fertilized with Struvite had more phosphorus, but triticale fertilized with 11-52-0 had more phosphorus. These results were invalidated when we learned of a laboratory accident that mixed our samples. With unreliable phosphorus analysis, conclusions were based on weekly growth data. We concluded that while the corn grew better with Struvite it was because the corn plants use phosphorus in the beginning of plant growth. The triticale didn't respond to Struvite as well, which was attributed to the fact that a shortened growth period may have prevented us from seeing how much phosphorus it would absorb over time.

2005 - EV316

ZOOM-ZOOM-DOOM WHAT EFFECT WILL ASPHALT RUNOFF WATER HAVE ON POND ECOSYSTEMS?

Cassandra Beumler Pardee, Jessica Alice Mason
Buena High School, Sirra Vista AZ, USA

We wanted to find what effect asphalt water had on ecosystems in pond water. It is assumed that chemicals from the asphalt would kill the organisms, but how much was not known. We tested two types of asphalt water. One had been sitting on the pavement for an extended period of time, and the other ran off the asphalt and then put directly into tank two. Next, we wanted to reverse the effects of the asphalt water by adding nutrients to make algae grow. We decided to add Miracle-Gro, because of the large quantity of phosphorus, iron, and other nutrients. We set up tanks and put equal masses of pond water and algae form the Buena pond into each. Then we added asphalt water to the test tanks. We conducted tests to find the health of the tanks, and looked at samples under a microscope to see the diversity in the tanks. When we added the Miracle-Gro to tank two, we continued taking tests, to see if helped rejuvenate the tanks. We found that the sitting water damaged the aquatic ecosystems faster than the runoff, but the runoff had more devastating results. We believe that this is because the runoff didn't have time to dilute, unlike the sitting water. The Miracle-Gro did have the desired effect on tank two. The algae started to grow back, and we hope in the long run it would help the tank become healthy like in the beginning of testing.

2005 - EV317

ENVIRONMENTAL IMPACT OF THE ECOSYSTEM OF THE COASTAL ADGE OF THE CITY ANTOFAGASTA REGION CHILE BY EMISSIONS ORGANIC

Gonzalo Raúl Aravena Rojas , Diego Alex Latrille Martínez, Jonathan Andrés Fortt Ahumada
Colegio Part. Antofagasta, Región de Antofagasta, Chile

The environment impact produced by pollution of the seashore due to organic emissions of residential and industrial residues and hidrocarburants emitted by fuel plants in Antofagasta city, second region of Chile, is affecting flora and fauna population density on the seashore. This investigation was realized in order to make people conscious of this pollution and how it influences in their life quality. It was made in two different places in Antofagasta seashore. A contaminated beach in front of a served water treatment plant named CASCAL and EL LENGUADO beach at Antofagasta southside. To determinate the number of habitants and realize a quantitative comparison, we used the quadrant method and abundance measurement (Guerra, C., 2000). As a result, we obtained that flora and fauna in a contaminated place varies considerably compared to a non-contaminated one. In El lenguado beach, we found 1810 specimens in a quarter of a square meter(1/4 m2), and 810 specimens in a quarter of a square meter in a contaminated beach. This could be the reason of gastro-intestinal diseases because population living close to the contaminated beach use it for fishing and mollusks extraction. The contribution of the project, is in the first place, to bring to light the flora species decrease and marine fauna and the alterations produced in the human health due to the toxicity presented by the marine water of the zone. In second place to try that the governmental authorities become aware of this ecological imbalance and that the plants of fuel generate their own resources of decontamination; besides to organize advertising campaigns to educate to the population of our country.

2005 - EV318

PRESENCE OF COLIFORM BACTERIA IN SHORELINE SOILS AND PUBLIC BEACH RESORTS IN PUERTO RICO

Roxanne Alvarado, Angel M. Suárez Márquez
Miguel Meléndez Muñoz High School, Cayey, PR

The presence of coliform bacteria in shoreline sands from several places in Puerto Rico was examined. The purpose was to determine whether this type of bacteria, used as indicative of fecal contamination, was present in shoreline sand. The number of coliform bacteria was expected to be higher in public beach resorts than in other shoreline soils. The samples were handled ascepticaly and collected in sterile vials. Five grams of soil were vortexed in 10mL of sterile water. Serial dilutions were prepared. One milliliter samples were spread plated in Mac Conkey agar, a selective medium for coliforms. Bacterial colonies were counted after 48hours of incubation at 37°C and a total viable organism per gram of soil was estimated. Sand samples from public beach resorts were expected to produce more colonies since these are exposed to more frequent human activities, nevertheless, the results were not as expected and a higher number of colonies were obtained from shoreline soils from a different source.

2005 - EV319

ANCHOR PIT: A CORRELATION BETWEEN DENSITY AND TOTAL DISSOLVED SOLIDS

Katherine Rose Aurand, Jessica DeVries
Stevens High School, Rapid City, SD, U.S.A.

Research project was designed to determine the correlation between density and total dissolved solids in water samples from Anchor Pit at the Gilt Edge Mine EPA Superfund site. It was hypothesized that the hydrometer would aid in finding the correlation. Samples of distilled water and water from varying depths in Anchor Pit were taken, and different amounts of NaCl were added to each 500ml sample type (0g, .5g, 1.0g, 1.5g, 2.0g, 2.5g, and 5.0g). The samples were tested with a hydrometer, with a thermometer, and with an electrical conductivity meter to determine the density, the temperature, and the total dissolved solids. The results from the specific gravity tests were averaged to reach an increase of .0007. For every .5 grams of NaCl added to the 500ml sample, it increased the total dissolved solids by 1000. This information aided in formulating a calculation to find the total dissolved solids in water samples. This equation was formulated: the corrected specific gravity from the water sample, minus the standard specific gravity, divided by the average increase in the corrected specific gravity, multiplied by the amount of total dissolved solid increase for every .5g of NaCl. Another way of writing this is specific gravity of the sample – 1.0013/ .0007 x 1000= the total dissolved solids in the sample. It was concluded that the total dissolved solids of water from Anchor Pit can be found using only a hydrometer, thermometer, and the equation. This would allow for fast on site testing.

2005 - EV320

ON GOLDEN POND: THE STUDY OF MICRONUTRIENT DEFICIENCY IN GOLDEN ALGAE, P. PARVUM

Summer Dawn Sink, Crystal Daisy Wong
Burkburnett High School, Burkburnett, TX, USA

The purpose of this project is to determine which micronutrient is most necessary for the P. parvum alga to survive. In recent years, golden alga has been responsible for killing thousands of fish in many different water reservoirs in Texas such as the Brazos, Pecos, Red and Colorado drainages. By testing the micronutrient needed for P. parvum to survive, we may be able to slow the reproduction of this alga. By inhibiting the amount of any one micronutrient will have an adverse effect on the growth of P. parvum. The most needed trace element was determined by making seven different micronutrient stock solutions, each leaving out one element, and one control, which included all seven elements. The test was carried out in eight test tubes: one control, and seven of which were treated with one of the seven micronutrient solutions lacking an element. A macronutrient stock solution was also made and was added to each of the eight bottles. One mL of cultured P. parvum was added to the solutions after taking an average alga count for the culture. The solutions were left by a window in order to allow the photosynthesis process to occur. Each day, 1 microliter each of the macronutrient and micronutrient solution were added to each test tube. After the ten-day testing period, several drops of each of the samples were analyzed and an average alga count for each test tube was taken in order to determine whether the alga underwent growth or reduction. The control sample endured a growth because the sample received all of the seven micronutrients available in the accepted pond water solution. Our initial hypothesis was correct; the removal of any one micronutrient decreased the growth of the P. parvum. Of the seven test samples in the trial, on average, the sample lacking Iron showed the largest amount of alga depletion. Zinc posed as its second most needed micronutrient.

2005 - EV321

CONVERSION OF HAZARDOUS PETROCHEMICAL SLUDGE WASTE AS A NEW HIGH DIELECTRIC CONSTANT MATERIAL

Ahmad Syafiq bin Ahmad Hazmi, Khairul Ihsan bin Talib, Nurul Farhana bt. Zulkifli
MARAJunior Science College Taiping, Taiping, Perak, Malaysia

Petrochemical sludge (scheduled waste) is hazardous to the environment and improper disposal poses a serious problem as the waste treatment is expensive. Currently only limited amount of this treated waste is reused mainly for infrastructure materials such as artificial stones. The aim of this project is to produce a composite with its specific characteristics. Contaminants such as water and organic compounds in the waste are removed through firing. The ash from the sludge, that contained various metal constituents, added with soda-lime glass at the ratio of 95% glass and 5% ash by using the Powder Metallurgy method. The mixture is then sintered at 800 Degree Celcius for 45 minutes and it produces a semi-crystalline composite which is determined by X-Ray Diffraction (XRD). We examined the soda lime glass-sludge's electrical and mechanical properties. It has a high dielectric constant value of 20.7 compared to 5 in Silicon dioxide (SiO2). The resistivity of the composite at 27 Degree Celcius is 2402 Ohm-cm and the band gap energy is 0.08 eV. The main elements detected by using Scanning Electron Microscope is Silicon (Si) in matrix area while Manganese (Mn) in filler area. There are two significant contributions of this project. Firstly, because of its high dielectric constant property, soda lime glass-sludge has a great potential to be used as a capacitor in the next generation of high capacity integrated circuit. Secondly, improper waste disposal can be prevented because the composite production cost is much lower than the waste treatment cost (USD 0.48/kg vs USD 0.73/kg).

2005 - EV322

TRADITIONAL SPICES AS BIO PESTICIDES

Suvrata Desai, Mallika Desai
Jawahar Navodaya Vidyalaya, Canacona, Goa, India

This Project is based on Pesticidal properties of Spices like Chilly, Turmeric, Garlic, Asafoetida, Cloves etc. Spoilage of food grains by Pests such as Beetles, Weevils, and Granary Weevils is a common problem causing heavy losses. This project brings easy, Ecofriendly solution to this problem. It was hypothesized that Spices can be used as Pesticides. Tablets prepared out of these Spices were tried upon different Pests and positive results were obtained. Experiments were also conducted to verify preventive properties of Spices. It was found that pests didn't multiply in presence of Spice Tablets. Results were compared to Pesticidal properties of Neem leaves and Spices are found to be more effective. It is concluded that, " Spices can act

as effective. Harmless and ecofriendly Pesticides".

Awards won at the 2005 ISEF

Second Award of \$500 U.S. Savings Bond - Ashtavadhani Vidwan Ambati Subbaraya Chetty (AVASC) Foundation

2005 - EV323

THE EFFECTIVENESS OF ARTEMIA AND VIBRIO BIOASSAYS AT THE PREDICTION OF LOW LEVELS OF LEAD

Marisol Ryu, Chris Kostoulas

Manhasset High School, Manhasset NY, USA

International Development Research Centre reports that the US spends \$70 million on pollution abatement. Copper miners spend up to 41% from total capital expenditures on pollution regulation and monitoring. A cost efficient, accurate, and rapid assay is needed to monitor heavy metals. Pandey (1991) suggested that Artemia is an excellent alternative to complex animals for the study of marine pollution. Thomulka (1993) determined the light output of various bioluminescent organisms to vary in response to biohazardous materials. Therefore, the purpose of this study is to determine the effectiveness of Vibrio and Artemia bioassays at the prediction of low levels of lead in marine environments. Nauplii and adult groups were divided and exposed to known lead concentrations of 0, .05um., 10um, and .15um. Development and population were observed. V. Fischeri were exposed to the same Pb concentrations and absorbance values were taken using a Unico 2100 spectrophotometer. V. Fischeri were also exposed to water samples gathered from local areas and absorbance values were recorded. The results indicate that Artemia can detect the presence of Pb concentrations as low as .05um. V. Fischeri results show that a decrease in luminescence suggests an increase in Pb concentration. The correlation between Artemia population and lead concentration was -.94. The correlation between Vibrio and lead concentration was -.90. In conclusion, the study supports Pandey and Thomulka. The ability of Artemia and Vibrio to distinguish quantities of Pb in a sample makes them efficient candidates as useful tools to monitor metal contamination in environmental samples.

2005 - EV324

MORINGA OLEIFERA: NATURE'S COAGULANT

Shane Suazo, Yo Mayamoto

Hillsdale High School, San Mateo CA, USA

The purpose of this project is to evaluate the coagulating properties Moringa oleifera seed kernel powder and Moringa oliefera de-oiled seed powder and compare their effectiveness to common coagulants. "Effectiveness" was determined within each coagulant's optimum conditions, and based on the ability to lower turbidity, and remove bacteria. The primary focus of this project is its application in developing countries; in reference to the coagulant's potential to prevent the spread of waterborne diseases.

 Our hypothesis was as follows: Moringa oleifera seed powder will, within its optimum operating conditions, display coagulating properties similar to conventional coagulant compounds. Moringa oleifera will effectively lower turbidity, and total coliform populations. Such coagulating properties will be more pronounced in the de-oiled version of the seed powder and both will work more effectively at higher turbidities. To test our hypothesis "optimum" operating conditions for each coagulant were determined. Using these optimum conditions, a series of jar tests was conducted for each coagulant to compare their performances. In addition to these tests, water samples synthetically "contaminated" with e. coli were screened before and after coagulation for total coliform populations.

 Both Moringa oleifera coagulants effectively lowered turbidities. Their effectiveness proved comparable to aluminum sulfate and ferric chloride. The de-oiled version of the seed powder proved more efficient than the original version and both coagulants were more effective at higher initial turbidities. Both Moringa oleifera coagulants effectively removed coliform bacteria; Moringa oleifera de-oiled seed powder more effectively, removing over 90% of bacteria.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Team Projects - Presented by Ricoh

2005 - EV325

ENGINEERING ENVIRONMENTALLY SAFE SELF EXTINGUISHING POLYMERS

Daniel Hefter, Aryeh Sokolov

D.R. Stahler Yeshiva H.S. for Boys, Woodmere; Hebrew Academy FTR, Cedarhurst, NY

As polymers are replacing natural materials, concern has grown regarding their flammability, especially for widely-used acrylics. Acrylics are combustible polymers and immiscible with flame-retardant materials. In a Rhode Island night club, acrylic paints and foams were responsible for sustaining a catastrophic fire. Currently, halogenated compounds, generally bromine compounds, are added to render materials flame-retardant with the following disadvantages: (a) Do not disperse well in most polymers and require large quantities. (b) Brominated compounds are found in the milk of nursing women, soil, agricultural products and water supplies. (c) Are implicated in neurological disorders of newborn infants and children, banned in Europe and will be banned in California. Fire and smoke from ubiquitous polymeric materials are significant environmental hazards. Therefore, it is imperative to find an environmentally safe alternative to these compounds to render a broad class of polymers resistant to fire. We hypothesized that adding functionalized clays, which are flame-resistant, can achieve this goal. They also confine burning gases and allow other additives to be more efficient in neutralizing the ionic radicals produced while burning. We experimented adding clays to polymers with either phosphorous or brominated polystyrene. These compounds are environmentally benign and do not penetrate into living tissue. We found the addition of less than 10% clay conferred complete resistance to fire with the addition of only 4% brominated polystyrene or 10% phosphorous. This mechanism worked very well for a broad class of polymers, including acrylics and styrenic materials. We now present a model for this phenomenon.

Awards won at the 2005 ISEF

Third Award of \$1,000 - Team Projects - Presented by Ricoh
Scholarship Award of \$1,000 - National Collegiate Inventors and Innovators Alliance/The Lemelson Foundation
Award of \$450 - Sigma Xi, The Scientific Research Society
Team Award of \$1,500 for each member - U.S. Air Force
UTC Stock with an approximate value of \$2000. - United Technologies Corporation

2005 - EV326
COMPARATIVE EFFECTS OF UHF EMR ON PLANTS OF THE ORDER DICOTYLEDONAE

Ery Anguiano, Johnny Ng
Itineris Early College High School, West Jordan Utah, United States

This project involved subjecting different species of plants to radio waves in the ultra high frequency electromagnetic radiation (UHF EMR) region. Its effects on plant height, biomass, and protein distribution patterns were examined as a consequence of the treatment. The purpose of this experiment was to determine the radiation's effects on plants that are exposed to similar commercial radio frequencies in their environments and to establish its potential viability in agriculture. Plants tested were: Phaseolus vulgaris, Lycopersicon esculentum, Avena sativa, Lolium multiflorum, and Fagopyrum esculentum. The different plant species were separated into three categories: Experimental, Control, and Standard. The Experimental groups were submitted to UHF EMR for three hours within a dark enclosure. Radiation was emitted through an antenna connected to a radio transmitter tuned to a 462.125MHz frequency and transmitting at 5 watts. To eliminate the exposure hazards of EMR, treatment was given inside a Hoffman electrical enclosure. Simultaneously, the control groups were administered three hours of darkness within sealed plastic containers. The standard groups remained in ambient lighting throughout the entire experimentation session. Height was measured in centimeters from a uniform soil level to the apical meristem. A biomass value was obtained by removing and weighing the plant tissue. Proteins were extracted from leaf samples with 10 % TCA and 0.07 % 2-mercaptoethanol for SDS-PAGE analysis. Our research indicates that UHF EMR positively contributes to the height and weight of the exposed plants in the first several days of treatment, but has a negative impact on long-term growth.

2005 - EV327
DEVELOPMENT OF A QUALITATIVE TNT SENSOR BY USING NATURAL COW GELATINE AND TNT DETERMINATION

Enis Eray Ercag, Ismail Sizer
Private Fatih Science Highschool, Istanbul, Turkey

Contaminated land and groundwater remediation in military waste dumping sites and war area often necessitates the use of simple, cost-effective and rapid tests for detecting trinitrotoluene (TNT) and tetryl residues in the field. Using TNT as the modal compound, a simple and field adaptable (on-site) colorimetric method was developed for quantifying TNT in the presence of tetryl. Most commercialized methods for TNT assay-with the exception of Cold Regions Research and Engineering Laboratory of U.S. Army (CRREL) method-use proprietary chemicals, and color stability and intensity are highly dependent on the composition of the organic solution into a soil. The developed colorimetric method is based on the extraction of TNT from soil with water-acetone (2/3, v/v) solution and the filtration through a filter paper and dropping this solution mixture onto the developed sensor. The sensor was made by cow gelatine dissolved into some hot water and add specific amine. The red-violet color was due to intermolecular charge-transfer (CT) between the electron attracting TNT and electron-donating amine. On the other hand the developed colorimetric method is based on the extraction of TNT from water-acetone solution into organic solvent mixture of DCHA-isobuthyl methyl ketone (IBMK) (10:1, v/v), filtration through a filter paper into a stoppered optical cell and measurement of absorbance of the organic extract at 530 nm after 5 min. Unlike other spectrophotometric methods, the developed assay was basically tolerant to common cations and anions found in soil and water at 100-fold weight ratios, and to soil humic acids. Among a number of compounds that may be encountered in polynitro-explosive storage and waste reclamation sites such as picric acid, dinitrophenol and tetryl, only high tetryl concentration interfered with the developed TNT sensor. Water tolerance and exploitability over a wide pH range were other superiorities over the CRREL method.

Awards won at the 2005 ISEF
Third Award of \$1,000 - Team Projects - Presented by Ricoh

2005 - EV328
GET THE LEAD OUT!

Tyce Landon Foster, Janay Brashear, Diana Caldera
San Jon High School, San Jon, NM, USA

Lead is a naturally occurring metallic element found in the earth's crust at about 15 grams per ton (Colorado Department of Public Health and Environment, 2002). Lead is a highly toxic substance and if exposure occurs, it can produce a wide range of health problems. The purpose of this experiment is to test the effect of the plant material, Medicago Sativa, (Alfalfa) on the remediation of lead contaminated water. It was hypothesized that the alfalfa would remediate the lead contaminated water. Alfalfa has been demonstrated to remove gold from contaminated water indicating it may be effective for other metals. Alfalfa leaves and stems were put into a reverse column filter and batch reactor at the following Pb concentrations, 10ppm, 50ppm and 100ppm. It was then filtered and stabilized, to a pH of 4 with concentrated nitric acid. (HNO3) Pb samples were analyzed using an Atomic Absorption Spectrophotometer. The reverse flow column filters removed a significant amount of Pb at all concentration levels with an average of 93% removal. This indicates Alfalfa may be a good filter media to remove Pb as well as other metal Contaminants. The batch experiments at all Pb concentrations removed an average of 10% Pb. The amount of material used in the batch experiments (0.05g) may not have been sufficient to remediate all of the Pb. Further experimentation should include a wider range of pH and different types of contaminates such as mercury Hg, or Cadmium.

2005 - EV329

BIOREMEDIATION OF POLLUTED WATER WITH HYDROCARBONS

Marisol Perez Rangel, Maria del Rocio Duarte Castillo
Cecyteg, Irapuato, Guanajuato, Mexico

Bioremediation is a process in which biological organisms are used for decontamination and detoxification of a determined natural environment. In Salamanca, Guanajuato, is located an oil refinery which spills to Lerma river a great amount of hydrocarbons. This water is used for cattle consumption and agriculture irrigation, contributing this way to the contamination of water and ground, with subsequent damages for the ecosystem.

The objective of this work was to identify and isolate from the water a microorganism capable to degrade hydrocarbons to simple components, with a smaller toxicity.

Water samples were taken from the river to be analyzed and inoculated in means of culture (liquid) enriched with petroleum and incubated during 72 hrs. at 30 degrees C. After, we got isolation and identification of the microorganism (genus Citrobacter); to verify its degradative capacity were made analyses of pollution indicator parameters, being the main ones Fats and Oils, Biochemical Demand of Oxygen (BDO) and Chemical Demand of Oxygen (CDO). As a result of the analyses, we obtained the following: Fats and oils were reduced from 163.7 to 86.2 mg/1 (52.65%); BDO, from 2156.6 to 911.6 mg/1 (57.8%); CDO, from 2568.1 to mg/1 to 917.2 mg/1 (64.3%), in a treatment period of 10 days.

These results are encouraging since the reduction in the compared initial levels with the end ones demonstrates an important diminution in the proportions as far as the mentioned parameters; this indicates that the isolated microorganism degrades hydrocarbons indeed.

Awards won at the 2005 ISEF

Fourth Award of \$500 - Team Projects - Presented by Ricoh

2005 - EV330

THE BIOREMEDIATION PRINCIPLES AND ITS APPLICATION TO A MICROBIAL BIOREACTOR

Kevin Y.W. Luu, Vaseem Basilio Anwar
Maryknoll High School, Honolulu HI, USA

A continuing problem that occurs in Hawaii is its massive use of fresh water, where one source of the problem is from the wastewater created by air-conditioning systems, such as Maryknoll High School's cooling tower. This project utilizes bioremediation to degrade the toxic component of the wastewater. It has been a continuing research for the past three years. Over this period, many experiments were conducted, with the results incorporated into the final phase of the project: the design and construction of a microbial bioreactor that will provide an ideal environment to maximize the microbial activities in the bioremediation process of toxic component.

Main procedure taken in attempt to find the optimal design is the evolutions of ideas, where modifications have been made constantly from findings of previous works, common principles of bioremediation, and inputs from mentors and expertise.

The design offers many unique features that focus upon the primary parameters. One feature that the bioreactor offer is the chamber system, where each of the four chambers in the bioreactor theoretically solves the conflict caused by continuous flow of wastewater and the time necessary in order for the microbes to successfully degrade the toxicity level. Individual chambers also offer a unique feature, the baffle system. Walls with meshed microbes force the wastewater to travel in a maze-like effect, attempting to maximize the physical contact between the soil microbes and the water supply.

The current design is only based on theoretical parameters. Testing the prototype is the next phase, to further determine the most efficient design that will optimize the degradation rate of the system.

2005 - EV331

IDENTIFICATION AND ASSESSMENT OF URBAN DEVELOPMENT ON AN AQUATIC ECOSYSTEM

Cailyn Annalece Estey, Susan Barfield
Grenada High School, Grenada, Mississippi, United States

The purpose of this project is to identify areas in Grenada County in need of environmental management through education, conservation of natural resources, and reduction of pollution while maintaining community, corporate and cultural relationships. Ecosystems are impacted as urban areas are developed. Browns Creek is impacted differently by recreational, residential, and commercial developments. In this experiment various tests are performed along Browns Creek. Eight test sites were chosen to represent the areas in question: residential, recreational, and commercial. Each site is tested for phosphates, pH, iron, dissolved oxygen, total bicarbonate alkalinity, sulfides, calcium carbonate alkalinity, temperature, and coliform bacteria three times. Results indicated that all tests were in the accepted range, however some were on the borderline. Additional changes need to be made to insure that safe standards are met and the public made aware of the problem.

2005 - EV332

TORTAVE: LESS POLLUTION IN THE AVICOLE INDUSTRY

Jonathan Mendez-Garcia, Darwin Vinicio Trejos-Castro
Colegio Tecnico Profesional de Guaycara, Rio Claro, Golfito, Costa Rica

This project was born for the need of providing an answer to pollutants resulting from poultry wastes in the Colegio Tecnico Profesional Guayacara and develop a nutritional supplement for pork feed. The production process of this supplement is made of a series of steps where wastes described above are transformed (blood, feathers, head, viscera) such as raw material collection, trituration, cooking, hydrolization, drying and grinding to get "Tortave" with organic-leptic characteristics and with nutrients with a verified shelf life of six months (under appropriate sanitary conditions).

The implementation of this technique generated the expected results such as the elimination of pollution in agro-ecological areas and the development of a supplement with excellent nutritional features and the possibility of developing further productive, institutional projects.

2005 - EV333

D-TAPE, D-BORE AND D-ENSITY

Allison Marie Jones, Whitney Stevens

Stevensville High School, Stevensville, Montana, United States of America

Studies performed in the Pacific Northwest have indicated that individual tree growth can be increased if a certain amount of thinning takes place (Covington, Moore, 1994). The purpose for this experiment is to provide information on how trees grow in different levels of density. Tree density was determined by measuring the Basal Area in 10 different plots of Douglas Firs. Transects were used to locate plot centers in increments of 200 feet. Basal Area was measured using a prism arms length away from the operator with their back against tree. Diameter was retrieved using a D-Tape. A core sample was taken applying an increment bore. Ten and Twenty year radial growth rings were marked and measured using a millimeter ruler. It was concluded the ten-year radial growth decreased as density increased. The amount of growth decrease was 3.3 millimeters from 50 to 150 sq. feet of BA/acre. The twenty-year radial growth decreased 10.2 millimeters from 50 to 150 square feet of BA/acre.

2005 - EV334

CALCULUS FOR OPTIMUM CAN DESIGN: A SOLUTION FOR VARIOUS NEEDS.

Fany Siss-Zomer, Yuen Wa Wong Lei, Daniel Camilo Rojas Quirós

Colegio Científico Costarricense, sede San Pedro, San Pedro, San José, Costa Ric

By means of differential calculus, this project aims toward minimizing the amount of material required for the production of a can: getting the optimal design without altering the volume it contains. For this purpose, the cans studied were approximated to cylinders to ease the processes of 1) taking samples and 2) calculating their optimal dimensions. The third step focuses on companies that manufacture cans in order to analyse the feasibility of a design change.

Results of the mathematical procedure suggest that the optimum design occurs when the diameter of a can is equal to its height. Almost 100% of the product examined did not satisfy this relation, although there were two exceptions that were very close. As the proposal involves a design, and not a material modification, it is possible to optimize any form of container but only if its surface area can be expressed as a function. However, the material from which the can is built may determine the reconfiguration of the manufacturing system, so it can be adjusted to the new design. Ideally, the economic savings due to materials and energy, will surpass this initial invention (including the rearrangement- replacement of the machinery).

The contribution of this project is the possible application of a procedure – which can be applied to different containers- that aims at reducing the environmental impact as it fits the manufacturer and consumer needs while benefiting them.

2005 - EV335

FROM HOUSEHOLD WASTE TO GARDEN GOLD (PHASE 2)

Kelvin Tak Lek Chiong, Sean Chang Sung Wong

SMK Batu Lintang, Kuching, Sarawak, Malaysia

phase 1 study, we found that compost of different household waste have different pH and mineral contents. We would like to further investigate a) how these household waste will affect the colour of Hydrangea flowers b) how we can increase the nutrients to produce better plant yield .

 Hydrangants were fertilized with different household waste composts (kitchen waste, fruit waste, garden waste, soap water and chicken manure).The number and the colour of t he flowers were observed for 6 months. Fresh compost was added after 3 months. The effects of different compost and compost tea of different concentrations on the growth of water spinach were also investigated. The average height of plant, the average number of leaves per plant and the length of longest leaf of the plant were measured every week for 4 weeks. The fresh and dry weight per plant harvested after four weeks were compared.

 The result showed that Hydrangea plant fertilized with fruit waste compost and chicken manure produced blue flowers, kitchen waste produced purple flowers whereas garden waste produced pink flowers. The soil fertilized with these compost and watered with 50% compost tea showed similar increase in the yield of water spinach as using household compost mixed with chicken manure in ratio of 3:1.

 Therefore, we concluded that different types of household waste can be used to grow different colours of Hydrangea flowers . The use of household compost and compost tea of 50% can greatly increase the yield of water spinach . We hope this will help to achieve zero organic wastes in Kuching City and thereby ensure a more sustainable environment.

2006 - EV001

IMPACT OF WATER RECLAMATION: AN ANALYSIS OF WATER QUALITY AND THE GROWTH, DEVELOPMENT, AND PROPAGATION OF BRASSICA RAPA

Yun Li

Stanton College Preparatory High School, Jacksonville, Florida, United States

Water reclamation is one of the most beneficial environmental breakthroughs of the 20th century. This project examines the quality of reclaimed water and its effect on growth and propagation of rapid-cycling Brassica rapa.

To test for reclaimed water's impact in B. rapa's life cycle, 216 seeds were planted in respective quad cells. The control group, watered with potable water, as well as the experimental group, which received reclaimed water, were placed under similar conditions. Pollination was performed by hand and pods developed within twenty-five days into the experiment. After about 80 days, the pods were harvested.

The water quality was significantly better for the potable water, which had a much lower salinity and conductivity. The performance of the Brassica rapa plants are assessed by growth and propagation. B. rapa plants in both groups experienced similar trends in germination, emergence of true leaves, and final height. Although experimental plants initially grew faster, it's growth and development slowed down by day 30. This overall trend is similar for the propagation of B. rapa. At a 95% confidence interval, the control had better flowering, pod maturation, and seed production. The t-test indicated increased

statistical significance between the control and experimental groups as the experiment progressed. Control plants had on average four more seeds per pod than the experimental plants. An overall decline in experimental performance may have been caused by the retention of metal ions and microorganisms, resulting in both chemical imbalance in the soil and higher levels of infections.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV002

WILL THE SATURATION LEVELS INCREASE IN AN ESTUARY?

Nicole Kimberly Bell

Central High School, Brooksville, Florida, United States

The purpose of this project is to find if the saturation levels in an estuary will affect it in a negative way. The water in the bay will start at the same saturation level as the gulf. The bay will have a scale of 70:1 to replicate Tampa Bay. At the beginning of each tide 69 g of sea salt was added to the mixing chamber.

 The procedure used was to be a scaled model of a Tampa Bay. A series of pipes were connected to a pump that would pump water from the gulf into the bay. From the bay, a pump would pump water into the mixing chamber where the salt would dissolve and would be mixed back in with the bay during a high tide. Prior to each tide the bay and gulf was tested for the saturation levels.

 The conclusion of this project found that the hypothesis was stated correctly. The concentrated salt solution was increasing and having a negative affect on the environment of the bay. Within the 120 tides that were examined in this experiment the concentrated salt solution levels had increased by 0.96 g/L. When calculated into a yearly statistic, the resulting value would equal 2.92 g/L. With this increase the amount of concentrated salt solution would increase to a dangerous level for the environment in a matter of years.

2006 - EV003

BIOREMEDIATION OF OIL USING THE PSEUDOMONAS AND PENICILLIUM SPECIES

Sunny Jay Panchal

Bellevue High School, Bellevue, FL, United States

Bioremediation is the process in which petrophilic bacteria and fungus are used to degrade oil. The species are naturally occurring. The process of bioremediation is a lot cheaper than other methods and as far as research can show us so far it is very safe.

When oil spills occur in oceans the sea animals, the quality of the water, and the shorelines are horribly altered. It takes sometimes months to clean up all the oil. Every single animal on shore has to be cleaned by hand to make sure that they are free of the oil. The fish in the water are not as lucky as the land animals and are majority of the time killed.

The purpose of my experiment was to show which of the microbes would be the most efficient in the degradation of the oil. I put the species in the proper petri dishes and test tubes and added 5 ml of water to the jars and specified increments of crude oil. For the petri dishes we added 5g of fine laboratory sand. I then added a nutrient fertilizer to all the samples. I recorded the turbidity for the test tubes and the amount of remaining oil for the petri dishes. The Pseudomonas species did not degrade the oil as quickly as the Penicillium. In some of the trials the Pseudomonas did not even degrade all of the oil. I had to create two control groups to show that the microbes weren't using the oil as a food source explaining how my project works.

2006 - EV004

DETERMINING THE BIOAVAILABILITY OF HEAVY METALS IN POTENTIAL LAND APPLIED WASTES USING A STOMACH SIMULATOR

Shivani Bharat Parikh

Lecanto High School, Lecanto Florida, United States of America

The rapid growth of Land Applied Material (LAM) waste raises a hazard due to the oral toxicities of its metal components. This study aimed to test relative stomach and digestive tract absorptions of various LAM elements in a stomach-like environment.

 Judging by previous research, it was anticipated that fly ash would contain the highest heavy metal levels and bioavailabilities.

 All land applied materials were digested through TCLP (Toxicity Characteristic Leaching Procedure) to detect heavy metal concentration. The digestates were put through Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) and measured for arsenic, barium, beryllium, cadmium, chromium, lead, and selenium concentrations. The ash and sludge samples were leached with a simulated gastric fluid, and subsequent levels of leached metals were measured. Bioavailabilities (relative gastric absorptions of metals) of particular elements were calculated according to a specific formula. It was found that the waste water treatment sludge from a local county WWTP contained the highest levels of arsenic, beryllium, and selenium. The results indicate that the proposed hypothesis was incorrect. Fly ash did not have the highest levels of any of the heavy metals tested.

 The conclusion of this experiment indicates that WWTP sludge 1 along with all three ashes contained too high levels of one or more heavy metals to be used as land applied materials. The total metal analysis of the three ashes revealed heavy metal concentrations that were above the suggested EPA drinking water levels. Fly ash and WTE ash exceeded the SCTL (Soil Cleanup Target Levels) suggested by the EPA. Several diseases, such as cancer and neuropathy, can result from intoxication by heavy metals. The disposal of these wastes should be cautioned due to their excessive heavy metal concentrations.

2006 - EV005

HIPPOSPONGIA LACHNE VERSUS HYPOXIA

Benjamin R. Fruits

J.W. Mitchell High School, New Port Richey, FL, USA

This research was conducted to determine if it is possible to use hippospongia lachne as a safe method to reduce the amount of nutrients allowed into local

water habitats.

By using sponges as a filtering medium, it was hypothesized that natural sponges could be used to reduce excess nutrients from contaminating local water locations.

The first step was to locate an algae bloom and collect water samples. Next, I mixed Miracle Gro and non-treated well water to make a 2.5 percent fertilizer solution. I cut the sponges to 6 cm thickness, positioned a sponge 5 cm below the rim of the filtering chamber, and transferred 250 mL of one liquid sample to the filtration bottle. I secured the filtration bottle 3 cm above the sponge in the filtering chamber, monitored the process until the water had moved from the filtration bottle through the filtering chamber and into the retention container. I repeated the process three times for both liquid samples.

In every trial, the data showed significant changes before and after filtering. The change in my focal point, the total dissolved solids, was dramatic. After three tests on creek water, the average change in the total dissolved solids was nearly 200 ppm. More significantly, the average change from pre to post filtering of the fertilizer solution was 5000 ppm.

The results of my experiment showed that my hypothesis was correct. The hippospongia lachne provided a safe method to reduce the amount of nutrients allowed into local water habitats.

2006 - EV006

TRIBUTARY IMPACT: THREE POINTS OF INTEREST A FIELD & LABORATORY STUDY OF HONEY CREEK & ITS TRIBUTARY, CAVE SPRINGS BRANCH

Molly Kathryn Steen
Grove High School, Grove, OK, USA

Cave Springs Branch is considered an impaired and problematic stream.(1) It contributes those impaired waters to Honey Creek. By analyzing Honey Creek above and below the confluence of Cave Springs Branch, a direct correlation can be made between the impairment of Honey Creek with the contributions made by Cave Springs Branch. Does the tributary of Cave Springs Branch degrade the water quality of Honey Creek? If so, what is the overall impact on the receiving stream?

The general hypothesis is that the tributary, Cave Springs Branch, has a negative impact on Honey Creek below the confluence of the two streams. It is also hypothesized that macroinvertebrates will indicate a negative impact by counting, analyzing diversity and identifying types present. It is further hypothesized that a stream with lower water quality will have the highest levels of algae.

In this study, water will be drawn from both streams at several points above and below the convergence. Several water quality tests will be done in order to assess the condition of the streams. Test methods include: macro-invertebrate collection and evaluation, visual assessment of the stream, nitrate levels, phosphate levels, ammonia, chlorides, chlorine, pH, total dissolved solids, conductivity and an algae growth test designed by myself and my supervisor.

The algae test, TDS, CON, DO, nitrates, orthophosphates, and chlorides were all consistently higher in the tributary of CSB and lower in the background stream. The receiving stream had levels that fell in between the levels of the tributary and the receiving stream. It is evident that the tributary is impacting the receiving stream.

Awards won at the 2006 ISEF

Award of \$500 - North American Benthological Society

2006 - EV007

EVALUATING THE SYNERGISTIC EFFECTS OF LEAD, CADMIUM, ZINC, AND MANGANESE ON SELECTED CELLULAR MODELS

Kristen Elaine Fenska
Miami High School, Miami, OK

According to the Environmental Protection Agency (EPA), over 217,000 sites in the United States urgently require remediation from heavy metal contamination. The Tar Creek Superfund site is one of the largest Superfund sites in the United States covering an area of approximately 40 square miles. Decades of mining for lead and zinc ores have resulted in abandoned mine shafts and towering chat piles that are major sources of water and soil contamination in Northeastern Oklahoma and Southeastern Kansas. However, heavy metal contamination expands beyond the site for chat from the old mines has been distributed as sand and gravel fill and because acid mine drainage—containing high levels of heavy metals—threatens area surface water and the underlying Roubidoux Aquifer. The Tar Creek Superfund site contains four specific heavy metals: lead, cadmium, zinc, and manganese. The TEAL Report (2002) suggests that lead burdens on school children living around the superfund site far exceed established safety limits. However, little research has been completed to assess the synergistic effects of lead in association with cadmium, zinc, and manganese. This study focuses on the synergistic effects of these four metals on the cellular level. Cellular models include: Cell regeneration, Lumbriculus variegatus; Enzyme function, catalase; Motor function, Drosophila melanogaster; Early Embryo Development, Purple Sea Urchin; and Cell reaggregation, Red Rock Sponge. All models were exposed to single heavy metal burdens or co-exposed to lead combined with the other heavy metals. The results suggest that the synergistic effects of heavy metal burdens are significantly more toxic than the individual heavy metal exposure with the highest toxicity associated with the lead and manganese combinations. These findings further support recent research that suggests the severity of manganese toxicity. Statistical analysis indicates the results to be significant for each assay evaluated (ANOVA p < 0.01).

Awards won at the 2006 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh
Second Award of \$250 - Society of Environmental Toxicology and Chemistry
Tuition Scholarship Award in the amount of \$8,000 - Office of Naval Research on behalf of the United States Navy and Marine Corps.

2006 - EV008

A DEVICE TO MINIMIZE THE PERCENTAGE OF ACIDIC GASES IN DIESEL EXHAUST

Dana Jamal Abdul - Jaleel
Modern Montessori School, Amman, Jordan

The concentration of acidic gases in diesel exhaust was measured. A device was made and tested to minimize these gases.

A 100ml of diesel exhaust was collected, and injected into a known, and excess sample of NaOH. The NaOH reacted with the acidic gases in the diesel exhaust. Back titration

was then carried out to find the moles of the excess NaOH.

The moles of the reacted NaOH were calculated. From which, the acidic gases concentration in the exhaust of diesel powered cars was found to be $8.8 \times 10^{-3} \text{ mol.dm}^{-3}$.

Gas exhaust was pumped into 500ml of water (pH 6.69) for a period of 25seconds. The pH of the solution was found to be 4.84.This value was then used to find the number of moles of H^{+} in the sample (1.425×10^{-5} moles).

The flow rate of diesel exhaust was calculated, and was used to find both; the total volume of gas exhaust released into the environment every four month, and the concentration of H^{+} in the gas exhaust. This enabled me to find the number of moles of H^{+} released every 4 months (1.98mol).

A pipe was filled with 55g of CaO and Ca(OH)_2 , and was attached to the exhaust.. As a safety precaution, a pressure valve was attached to the duct, so as to ensure that no gas remains confined within the vehicle.

Acidic gases in diesel exhaust were reduced by 98%.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV009

THE USEFUL DIMP SPRING (DEVICE FOR IMPROVING THE MIXING PROCESS) IN GASOLINE ENGINES

Sa'ed Younes Aldaraghme

King Abdullah The Second School For Excellence, Amman, JORDAN

This project in its present form is a device used for reducing pollution, fuel consumption and improves the mixing process in gasoline engines.

The environmental pollution problem is one of the greatest problems in the modern age, as well as the increasing of fuel consumption and its high cost. The effective solution is to use a homogeneous mixture of air and fuel in the carburetor gasoline engine.

In this project, several tests have been done on Mercedes and Volkswagen cars (as they have different characteristics and mechanical structure) , studying the quantity of consumption and temperature of exhaust gases.

A device has been manufactured in the school's workshop with simple tools and material, so that it is very simple and cheap.

The device is a simple metal spring with special features (high humidity resistance, dynamic form to decrease friction..), installed in the suction pipe of the engine which makes the fuel particles (drops) smaller and smaller and creates a circumvolution in the suction pipe, so that a homogeneous mixture is obtained and admitted to the cylinders. Two different sizes have been manufactured to fit the Mercedes and the Volkswagen, as the size of the suction pipes of the two models is different.

After fixing the spring to the two models, it has been found that the fuel consumption was reduced by 10 -20 %, and the temperature of the exhaust gases was lowered by app. 20oC.

We find this technique is a method to reduce pollution on earth.

Awards won at the 2006 ISEF

Second Award of \$250 and a certificate - American Intellectual Property Law Association

2006 - EV010

QUANTITATIVE DETERMINATION OF THE CADMIUM INFLUENCE ON THE MAMMALIAN ORGANISM AND ITS INTEGRATIVE INDEX

Nataliya Ihorivna Mysula

School with the Deep Study of Foreign Languages 3, Ternopil, Ukraine

Cadmium accumulation in organs and tissues of mammals is an important environmental and biochemical problem. The development of severe intoxications among the population and appearance of new pathologic forms in human beings are linked with the spread of cadmium.

The aim of the work is quantitative determination of the cadmium influence on a mammalian organism. After cadmium chloride inputs to rats, which has been done by qualified adult researchers, I determined the quantity of lipid peroxidation products, such as malonic dialdehyde, diene and triene conjugates, and the intensity of the weakest tissue lighting – chemiluminescence in liver tissues.

I developed an integrative index for quantitative determination of cadmium influence. The integrative index, which is calculated for each term of investigation, provided a possibility of determining informative parameters of cadmium influence on mammalian organisms and timely prevent the development of diseases which were caused by the level of cadmium in organism or begin its treatment .

The following conclusions have been made:

1. Integrative index enables to determine the influence of cadmium on the organism of mammals.

2. Quantitative method of determination the cadmium influence provides a possibility to identify the informative significant ranges of concentration.

3. Extrapolation of informative significant limited parameters of integrative index of cadmium influence to the actual environmental situation may be the base of technology for ongoing computer monitoring of cadmium concentrations in the environment.

2006 - EV011

CORRELATION OF DISSOLVED OXYGEN AND TURBIDITY IN THE MINNESOTA RIVER BASIN.

Lisa Pauline Broderius

Glencoe-Silver Lake High School, Glencoe, Minnesota, United States

This project looked into the correlation of dissolved oxygen and turbidity in the Minnesota River Basin. Oxygen is important to a body of water because it can increase the reproduction and growth of fish life, and reduce some pathogenic bacteria. Turbidity is a simple water clarity measurement. My hypothesis was that there will be a positive correlation between the two. This is based on the following: Turbidity is caused by silt and other matter in the water. Phosphorus adheres to silt. Increased phosphorus levels will increase algae growth. Increased algae growth will use up oxygen as the algae dies, thereby lowering the oxygen level in the water. I took samples from twenty-four sites along the river from Ortonville, MN to the Twin Cities and traveled nearly five hundred miles. I also recorded temperature, TDS (total dissolved solids), and phosphorus levels from these locations. My results showed a negative correlation between the dissolved oxygen and turbidity levels in my tests. An interview with a marine biologist after my experiment led me to believe that this negative correlation could be the result of cold temperatures. My sampling was taken near the end of November and cold water temperatures would have allowed less algae growth thereby decreasing its use of the oxygen in the river. Next year I hope to continue my study with samples taken during hot weather.

2006 - EV012

POISONOUS PLAYGROUNDS 3: WHAT'S THE REAL PROTECTION?

Kaitlyn Rebecca Milman

Thomas Stone High School, Waldorf, MD, USA

In my first project, I tested if the CCA pressure treated lumber was leaching any arsenic. My second project was to see where the arsenic was going, by testing the surrounding plants and soil. This year's project is testing the different hypothesizes of preventing the arsenic from leaching into the soil, surrounding plants, and how to up take the arsenic already in the environment. My hypothesis is even though the sealents/paint do prevent leaching, the ferns will up take the arsenic and are more environmentally/economically viable.

A total of 160 plots were constructed, each plot was 76cm by 80cm. The pressure treated wood that was used was approximately 15 years in age and leached an adverage of 70ppb of arsenic. 120 fence stakes were used, measuring 3cm by 30cm. 20 were painted in an oil-based stain, 20 were painted in 2 coats of the previous mentioned stain, 20 were painted in acrylic soild color deck stain, 20 were painted in 2 coats of the previous mentioned stain, 20 were painted in a water based paint, and 20 were painted in 2 coats of the previous mentioned paint. 80 ferns were used, 2 different species, the Pertis vitata and the Arachnidoes. These ferns' roots were washed in distilled water to remove any soil to prevent contamination. 40 ferns were planted 10cm away from the lumber (20 of each, 2 in each plot) and 40 were planted 35cm away from the lumber. Natural rainfall supplied most of the rainfall, but periods of 5 days without any rainfall, each plot recieved 1in per week. The plots were observed for 6 months. Core samples were taken (directly next to the lumber, 10cm, 35cm away). Controls were of only soil, fern A, fern B, and a stake made of soft pine (no CCA treatment).

My conclusion came to the sealers and paints prevented 96% of the leaching, while the ferns absorbed 88% of the arsenic. The paint began to chip, making the ferns better.

2006 - EV013

HARVESTING ENERGY FROM WASTEWATER IN A 2-CHAMBER MICROBIAL FUEL CELL

Sikandar Singh Porter-Gill

Gaithersburg High School, Gaithersburg, Maryland, U.S.A.

Present day wastewater treatment plants utilize high amounts of energy and are costly to operate. These conventional wastewater treatment plants utilize aerobic bacteria. Organic material in wastewater contains energy that can be harvested. I propose to biologically harvest this energy in the form of electricity from wastewater obtained at the Seneca Wastewater Treatment Plant in Germantown. Besides capturing energy in the form of electricity, one could use that electricity to power the wastewater treatment plant and clean the water.

To construct a microbial fuel cell (MFC), it takes a source of bacteria, food, no oxygen, and two electrodes. The microorganisms oxidize the organic food matter, and transfer the electrons to the anode. The electrons travel on an insulated copper wire to the cathode to generate a current. Many MFCs use a proton exchange membrane (PEM) to keep the electrons on the anode side from escaping to the cathode side, but allow the protons to pass through. At the cathode chamber, the protons combine with purged oxygen to form water. The cathode chamber contains a phosphate buffered saline solution.

I want to test whether it is essential to incorporate a PEM into the MFC design, or whether a cation exchange membrane can replace the PEM. A PEM is quite expensive and requires a platinum catalyst, which is also costly. Although I believe that a PEM is essential in the productivity of a MFC, it is crucial to reduce the cost of a MFC.

Awards won at the 2006 ISEF

Second Award of \$1,500 - United States Air Force

2006 - EV015

THE EFFECTS OF NUTRIENT ENRICHMENT ON THE GROWTH OF ALGAE

Yun Liu

Terrebonne High School, Houma, Louisiana, USA

The purpose of this project was to find out if the addition of various nutrients would affect the growth of algae. Algae are microorganisms that live in water and are found all over the world. They perform photosynthesis to make food and are an important part of many aquatic ecosystems. I believed that adding nutrients to the algae would stimulate their growth. Algae taken from waters with a salinity of 20 ppt were used in the experiment. The algae were grown for two days in samples with three different nutrients added, Na2SiO3 (silicate), NaH2PO4 (phosphate), and NaNO3 (nitrate), and in a sample with no nutrients added. After each day, the algae were counted under an epifluorescence microscope and were measured for their chlorophyll using a fluorometer.

In the end, the results mostly supported my hypothesis that the addition of the nutrients would stimulate the growth of the algae. The cell number of the algae increased steadily for all treatments throughout the experiment. The chlorophyll levels of the algae stayed about the same after 1 day, but only the nitrate treatment showed significant increase after 2 days. The disagreement between the cell count and chlorophyll of the algae could be due to the decrease of cellular chlorophyll contents caused by nitrogen limitation in the treatments without nitrate additions. Therefore, results from this experiment show that adding nutrients to the algae increases their growth rate and cell number, but only the nitrate had a positive effect on the chlorophyll of the algae.

2006 - EV016

WATER AND SOIL DESALINIZATION USING IRIS GIGANTICAERULEA, NATIVE TO LOUISIANA

Alicia Marie Ranney

Lafayette High School, Lafayette, Louisiana, United States of America

Hurricane Katrina and Rita, coastal regions along the Gulf of Mexico were flooded with salt water, and after the water retreated, the salt was left behind. Accor ding to research done by Louisiana State University's agricultural department, salt concentrations in Louisiana's fields rose up to 13.1 ppt and salt conce ntrations over 2.0 ppt will cause substantial yield reduction of most crops (Saichuk, 2006). One plant tolerable of high salt concentrations and freshwater is Iris

giganticaerulea, commonly known as the giant blue flag iris, and it is native to Louisiana, Mississippi, and Texas.

 This study investigates whether this iris could be used as a means of desalinization. Plants were acquired and their growth was maintained in salt solutions with concentrations of 0, 5, and 10 ppt. Five plants from each solution were collected weekly for 6 weeks. As a control, five plants were collected at week 0. The plants were dried for one week, weighed, and then ground. Samples were digested using EPA SW-846 method 3050. An atomic absorption spectrophotometer was used to analyze the concentrations of sodium ion. An F-Test was performed and values less than 0.05 were considered significant.

 The sodium chloride concentrations from the leaves were all significantly increased. The projected removal of sodium chloride over an extended period of time was calculated. The calculations were based on 25 plants growing in an area of 1 square foot and 6 inches deep. For example, a 10 ppt concentration was calculated to be reduced to 5.80 ppt in 24 weeks, and a 2 ppt concentration was calculated to be reduced to 1.16 ppt in 24 weeks.

 The data suggests that Iris giganticaerulea could be used as a means of desalinization of soil and water. After a sufficient amount of time, the leaves could be harvested, collecting the salt they absorbed, while the rhizomes are left behind. The plants could then re-grow their leaves and absorb more salt.

2006 - EV017

MICROBIOLOGICAL REDUCTION OF GLYCERIN IN BIODIESEL

Rachel Nicole Levron
Colquitt County High School, Moultrie, Georgia, United States

Biodiesel is an alternative fuel source that works well in warm climates. However, due to a glycerin by-product, the fuel clouds at lower temperatures and its effectiveness is limited. Current methods for the extraction of glycerin are costly and generally make biodiesel unaffordable to those who only produce small amounts. The purpose of this experimental research is to develop an affordable procedure for the extraction of glycerin by-products from biodiesel fuel using bacteria. The experimenter hypothesized that a bacterium can be cultivated that will enhance the performance of biodiesel fuel at lower temperatures. The experimenter used a known method to produce biodiesel fuel. Using this method, glycerin is formed as a by-product and remains in the biodiesel. The experimenter cultured clostridium butyricum, a bacterium that feeds on glycerin. The experimenter then tested the bacterium in a Petri dish with a sample of biodiesel fuel. Afterwards the bacterium was introduced to the remaining biodiesel fuel. A method was developed to measure the intensity of light as it passed through the biodiesel fuel at various temperatures. The biodiesel that was not inoculated with bacteria gelled at low temperatures. The experimental biodiesel with the added bacteria gelled at a lower temperature than that of the unaltered biodiesel. Affordable biodiesel fuel can be made using bacteria to remove the glycerin that remains after the common procedure for making biodiesel fuel.

Awards won at the 2006 ISEF

Scholarship Award of \$1,000 - National Collegiate Inventors and Innovators Alliance/The Lemelson Foundation

2006 - EV018

MYCO-RESTORATION

Sishir Mannava
Classen School of Advanced Studies, Oklahoma City, OK, USA

This project dealt with the use of mushroom cultivation to restore fire disaster environments. The purpose of this project was to gain information about the restoration capabilities of mushrooms and their contributions to the environment.

Using research, it was hypothesized that boiling water treatment coupled with Shitake mushroom substrate would generate the best height and reproducibility among fenugreek seeds. Three different species of mushrooms, treatment supplies, and composting equipment were used for the experiment. Three different mushroom tissue cultures were implanted into simulated fire disaster environments and then treated with boiling water, steam, or chemicals. The mixtures were allowed to fully colonize the substrates and then decomposed into rich nutritious soil. The fenugreek seeds were then implanted into these soils and were allowed to grow and reproduce for 5-7 days, and the heights and number of plants produced were recorded, graphed, and analyzed.

After data collection, it was concluded that an Oyster Mushroom restoration process with steam treatment was best for fire disaster environments. Steam treatment of substrates is the best option for removal of competitor organisms, mainly due to the fact that the steam treatment chamber pasteurized the substrates at extremely high temperatures and isolated the competitor organisms.

2006 - EV019

"BOARDS AND BRANCHES - YEAR 5" A CONTINUED MULTIVARIABLE STUDY OF SNOW INTERCEPTION FOR WATER CONSERVATION

Erica Elizabeth David
Pinedale High School, Pinedale, WY, USA

What are effects of snow-fences and shrubs on interception of snow? Snow is a vital consideration as potential water supply during drought. Dense drifted snow melts more slowly and sublimates less; therefore, development of economical methods to intercept windblown snow into dense drifts is of major concern. As many drought afflicted areas are predominantly vegetated by sagebrush (Artemisia tridentata), snow interception by this shrub is noteworthy. However, interception of falling snow by sagebrush can increase loss of snow through sublimation, thus decreasing potential water supply.

 The project included two experiments. The first experiment used one-meter tall snow-fences to develop a more economical version of the previously tested Thick Fence, which produced short length, high volume drifts. The second experiment measured interception of snow by sagebrush and force needed to bend branches at subzero temperatures, which affect snow retention.

 The 3-Piece Fence was a more economical version which retained the drift characteristics of short length, high volume drifts, therefore supporting the first part of Hypothesis 1A. All other snow-fence design hypotheses were not supported. The Angles Fence was similar to the Control-Thick Fence, while the 3-Piece was the least expensive, enhanced drift characteristics earlier during winter, and had higher density with more distribution of rounded particles.

 All sagebrush hypotheses were supported. As shrub maturity increased, branch resistance to bending increased, and percent of intercepted snow increased.

 These results will help scientists use "Boards and Branches", snow-fences and sagebrush, to

2006 - EV023

STUDIES ON ENVIRONMENTAL INDICATION AND ECOLOGICAL FUNCTION OF BRYOPHYTES IN SHANGHAI CITY, CHINA

Zhirui Zhu

Shanghai Luwan High School, Shanghai, China

Biological indication and ecological function of bryophytes, a plant sensitive to environments, in Shanghai, the largest and most industrialization city of China, are studied.

(1) The experimental results of ecological function of bryophytes compared with bare soil and grasses indicate the bryophytes have stronger ability of absorbing and keeping water than the grasses. The soil covered with bryophytes has higher concentration of water, total N, P and organic substance than bare soil.

(2) Based on sampling at main parks in the city, distribution pattern of epiphytic bryophytes in Shanghai shows that the numbers of species and coverage are decreased from downtown to suburb and have a negative correlation with concentration of SO2 in atmosphere.

(3) The heavy metals (Cu,Cr, Cd, Zn, Pb) in plants of a moss Haplocladium of fresh samples collected from 31 spots in Shanghai in 2005 and the dried historical specimens at Shanghai Nature History Museum collected during 1960s'-1990s' were measured by Atomic Absorption Spectrometer. The results of statistical analysis show that the concentration of heavy metal has increased since 1960' s to 2005 and is higher in the center of city but lower in suburb, well correlated with the industry distribution in Shanghai. Stress effect of heavy metal to Haplocladium plants are also observed and studied by SEM, TEM and EDS.

In conclusion, bryophytes could be used as a bio-indicator of environmental quality and changes for long-term monitoring in cities and could become one member of ground cover plants to play certain ecological function in city greening.

Awards won at the 2006 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2006 - EV024

INITIAL GREENHOUSE GAS INVENTORY OF COOK STOVES

Laura Elizabeth Willson

Rocky Mountain High School, Fort Collins, CO, United States

I have undertaken an investigation to measure the greenhouse gas emissions from both a "Gasifier" stove and a basic "Rocket Stove". Both the Rocket Stove and Gasifier stove are stoves used in developing countries because they provide a more fuel efficient and safer way to cook daily. This stove technology is just developing and the greenhouse gas impact of these stoves has not been looked into, hence my involvement in this project. Specifically, emissions of CO2, CH4, N2O, NO, CO, NO2, and VOCs were tested. I executed this survey to serve as an introduction and reference point for future studies of this type. Gas quantities were measured using a Fourier Transform Infrared (FTIR) method. Tests were conducted for two fuel variations for each stove. Dry pine and wet pine sticks (1" by 1") for the Rocket Stove and dry and wet pine chips for the 'Gasifier'. The wet pine was soaked in water for several days, with the chipped wood being chipped after soaking. A trial of each was performed for each fuel/stove combination. TO describe the greenhouse effect of these gases, weightings were used from the Intergovernmental Panel on Climate Change (IPCC) database and other sources. I found that the the greenhouse gas emissions was much higher than i had expected it to be.

2006 - EV025

DETERMINING THE EFFICIENCY OF A CYANOBACTERIA BIOREACTOR IN THE REDUCTION OF CO2 IN AN INDOOR AIR ENVIRONMENT

Scott Potter

Carbon High School, Price, Utah, United States of America

The purpose of my experiment was to determine whether a cyanobacteria bioreactor would be able to cause a substantial decrease of CO2 within a day. My hypothesis is that, as time goes on, the cyanobacteria will reduce the carbon dioxide concentration in the air. It will also take a time period of less than twenty-four hours for the CO2 level to go from a high concentration of around 1,000 ppm, to a concentration close to that of ambient air. The test system, or bioreactor, consists of an aquarium with a strain of the cyanobacterium Oscillatoria. The CO2 level is raised in the air space of the tank and tupperware box. An aquarium pump then circulates the CO2 into the aquarium containing the cyanobacteria. The cyanobacteria then perform photosynthesis and the level of oxygen increases as the level of CO2 decreases. A CO2 monitor then tracks the changes and records them on a computer. A bioreactor would be able to decrease the level of CO2 in a typical office space within a day. The CO2 level decreases over time, but then levels off at a concentration close to 150 ppm. An algal matt approximately 860 cm2 can cause a significant decrease in CO2 concentration in the atmosphere of a room approximately .036 m3. Over a six-hour time period, if scaled to the proper size, a bioreactor can make a significant decrease of CO2 in a typical work environment to a level close to or below ambient air.

2006 - EV026

THE ENVIRONMENTALLY-SAFE ERADICATION OF RETICULITERMES FLAVIPES THROUGH THE UTILIZATION OF AMOXICILLIN AND ASPERGILLUS NIGER

Ramsey Harbi Shadfan

Keystone School, San Antonio, TX, U.S.A.

Termites, especially Reticulitermes flavipes, cause millions of dollars of damage yearly and are a growing concern within North America. The purpose of this project was to discover two new, environmentally-friendly pesticides for termites: the antibiotic Amoxicillin and the fungus Aspergillus niger.

It was hypothesized that Reticulitermes flavipes' lifespan would be decreased by the antibiotic Amoxicillin and the fungus Aspergillus niger. It was also hypothesized that crushed and suspended samples of Amoxicillin-treated Reticulitermes flavipes would inhibit the growth of bacteria, and that an electrophoresis gel would show a change in protein expression between treated and untreated termites.

Nine different concentrations of Amoxicillin were created, ranging from

1378 ppm to .000137 ppm and two amounts of *Aspergillus niger* were studied. Habitats were created using paper towels, rotting wood, and plastic containers in five replicates each for Amoxicillin and *Aspergillus niger*. Crushed samples of *Reticulitermes flavipes* were suspended and placed into 3 replicates of blood agar plates inoculated with *Salmonella*. Proteins were extracted from crushed termites and run on an electrophoresis gel.

The results showed that as concentrations of Amoxicillin and *Aspergillus niger* increased, death rates rose. All studied concentrations were capable of killing the termites in less than 7 days. The treated termites showed slight but not a significant inhibition of bacterial growth in the Petri dishes. The electrophoresis gel showed that the treated termites exhibited bolder protein bands than the untreated.

These results conclude that Amoxicillin and *Aspergillus niger* can be used in very small concentrations as pesticides for termites.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV028

LONG TERM MONITORING OF THE RIO SAN JOSE WATERSHED

Kendra Ann Valdez

Grants High School, Grants, NM, USA

In this longitudinal study, Bluewater Creek was monitored from June 2004 to January 2006. Monitoring was performed in order to maintain and restore the chemical, physical and biological integrity of the watershed. This investigation determined current conditions and began remediation processes. It was hypothesized that Bluewater Creek would maintain more ecological integrity in year two of the study. It was predicted that macroinvertebrate identification and habitat assessment scores would correlate with water chemistry results- indicating a healthy watershed. Also, it was believed that nitrate would be removed during phytoremediation using duckweed.

To perform this investigation, water samples were gathered from areas along Bluewater Creek, beginning upstream and continuing downward. The pH, dissolved oxygen content, turbidity, conductivity, air temperature, water temperature, stream flow rate and nitrate content was examined. Habitat and benthic macroinvertebrate assessments were performed. The presence of coliform bacteria was determined and nitrate phytoremediation techniques were practiced.

In conclusion, the hypothesis was proven correct. Bluewater creek did in fact maintain more ecological integrity in year two of the study. Habitat and macroinvertebrate assessment scores correlated to water quality results, indicating a healthy watershed. Using phytoremediation techniques, small amounts of nitrate were removed from contaminated water. No coliform bacteria was detected in the creek. A database was constructed that can be used both as a reference for future studies, and to determine current watershed conditions. The results of this study will prove useful in producing a healthy environment for both human and wildlife interaction.

Awards won at the 2006 ISEF

Honorable Mention Award - Bureau of Reclamation/U.S. Department of the Interior

Honorable Mention Award - North American Benthological Society

2006 - EV029

DETERMINING ANALYTICAL CHARACTERISTICS OF BIOLUMINESCENT- SIGNALING BACTERIA FOR USE IN BIOSENSORS

Daniel James Tao

Jefferson High School, Lafayette, IN, USA

Heavy metals can pose a serious threat to the environment. Therefore, ways to rapidly detect heavy metals would be advantageous for short-term or long-term surveillance applications. A potential heavy-metal two-component signal transduction system has been previously identified in the ubiquitous bacterium, *Pseudomonas aeruginosa* for generating a living whole-cell bioluminescent (lux) bioreporter. Experiments were performed on two phenotypically different *P. aeruginosa* bioreporters with different concentrations of the heavy metal zinc. A significant increase in bioluminescence was detected for both phenotypes at concentrations of 10 – 200 ppm zinc following a 30 minute exposure time and continued to increase over the two hour time interval. However, the nonmucoid phenotype produced a two-fold average increase in bioluminescence at 15 minutes when exposed to 100 or 200 ppm zinc. A possible explanation for this is that the exopolysaccharide, alginate, produced by the *P. aeruginosa* mucoid phenotype may play a role in the decreased movement of zinc to the cell membrane. No differences in bioluminescence were observe at 1 ppm zinc over the two hour time course experiment suggesting the detection limit is between 1 - 10 ppm.

2006 - EV030

INVESTIGATION OF DIFFERENT CONCENTRATIONS OF MICRONUTRIENTS (MOLYBDENUM AND IRON) ON GROWTH OF NUISANCE ALGAE (LYNGBYA WOLLEI AND VAUCHERIA SP.) FROM FLORIDA SPRINGS

Ankur Deepak Bhatia

RL Paschal High School, Fort Worth, Texas, USA

Nuisance algae have caused a severe impairment in the waters of Florida Springs due to increased presence of nitrogen and phosphorous that has propagated the growth of algal communities. However, there are sites where levels of nitrogen and phosphorous are high, but no significant algal growth has been observed. Thus, there is reason to believe that other microelements, iron and molybdenum, at various levels, could be effecting the growth of the nuisance algae.

A fully crossed factorial experiment was designed to be able to detect growth of algae filaments with two levels of iron (200, 600 µg/L) and four levels of molybdenum (0.0, .07, .7, and 2.1 µg/L), creating 8 total treatments. Filaments of algae were manually cut and placed in microcentrifuge containing respective solutions and concentrations of microelements. Media was changed regularly, and tubes were kept in temperature and light controlled incubation room. After a duration of 12 days, filaments were measured again to show change in growth and relative growth rates.

Effects of iron and molybdenum on the two algae were relatively similar. Iron had relatively little effect and very low molybdenum in high iron had negative effect on algal growth

rate. This could be explained by the theory that molybdenum facilitates the use of iron as a growth factor for nuisance algae; otherwise iron is toxic in high concentrations

2006 - EV031

INVESTIGATING THE BEHAVIORAL EFFECTS OF CONJUGATED ESTROGENS ON DAPHNIA MAGNA AND HYDRA OLIGACTIS

Stephanie Elizabeth Hamm

Perham High School, Perham Minnesota, United States of America

Estrogen pollution has affected organisms in lakes and streams worldwide for years and can affect the nervous systems of invertebrates. The purpose of this research was to investigate behavioral effects that conjugated estrogens have on aquatic invertebrates, more specifically, Daphnia magna and Hydra oligactis. Conjugated estrogens derived from the hormonal drug Premarin were made into solutions equivalent to 0.3 mg/L, 0.625 mg/L, and 1.25 mg/L. Next, twenty organisms were placed in each Petri dish filled with the solutions, as well as one control group for each organism. The daphnia were then monitored and the number of antennae movements were recorded and timed for thirty seconds, using a random daphnid each time. The hydra were prodded to force the protective response of contracting into a smaller size. Testing showed that daphnia in the estrogen solutions had much faster movements in comparison to the control group and the hydra in the 1.25 mg/L group experienced a slower reaction time, taking up to seven prods to achieve contraction. Mortality rates in the daphnia were also higher in the estrogen solutions compared to the control, while all levels of hydra experienced 100% mortality over five days. Therefore, it can be concluded that conjugated estrogens affect the nervous system of Daphnia magna and Hydra oligactis.

2006 - EV033

TIDES - A SUSTAINABLE SOLUTION FOR CONTINUOUS GENERATION OF ENERGY

Sarah Lane Menezes

Escola Americana de Campinas, Campinas SP, Brazil

The purpose of this project was to create a mechanism through which energy could be constantly generated using the movement of tides. In order to do this, a tank that simulated the tidal movement and a mechanism that used 3 water reservoirs that worked in different time periods was created. This made it possible for movement to be constantly created even when the water level in the tank continued to rise and fall. This project could be used to generate 100% clean, renewable and sustainable energy.

2006 - EV034

DEVELOPING A MATHEMATICAL PREDICTIVE MODEL USING FACTORS AFFECTING ESCHERICHIA COLI LEVELS AT FAIRPORT HARBOR BEACH

Tessie Rose Panthani

Mentor High School, Mentor, OH, Lake County

Beaches often test water quality by measuring E. coli concentrations. If E. coli levels exceed 235 colonies/100 mL, the concentrations of other pathogens are likely to be high and therefore beaches are closed. However, it takes twenty four hours to test the water and determine actual E. coli concentrations. Beach closures are therefore not always accurate because they are based upon previous days' results. One possible solution to this problem is to develop a mathematical model that could predict if E. coli levels exceed the 235 colonies/100 mL threshold. The first step in developing a mathematical model is to do linear regressions to determine which factors have the most significant correlation to E. coli concentrations. Previous studies have shown that factors that stir up lake-bottom sediment typically have the strongest correlation to E. coli concentrations. Thus, the focus of this project was on factors that disturbed lake-bottom sediment. The hypothesis stated that at Fairport Harbor Beach wind direction, wave height, 3-day weighted rainfall and turbidity are correlated to E. coli levels and therefore could be used in a predictive mathematical model. Other factors that were examined and considered for a model include wind speed, water temperature, air temperature, rainfall, previous day's rainfall, number of birds and number of swimmers. The predictive model that was ultimately chosen included wind direction, wave height and three day weighted rainfall. The model's accuracy was then compared to the 5-day geometric mean's accuracy to determine which method was more effective.

2006 - EV035

COMPARING SALT MARSHES ON THE LONG ISLAND SOUND USING HEALTH INDICES IN FUNDULUS HETEROCLITUS

Andrew Joseph Taylor

Newtown High School, Sandy Hook Connecticut, United States

Water quality is often measured by water chemistry indices. Unfortunately these measures do not depict the long-term effect of human impact on the environment. Using biological indicators is, therefore, more indicative of water quality. Fundulus heteroclitus, small minnow fish, were demonstrated to be exceptional indices of the environment, being the dominant fish species in the marshes, and high enough up the food chain to bioaccumulate nutrition and toxins. Two samples of F. heteroclitus were collected in October, 2005 from Long Island Sound on the coast of Connecticut: one from Great Meadows Marsh in industrial-developed Stratford, and the other from pristine Barn Island in Stonington to compare water quality. They were analyzed using a condition index, liver-somatic index, and liver glycogen assay. The differences in overall health were indicated by the variances between the two data samples collected, which in turn correlated back to which of the salt marshes was healthier. Statistical comparison of data from the fish tested showed that the mean for the fish at Barn Island was larger in mass, length, liver mass and glycogen content. A two-way Analysis of Variance showed that the data series for the condition index was significantly different (ALPHA<.05) between the two sites and between genders. The ANOVA also assessed that the liver somatic index and the liver glycogen assay data series were significantly different between the two sites, but not between genders. All three indices demonstrate that the fish at Barn Island were healthier and thus that marsh has better water quality.

2006 - EV036

SAND PRAIRIES: RESTORING AN ENDANGERED BIOME

Anna Christine McReynolds
Sikeston High School, Sikeston, Missouri, USA

The alluvial sand prairie biome is a rare community in the central United States in which the endangered *Stylisma pickeringii* (Patterson Bindweed) plant inhabits. The area is nutrient poor, well drained, and consists of coarse, sandy soil. As in any type of biome, the producers are ultimately the beginning of every food source and biotic energy source. To restore the sand prairie biome to its climax community, these producers must first be returned in order to spread and reclaim the land. What scarification methods should be used to reduce labor intensity yet increase germination rates of *Stylisma pickeringii*?
If scarification methods (course sand with magnetic stirrer, manual sanding, incisions along the lateral side, pointed end, or blunt end of the seeds, or cracking the seed coat with a blunt instrument) are used to penetrate the *Stylisma pickeringii* seed coat, then the magnetic stirrer method will yield the greatest germination rate. Lateral incision, blunt-end incision, pointed-end incision, cracking the seed coat and manual sanding will follow respectively.
Groups of *Stylisma pickeringii* seeds were scarified using the various methods, planted in moistened coarse sand and placed into an environmental chamber at a constant temperature of 25 degrees Celsius. Daily observations and germination rates were recorded. Scarification on the lateral position of the seed resulted in the largest percentage of germinations at 43 percent whereas the less labor intensive magnetic stirrer method yielded no seed germination. It may be concluded that breaking the seed coat along the lateral position of the seed is the most beneficial method in increasing germination rates of *Stylisma pickeringii*.

2006 - EV037

REMOVAL OF ARSENIC FROM DRINKING WATER BY WATER HYACINTHS (EICHHORNIA CRASSIPES): YEAR II

Kathryn VanderWeele Snyder
Oregon Episcopal School, Portland, OR, United States of America

In Bangladesh the groundwater people drink has arsenic levels high enough to eventually cause death. Phytoremediation, the use of plants to remove pollutants, has been used to remove metals such as arsenic. Other scientists have tested water hyacinths' ability to remove arsenic from water with varying results. The purpose of my project was to determine if it is practical to use water hyacinths (*Eichhornia crassipes*) to remove arsenic from the water.
I did three experiments. First, I tried to maximize the number of times the same water hyacinths could reduce the arsenic concentration of water. I grew water hyacinths in 300 ppb arsenic water in a greenhouse. I added light and heat to try and increase their arsenic removal abilities. I found that the same water hyacinth plants could remove the arsenic seven times, but only completely down to the drinking water standard twice.
Second, I digested plant samples (for outside lab testing) to determine where the plants store the arsenic to help understand their removal mechanism. The results showed that the plants store the most arsenic in their bladders (which are for floatation) and the least in their roots.
Third, I digested the dead plant debris with hydrogen peroxide to attempt to remove the arsenic, to minimize the volume of waste generated. I tested the extracted liquid myself using ICP. The hydrogen peroxide digestion removed a significant portion of arsenic from the solids, which could allow most of the arsenic to be efficiently precipitated from the liquid for disposal.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV038

EVALUATION OF DIATOMACEOUS EARTH COMBINED WITH PYRETHRIN TO CONTROL RHYZOPERTHA DOMINICA IN STORED WHEAT

Abigail Marie Hines
Orchard Day School, Fort Wayne, Indiana, USA

Each year millions of dollars and valuable food commodities are lost because of stored product insects. One of the most destructive is *Rhyzopertha dominica*, the lesser grain borer. A new organic insecticide, a mixture of Diatomaceous earth (DE) and Pyrethrin, is used commercially. Yet, no scientific data is published on this combination treatment with *Rhyzopertha dominica*.
Two experiments were conducted. In the first test, two week old adult *Rhyzopertha dominica* (20 adults with 5 reps for each concentration) were exposed at 27°C, 57% and 68% relative humidity (RH) on untreated wheat (0ppm) and wheat treated with 200ppm-1000ppm DE/Pyrethrin. After one week, 100% of adults were suppressed. After 7 weeks, no progeny were produced in treated wheat. The only progeny were in untreated wheat, with a higher mean number of progeny obtained at 68% RH.
In the second test, 3-4 week old adult *Rhyzopertha dominica* were exposed at 27 °C, 47.1% and 62.7% RH on untreated wheat and wheat treated with 50-150ppm of DE/Pyrethrin. Mortality of the adult *Rhyzopertha dominica* after seven days was significant in respect to concentration (p<0.001). As concentration increased, survival of *Rhyzopertha dominica* decreased. The effect of RH on mortality was not significant (p=0.738), and the same effect of concentration was seen regardless of humidity (P=0.460). A few progeny were produced in lower concentrations. Again, more progeny were produced in 0ppm at 62.7% RH.
In summary, DE/Pyrethrin is effective against *R. dominica* in low concentrations, regardless of humidity, and 200ppm concentration produced 100% mortality with no progeny.

Awards won at the 2006 ISEF

Tuition Scholarship Award of \$5,000 per year for 4 years for a total value of \$20,000 - Indiana University

2006 - EV039

INVESTIGATING A MYSTERY IN A TRIBAL POND

Anna Maria Lopez
Coolidge High School, Coolidge, AZ, United States of America

My second year's project focused on Fox Butte Pond located on the Gila River Indian Community, Arizona. The pond system was monitored using *Daphnia magna*. Changes in the water environment caused the daphnia to immediately die when placed in the water samples. Possible causes of contamination in the water: 1. pollution was dumped into the irrigation system upstream; 2. the mine on the upper end of the water system flushed a waste pond; or 3. a Golden Alga (*Prymnesium parvum*) bloom.

 Water samples from the Fox Butte Pond and a second pond (Sacate) one mile away were collected from June through November 2005. Each month's experiment was set up to test a reaction from the *Daphnia*. The majority of the *Daphnia* populations died in each sample June through September, when placed in the Fox Butte Pond water samples, but the *Daphnia* were not affected in the Sacate Pond samples. The conclusion suggested that the contamination did not travel out of Fox Butte Pond. Life in the pond slowly returned to normal after the effects of the contamination finally ended after six months. The *Daphnia* populations began growing and reproducing in water samples from October and November 2005. Water samples were tested for copper and Golden Alga. Both tests came back negative, suggesting that contamination was dumped into the water system. This research proved a need for an early warning system to detect pollution in the Tribal Community's water resources.

2006 - EV040
RADIONUCLIDES IN THE MIOCENE AQUIFERS OF COASTAL GEORGIA PHASE II

Sherrie Alyssa Hall
Cedar Shoals High School, Athens, Georgia, USA

Chronic exposure to radionuclides can pose serious health risks. This study was conducted to verify measurable levels of radon in the Upper and Lower Brunswick aquifers, and evaluate the presence of dissolved uranium in groundwater from these aquifers. Two one-gallon (3.8 Liter) samples were taken from each of 13 wells near Brunswick, Georgia. Portions of each sample were prepared and tested in the Environmental Radiation Laboratory at Georgia Institute of Technology for uranium and gross alpha radiation. Samples for uranium analyses were prepared using an ion-exchange technique, and both tests were conducted using an Alpha Beta Proportional Counter. Later, two samples from each well and a trip blank were collected for radon testing in the Liquid Scintillation Analyzer at Georgia Tech. The data show that levels of uranium dissolved in the groundwater itself are negligible. Radon and gross alpha levels were consistent with values found in phase one. Lower Brunswick wells tended to have radon levels above the Maximum Contamination Level (MCL) of 300pCi/L, while Upper Brunswick wells were below the MCL. Both aquifers have gross alpha activity levels far above the MCL of 5pCi/L. In conclusion, the uranium that produces gamma radiation in these aquifers is not dissolved in the groundwater, but probably exists as a solid contained in the phosphate sands that comprise the aquifers. In addition, there are consistent levels of radon and gross activity within both aquifers throughout the area, although levels are higher in the Lower Brunswick.

Awards won at the 2006 ISEF
Award of \$250 - National Ground Water Association

2006 - EV042
BEHAVIORAL EFFECTS OF THE HERBICIDE METOLACHLOR ON THE PERCEPTION OF CHEMICAL STIMULI AND WINNER-EFFECT IN ENVIRONMENTS WITH AND WITHOUT PLANTS

Matthew Brian Newcomb
Peachtree Ridge High School, Suwanee GA, USA

Previous research has suggested that environmental pollutants interfere with perception of chemical stimuli. The effectiveness of phytoremediation of contaminated water sources was tested to examine a solution to the environmental problem. *Orconectes rusticus* were separated into two groups for all research in this study: farm-raised and river-trapped. *Orconectes rusticus* were classified into four groups based on metolachlor content found in water samples: 0 ppb, 25 ppb, 50 ppb, and 75 ppb. Each group was tested on three behaviors critical to their behavior and survival: 1) location of a food source, 2) reaction to damaged conspecifics, and 3) aggression interactions.

Results indicated that specimens were unable to successfully locate a food source after being exposed to metolachlor. In the presence of an alarm signal, exposed specimens tended to walk faster, exhibit increased levels of movement, and move toward the alarm signal. Interactions with other subjects indicated that subjects exposed to higher concentrations were more aggressive and had a diminished winner-effect. Introduction of *Cerataphyllum demersum* (coontail) significantly lowered metolachlor concentrations and subjects tested showed diminished aggression. Results of this study indicate impairment to both neuromuscular control and chemosensory ability to respond to stimuli.

This study shows that even though metolachlor is occurring at sublethal concentrations, biological effects not addressed by LC50 values still exist. Exposure to pesticides such as metolachlor may disable appropriate behavioral responses to food, predators, and hierarchical status.

Awards won at the 2006 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh
Student Membership in SETAC - Society of Environmental Toxicology and Chemistry

2006 - EV043
ASSESSING BIOACCUMULATION OF WATERBORNE ARSENIC AND SELENIUM IN PLANTS FROM THE POACEAE AND LINACEAE FAMILIES

Lindsay Rose Gilbertson
Elko High School, Elko, NV, USA

Barrick Goldstrike plans to construct evapotranspiration (ET) cells to collect draindown water from the AA Leach Pad for the next 50-100 years. My project's purpose was to assess plants commonly found in seed mixes of heap leach covers for their use in ET cells. To be used in the cells, plants needed to undergo risk assessment for potential assimilation by wildlife. Also, plant bioaccumulation of metals found in the water must be assessed. I grew seven grasses and one forb and used Barrick's draindown to water the experimental group, modeling the process that would occur in an ET cell. My hypothesis was the plants would accumulate <50 mg/kg As and Se, in levels that would not harm the plants but could potentially pose problems to wildlife. After thirty days, samples of plant tissue and soil were sent to Western Environmental Testing to be analyzed through Inductively Coupled Plasma Optical Emission Spectroscopy. All were found to contain <2.5 mg/kg As and Se. I concluded these levels pose no threat to wildlife, though further confirmation may be necessary. Calculations based on total input of As and Se into the system compared with test results suggested these plants may have the ability to volatilize selenium. Plants used in this study make good candidates for use in ET cells. They are inexpensive, require little soil and maintenance, germinate quickly, are easily harvested in case of future bioaccumulation, evapotranspire water, provide a dense cover for soil, and have shorter growing seasons than some other plants.

2006 - EV044

THE EFFECTS OF VARIABLE FISH COMMUNITIES ON TYPE 4 AND TYPE 5 WETLAND CHARACTERISTICS IN POLK COUNTY

Megan Marie Miller
Lincoln High School, Thief River Falls, Mn, USA

The purpose of this project is to see if fish communities affect Type 4 and Type 5 wetland ecosystem characteristics. Each wetland was analyzed for five response variables, chlorophyll a, June and July turbidity, total phosphorous and plant mass along with the count and identification of the fish population.

The experiment was conducted using mini-fyke nets, minnow traps, activity traps, secchi disk, turbidity meter and also through chemical analysis. These various tools were used to collect, count and identify a variety of organisms along with the chemical analysis completed in thirty-six different wetlands. For the quantitative portion of the experiment the p value for significance was set at alpha 0.05. If the p>F values for the response variables would have been <0.05, the differences between the five different fish communities would have been significant. The p value for chlorophyll a was 0.4138, June turbidity was 0.7373, July turbidity was 0.6674, total phosphorous was 0.6558 and plant mass was 0.8964. Although the quantitative analysis completed by the ANOVA, were insignificant, due to the trends that appeared in the final graphs there was evidence that fish communities do affect the ecosystem characteristics.

In the experiment, the wetland having the best water quality was fishless. This was followed by wetlands containing planktivores, benthivores and piscivores. Next, was the wetland with planktivores only then the wetland with planktivores and benthivores and lastly was the wetland with planktivores, benthivores, piscivores and carp. This experiment indicated that fish communities do have an affect on wetland characteristic.

Awards won at the 2006 ISEF
Honorable Mention Award - North American Benthological Society

2006 - EV045

GASEOUS EMISSIONS FROM AGRICULTURAL WASTE: PHASE II

Tara Ellen Gloyna
Temple High School, Temple, Texas, USA

CERCLA is a reporting requirement agency that imposes fines of \$27,500/day on institutions that do not document when their NH3or H2S emissions have exceeded 100lbs/day. The data used to calculate these emissions is considered outdated and perhaps inaccurate. Phase I of this research determined that the emissions rates of NH3 vary depending on the surface that the waste is deposited on. The purpose of Phase II research is to determine if a standard can be applied year-round for both beef and dairy operations.

It was originally thought that dairy waste (manure, urine, and manure/urine mixture) would produce the most NH3 for both summer (30C) and winter (7.2C) temperatures. Emissions from cattle waste were evaluated by placing 250g manure and 50mL urine samples in a temperature controlled chamber with a 5cc/min airflow for 8 hours, with data being collected in one-minute intervals in ppm. H2S was not measured because the amount produced was below the range of the sensor.

This experiment concluded that beef manure/urine produced 40.9% more NH3/gwaste than dairy waste at summer temperatures. Conversely, dairy manure/urine waste production exceeded beef at winter temperatures, with winter emissions being 5.17 times smaller than summer emissions. The difference between summer and winter production is likely due to the inability of microorganism to degrade uric acid into NH3, as well as the inhibition of urease in cold temperatures.

This study demonstrates that a specific emissions standard cannot be applied to all operations in all conditions. These results have significant regulatory and economic implications.

Awards won at the 2006 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV046

REPLACING PETROLEUM FUEL WITH ALCOHOL BLENDED WITH ORANGE OIL AND PINE OIL

Raymond Tan
William Mason High School, Mason, Ohio, USA

This work was conducted to determine the combustion behavior of fuel alcohol as affected by the addition of orange oil – limonene and pine oil - turpentine. It was hypothesized that the addition of either limonene or turpentine would make the fuel burn brighter, with higher flames, and hotter flame temperatures, while not negatively impacting the fuel flow or injection properties such as the kinematic viscosity. The combustion experiment was done with oil lamps containing alcohol mixed with 0%, 5%, 10%, 20% and 30% limonene and turpentine respectively. The combustion patterns were observed and recorded with a digital camera. The flame temperatures were measured with a thermocouple. The effect on the fuel mixture density and kinematic viscosity was also tested.

It was found that the addition of limonene or turpentine indeed made the fuel burn brighter, with higher and more vigorous flames. The flame temperatures

however did not differ significantly from alcohol despite that the pure alcohol flame looked dull and dim. Limonene addition helps flow viscosities, but it was discovered that adding 30% or more limonene would generate significant smoke and soot, and that 30% or higher limonene would not mix well with the alcohol. Alcohol and turpentine mixture burned clean, but it was limited by the increase in flow kinematic viscosity. In consideration of all the findings, it is recommended that up to 20% limonene or up to 30% turpentine be added to the alcohol as an improved biofuel based entirely on agriculture and forestry.

Awards won at the 2006 ISEF

\$5000 per year for four year scholarships. - Indiana University-Purdue University Indianapolis

2006 - EV047

HINSDALE GROUNDWATER STUDY

Christina Lee Mogan

Hinsdale Public School; Hinsdale, MT; United States

I studied the groundwater under Hinsdale via four monitoring wells which had been drilled and abandoned in 1985. Because one of the monitoring wells is located near an old Phillips 66 station, I decided to determine whether the groundwater had been contaminated by the underground fuel tanks by testing for the presence of volatile organic hydrocarbons in the water. I hypothesized that the water would contain contaminants from gasoline, therefore, I decided to determine whether the gasoline was breaking down by bioremediation. To resolve this question, I needed to know the direction of the groundwater flow. To start my experiment, with guidance, I learned to survey and ascertained the elevations of each monitoring well. Then, I determined the top of the water table and the depth of each well using a weighted cloth measuring tape. From this information, I graphed the elevations from each well and its water table to find the direction of flow of the groundwater. Using four different balers, I purged three to five times the volume of each well and then collected water to be tested for pH, conductivity, nitrates/nitrites, iron II/iron III, and volatile organic compounds in an approved research laboratory which I visited to observe the processes used. Using the results of the water tests, I found no evidence of volatile organic compounds and therefore, I did not continue to look for evidence of bioremediation. In the process, I also determined that the groundwater flows north to northeast under the town of Hinsdale.

2006 - EV048

EFFECTS OF SALICYLIC ACID ON FERTILIZER-INDUCED EUTROPHICATION

Rachel Beth Cohn

Niles North High School, Skokie, IL, USA

Eutrophication is the detrimental overgrowth of algae in aquatic environments. This experiment examined the effects of salicylic acid, a chemical algicide that could prevent eutrophication, on microorganisms and algae. Algae (*Oscillatoria*) was grown in the presence and absence of fertilizer to determine levels stimulating eutrophication. The growth and viability of protozoa and simple crustaceans was then tested in the presence and absence of the acid in conjunction with eutrophic levels of fertilizer. Algae samples were grown in a control medium, as well as in fertilizer medium containing salicylic acid concentrations of 0, 0.1, 0.5, and 2.5 millimolar (mM). Algae samples were incubated, then filtered to find their mass. In part two, *Paramecium aurelia*, *Paramecium bursaria* and *Daphnia magna* were grown in solutions containing the above concentrations of salicylic acid, all of which were duplicated in a set containing the organic fertilizer in addition. The abundance of *Paramecia* was measured with a spectrophotometer while the *Daphnia* were counted directly. The hypothesis, that salicylic acid would cause a decrease in growth for organisms in both tests, with higher concentrations causing a greater decrease in growth, was supported. The initial data showed that only the .5mM and 2.5mM concentrations of salicylic acid significantly reduced growth of *Oscillatoria*, indicating that salicylic acid could be a successful algicide. However, the data in part two indicated that use of salicylic acid to treat eutrophication might be unwise, as the 0.5 mM and 2.5 mM acid concentrations were also significantly detrimental to the other forms of pond life.

Awards won at the 2006 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV050

AN ANALYSIS OF THE EFFECTIVENESS OF CHLORAMINE IN MUNICIPAL WATER DISTRIBUTION SYSTEMS

Andrea Kate Jensen

Burnsville Senior High School, Burnsville, Minnesota, USA

primary disinfectants in today's municipal water-treatment facilities are chlorine and chloramine. Chloramine is used in water-treatment facilities because it is supposed to maintain higher levels of concentration for greater distances compared to chlorine. The objective of this experiment was to compare the residual amounts of the two disinfectants as the distances from the water-treatment plant increased and to determine if chloramine really does last longer in the water distribution system. Because of the size and difficulty of the experiment, only two cities were tested for each chemical, so a total of four cities were tested. Meaningful data was generated, because each sample was analyzed multiple times and samples from varying distances from the treatment plants were tested. When the experiment occurred, it appeared that chloramine was decaying at a faster rate than chlorine, contrary to research findings and expectations. Another observation was that some municipal water-treatment facilities might not be maintaining a high-quality standard for their water at all times. This study showed that chloramine did decay at a faster rate than chlorine. This study also showed that many other factors can impact the purity and chemical concentrations in drinking water, such as the age of the distribution pipes and monitoring by the treatment operators. This study also showed that in order to be completely confident about the purity of drinking water, consumers should install a point-of-use water-filtration system.

2006 - EV051

THE URBAN HEAT ISLAND AFFECT IN CITIES WITH POPULATIONS UNDER 20,000

Trevis J. Matheus
Fernley High School, Fernley Nevada, USA

With rapid urbanization occurring all over the world, it is surprising that little research has been done on the Urban Heat Island affect (UHI) on small cities and towns. Due to the lack of research I chose to investigate the UHI in cities with populations under 20,000 people. Since very little research has been done on this subject I had to develop my research protocols based on work done with larger cities. I collected data to determine if the difference between the in-city temperatures and out-of-city temperatures was statistically significant. I took temperature readings in my home city and the surrounding countryside using maximum-minimum thermometers which I placed according to specific criteria. These criteria include distance between thermometers, distance from structures, distance outside of the city, and elevation. I ran paired t-tests using the average highs and lows for both the in-city and out-of city readings for data taken in the winter and in the summer. The results showed that there was a statistically significant difference in the mean temperatures and support the idea that the UHI is measurable in smaller cities. If this is supported by further research on other small cities, then all human developments may be impacting our global climate and we need to be looking into mitigation strategies.

Awards won at the 2006 ISEF
Honorable Mention Award - American Meteorological Society

2006 - EV052
INVESTIGATION OF THE REMOVAL OF HEAVY METAL IONS USING TITANIUM DIOXIDE AND ULTRAVIOLET LIGHT

Megan Moulding
Fremont High School, Plain City Utah, USA

Silver, copper and lead are harmful heavy metal ions often associated with waste water streams from mining industry. Titanium dioxide in the presence of ultraviolet light can reduce heavy metal ions, removing them from contaminated water. The purpose of this project was to 1) determine the nature of the photocatalytic reaction; 2) quantify the levels of metal ion reduction; and 3) identify sites in northern Utah where heavy metal ions are found in waste water.

Stock solutions of silver, copper, and lead were diluted to parts per million concentrations considered toxic for ground water. These solutions were exposed to UV sources in the presence of titanium dioxide. Samples were taken at intervals of 1, 2, 4, and 8 hours and tested using atomic absorption spectrophotometry to determine the quantitative levels of heavy metal ions. Levels of lead and silver were significantly reduced using the process. The copper II ions were not reduced.

In another aspect of this project toxic levels of heavy metal ions were found in waste water associated with mine tailings near a local refinery in western Salt Lake County. Results indicate a clear association of heavy metal ions with mine wastes and techniques to measure the levels. The findings additionally provide a clear methodology for reducing the metal ions using photocatalytic reduction. Future research will introduce heavy metal ions to various concentrations of titanium dioxide flowing through the apparatus to determine optimum concentrations, titanium dioxide recapture, and effectiveness of metal ion reduction using a previously designed apparatus.

Awards won at the 2006 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV053
MANAGEMENT OF APHID PEST OF COWPEA BY A BIO-PESTICIDE FUSARIUM PALLIDOROSUM

SWATHI SOMAN
CHRIST NAGAR SR.SEC.SCHOOL, THIRUVALLOM, TRIVANDRUM 695027, KERALA, INDIA

Cowpea [Vigna unguiculata (L.) ssp. sequipedalis (Verdcourt)] is a major vegetable grown and consumed in the domestic and foreign markets. Aphis craccivora Koch. is an important pest of cowpea causing crop loss to the tune of 10 – 20 per cent. Current management practice of using chemical pesticide to tackle this pest are dangerous as it causes environmental and health hazards. So there is need to develop ecofriendly methods to tackle this pest. Fungal pathogens of insects play a key role in pest management in nature. Fusarium pallidoroseum (Cooke) Sacc. is a potent biocontrol agent of cowpea aphid. It is safe to other biotic fauna, parasitoids and pollinators found in the cowpea ecosystem. Fusarium pallidoroseum was found to be compatible with the common insecticides such as Malathion, Quinalphos, Dimethoate etc.

Awards won at the 2006 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV054
EFFECT OF SALINITY ON POPULATION DENSITY AND DIVERSITY OF BENTHIC FORAMINIFERA IN THE INDIAN RIVER LAGOON: YEAR TWO

Phaedra Calista Tinder
Sebastian River High School, Sebastian, FL

The purpose of this project was to determine the effects of salinity on population density and diversity of benthic foraminifera in the Indian River Lagoon, which is the most diverse estuary in North America. It was hypothesized that salinity and foram population density or diversity would have no significant relationship. Two sites on the Indian River Lagoon, Florida were selected: site MI on the north side of Memorial Island in Vero Beach; site SR at the mouth of the St. Sebastian River. Two replicate samples from each site were collected every other week from September 5 to December 10, 2005. On each day of collection, temperature, pH, and salinity were measured.

In contrast with year 1, multiple-regression models indicated that total foram population density was

related to both salinity and water temperature significantly. This year, the four most prevalent genera were, respectively, Discorbis, Elphidium, Ammonia, and Nonionella; in year one, they were Elphidium, Ammonia, Nonionella, and Rosalina. The difference reflects seasonal differences, and possibly the effects of the hurricanes each year.

 Multiple-regression models indicated that of the four factors used to analyze diversity (SHEN), three were tied significantly to salinity. Water temperature was tied to all four, and pH was tied to N, the number of individuals. Additionally, all four diversity measures are strongly correlated to each other, which indicates a need to preserve all aspects of water quality and all aspects of diversity. Site MI and site SR both had low evenness, although SR was generally slightly higher. MI, however, consistently had higher species richness and more individuals.

 In conclusion, the hypothesis was rejected because salinity was shown not to be independent of population density and population diversity of foraminifera.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV055

MUSSELS, DO THEY HAVE A PREFERRED ENVIRONMENT?

Cory Ray Knowles

Drew Central High School, Monticello, Arkansas, U.S.A.

The purpose is to determine if velocity, chemicals, depth and substrate affect the diversity and density of freshwater mussels. In trying to prove the hypothesis, a 2-station comparison was set up at the river; samples were taken once a month for four consecutive months. Each transition consists of three parameter boxes. Each box was a testing site. The dates chosen were June 18, July 16, August 13, and September 17, 2005. Mussels within the boxes were identified and measured. The tests were for water and air temperature, dissolved oxygen, water hardness, total alkalinity, pH, turbidity, nitrate-nitrogen, phosphate, total dissolved solids, iron, copper, acidity, carbon, velocity, substrate type, depth, rainfall, and the width of river. The range results for the quantity and size of the mussels at site 1 were squawfoot(7), 1.70-2.10; paper pondshell (93), .74-2.21; ebonyshell (1), 1.42; spike(2), 1.67-2.10; giant floater (1), 1.95-5.50; bleufer (3), 2.83-5.85; ouachita kidneyshell (1), 1.68; fluted shell (1), 4.32; wabash pigtoe (7), 1.01-1.76; threeeridge (5), .76-2.25; monkeyface(4), 1.65-1.79; pistolgrip (6),1.48-2.85; spectaclecase (3), 4.50-5.00; pimpleback (26), .81-1.68; and the western fantail (4), 1.39-1.41. The range results at site 2 were mucket (14), .89-2.79; and the asian clam (9), .38-.75. All the results were completed and compared. The hypothesis was proven incorrect after the completion of the experiment. There is a significant difference in the diversity and density of freshwater mussels in different environments.

2006 - EV056

IMMOBILIZATION AND RECOVERY OF AQUATIC METAL CONTAMINANTS

Morgen Elizabeth Anyan

Selah High School, Selah, WA, USA

Aquatic metal pollution is a serious problem around the world, especially in developing countries that lack the money or means necessary to clean contaminated water. Last year's project demonstrated that iron and sulfate reducing bacteria (SRBs) could immobilize soluble metals in water. This year's project was designed to determine the optimum conditions for metal immobilization, and to test two surfactants' abilities to recover metals from SRBs via floatation.

Eight simulated river environments (half with nutrients, half without) were constructed. Al, Cu, Mn, and Zn solutions were added to designated environments. Metal concentrations and pH were monitored over a three-day period. Three aerator depths, each corresponding to an aerobic/anaerobic ratio, were tested. The aerator depth of 16.20cm, without nutrients, was found to be the most effective for immobilizing metals.

Simulated environments utilizing the optimum conditions were constructed, metals added, and the levels monitored over three days. The SRBs were removed, divided into two groups, and either Aerosol OT or Si100 was added. Air was bubbled up through the solution for one hour. The amount of metal recovered was determined via atomic absorption. Aerosol OT recovered the greatest percentage of metals.

The results of this project show improved conditions for metal immobilization, and demonstrate which surfactant is the most effective for recovering metals from SRBs. This project produced a small-scale test of a metal immobilization and recovery system. It could be implemented in areas lacking funds for contemporary clean-up technologies, and provide a monetary incentive for the clean up of contaminated water.

2006 - EV057

SUN - TRACKER AN AUTOMATED BLIND SYSTEM

Raymond Claud Chassevent

Lake View Academy, Fountain Inn, South Carolina, USA

The goal of this project was to design and build a blind system that did not rely on manual operation to adjust for the changing angle of the sun. Blinds must be adjusted regularly to operate at maximum efficiency. Blinds that are not regularly adjusted cannot provide all the benefits they are capable of providing. Automating the blind would allow the blinds to operate at maximum efficiency.

 To accomplish the goal a faux wood blind was outfitted with a light sensitive sensor that fed into an electronic circuit. As the angle of the sun changed the circuit would run the motor in the needed direction in order to keep the slats perpendicular or parallel with the angle of the sun depending on the setting. A manual control box allowed the user to over-ride the automatic controller to adjust the blinds manually. A lamp was used as a test and demonstration light source.

 Automated blinds would increase the energy efficiency of a building by solar heating in the winter and reflecting heat in the summer. Automated blinds would make seldom occupied east, west, or south facing rooms, such as a dinning room or extra bedroom, seem alive with changing light.

Awards won at the 2006 ISEF

Second Award of \$150 - Patent and Trademark Office Society

2006 - EV058

MULTI-TIERED WETLANDS A TECHNIQUE FOR IMPROVING THE EFFECTIVENESS OF CONSTRUCTED WETLANDS

Andrew James Stewart

Karabar Distance Education Centre, Queanbeyan New South Wales, Australia

xperiment provides evidence for more effective constructed wetlands. Wetland design is complicated by the bi-phasic nature of a plants nutrient uptake. As a result, each wetland reaches a limiting concentration where nutrient uptake ceases to be efficient. The multi-tiered wetland theory overcomes the limitations of bi-phasic uptake.

Water recycling plants employing reverse osmosis, whilst efficient, produce high nutrient concentration brines that increase the risk of environmental damage to waterways. When used in combination with multi-tiered wetlands, reverse osmosis can achieve sustainability for water recycling. Simulated reverse osmosis brines were made from a mixture of ammonium nitrate and di-potassium hydrogen orthophosphate. The brines were subjected to a two-tiered wetland featuring Carex appressa and a combined concentration of 250 mg/L macronutrients (NPK).

Nitrogen, phosphorus and potassium were determined by ion selective electrodes (through a temperature correcting bath), colorimetry and flame photometry respectively. All nutrients were found to produce a bi-phasic reduction pattern that reached a limiting concentration in each wetland. This experiment has shown that the limiting concentration can be reduced by each wetland to produce a tiered reduction of nutrients. Adjusting the number of tiers determines the final concentration allowing optimal levels of nutrients to be maintained for the health of a waterway.

Field trials are planned for Goulburn Council's Sustainable Cities Program to help find solutions to a severe water shortage. This experiment has found multi-tiered wetlands can provide a sustainable and economical solution to water recycling.

Awards won at the 2006 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV059

"DON'T DRINK THAT!" ENVIRONMENTAL SENSITIVITY OF COLIFORM AND ENTEROCOCCUS BACTERIA

Rachel Elizabeth Pian

Yorktown High School, Yorktown Heights, New York, United States of America

Natural recreational water is often contaminated by microbial organisms, some of which have the ability to negatively affect the health of humans who interact with these waters. Water quality is universally determined by examining its levels of coliform, an indicator bacterium that is both gram-negative and facultatively anaerobic. Recently, the Environmental Protection Agency has advocated enterococcus, a gram-positive facultative anaerobe, as a replacement for coliform, due to coliforms often inability to accurately indicate the Escherichia coli pathogen. Coliform, fecal coliform, E. coli, and enterococci bacteria were analyzed for their interaction with ranging surface water temperatures during summer months from three specific Long Island Sound recreational water locations. Samples were analyzed for coliforms as well as for E. coli via the multiple-tube fermentation method, whereas the membrane-filtration method was demonstrated to analyze samples for the correlating presence of enterococci. In an aim at improving public safety and reducing revenues from unnecessary beach closures, optimal thermal conditions for coliform growth have been pinpointed, and enterococcus has been determined to be a more accurate, time efficient indicator of water quality.

Awards won at the 2006 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV060

THE DESIGN AND DEVELOPMENT OF AN UNDERWATER SYSTEM IN QUARTER MASTER HARBOR TO ANALYZE THE EFFECTIVENESS OF AERATION IN PLANKTON GERMINATION TRAPS

Meghan Elizabeth Gavin

Bellarmino Preparatory School, Tacoma, WA USA

Harmful algal blooms (HABs) are currently a major environmental issue because they threaten every coastal state rather than the previous four, an alarming number of people are becoming ill, and a method has not been found which can predict when these blooms will occur. In order to adequately address this concern, researchers must completely understand the plankton life cycle. There is a significant lack of knowledge concerning spores, which onset blooms. Therefore, two differing models of plankton germination traps were developed to capture the spores as they were excysting from the seafloor. One trap design was aerated, which allowed for a tidal flow, and the other was not. An underwater scuba system was designed and assembled to aid the divers in placing the eight traps sub-tidally in Quarter Master Harbor, Puget Sound for eight weeks. In order to evaluate the traps' effectiveness, six species of plankton caught by the traps were counted for the fourth and fifth weeks of the study; the aerated traps were more effective because the water advection helped move motile and non-motile species of plankton into the traps' upper chamber. If these traps are placed in excystment zones using this scuba system and procedure throughout bloom season, it can be determined whether an endogenous clock, environmental cues, or both trigger spores to excyst. Combined with what is already known about vegetative cells and environmental parameters, this knowledge can help create a predictive model of when HABs will occur, ultimately saving money, marine life, and human lives.

Awards won at the 2006 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV061

RECOMMENDATIONS FOR DEVELOPING A RIVER PURIFYING SYSTEM.

Minako Kohki

Okinawa Prefecture Kaihou Senior High School, Shimajiri-gun, Okinawa, Japan

Although the sea in Okinawa Island seems beautiful, the rivers are totally polluted. This is because the sewage disposal system has not expanded, and it often can be seen that household sewage directly goes into the river. In order to develop a purifying system for the river, I examined its water quality. The objects of this examination were the COD (Chemical Oxygen Demand) of both river water and interstitial water – water which is in the sediment. While the COD of the river water shows 50 ppm, the interstitial water shows 100 ppm. It means that the interstitial water is twice as polluted as the river water.

In general, it is known that a high level of COD means a low level of dissolved oxygen concentration in water. Therefore, for decreasing the COD of the interstitial water in the sediment, I collected the sediment of the river and then, compared the water purity of sediments including air with sediments not including air. As a result, while sediments including air decreased from 50 ppm to 10 ppm in five days, sediments not including air decreased only to 20 ppm.

In conclusion, I found it was important that not only the river water, but also the interstitial water needs to be purified to purify the river. In addition, it was proved that air is important for the purification process.

Awards won at the 2006 ISEF

Paid Summer Internship - Agilent Technologies

2006 - EV062

BREAKDOWN THE EFFECT OF THE PERCENTAGE OF RECYCLED FIBERS ON THE BIODEGRADATION OF PAPER

Shannon Lee Taylor

Mount Tabor High School, Winston-Salem, North Carolina, Forsyth

To test the effects of the percentage of recycled fibers in a sheet of paper on the rate of biodegradability, four samples of paper were obtained, each containing a different percent of recycled fibers (0%, 10%, 30% and 100%). After conducting some background research, it was hypothesized that the greater the percent of recycled fibers in a sheet of paper, the greater the rate of biodegradability, because recycled fibers are shorter and weaker than non-recycled fibers, which allows the bacteria and microorganisms present in soil to break them down more easily. Two half-sheets of each sample were buried for one month and two half-sheets of each sample were placed on top of the refrigerator in the basement to serve as the control group. After one month, the test samples were removed from the ground, placed in the basement and photographed. The test samples were compared to the control samples to determine whether or not the hypothesis was correct. After completing the experiment, it was concluded that the hypothesis was indeed correct and the greater the percent of recycled fibers, the greater the rate of biodegradability.

2006 - EV063

PURIFYING A TOXIC SOUP

Nabeel A. Lookmanjee

Clark High School, Plano, Texas, United States

The purpose of the experiment is to see whether algae can be used as a filtration system for removing heavy metals out of the water it is exposed to. In the first part, dialysis tubing was put inside beakers with separate chromium and lead solutions. The tubing was considered a simulation of a cell membrane. For the second part, a 500 mL solution of algae/water/soil was put inside a regular water bottle, and then had .80g of Lead II Nitrate and .65g of Chromium III Nitrate put in each of the bottles. In the first part, an average of exactly 36.1 % of lead and 28.2% for chromium entered the dialysis tubing. For the second part, Chlorella Green Algae had a 100% absorption rate for both heavy metals. Fischerella Blue-Green Algae had an average absorption rate of 64.1% for chromium and 41.7% for lead was recorded. Finally, the Spirogyra Green Algae had an average absorption rate of 57.4% for chromium and 26.3% for lead was recorded. Student's T-Test showed that 99.9% of the time the null hypothesis was rejected. The conclusion drawn from this experiment was that heavy metals could break through a cell membrane. It also proved that another plant besides a water hyacinth, being used by NASA, could be effective in removing heavy metals from water. Now it is known that at least one alga can remove 100% of heavy metals in water.

2006 - EV064

A STUDY OF THE EFFECTS OF BIOSOLIDS ON SOIL FERTILITY AND COLIFORM COUNTS

Catherine Michelle Seals

Central VA Governor's School/ Liberty High School, Lynchburg/Bedford VA, USA

The purpose of this study was to compare the effects of biosolids on the levels of nutrients and coliform levels in soil samples for two fields in Bedford County, VA. The researcher collected soil sample from two fields in Bedford County, Virginia between the last week in October 2005 and December 20, 2005. One field had been treated with biosolids, while the other field had had no treatment for at least five years. Eight soil samples were collected from each field every Monday morning during the duration of the study. The researcher preformed a soil coliform count of the samples at a local Central Virginia high school each Monday between the last week in October and December 20, 2005 using the SBC Method (approved by the VA DEQ on 11-23-04) that uses the Millipore M-ColiBlue24 broth as the testing media. The researcher also sent a sample of soil from each field to the Virginia Cooperative Extension's Agricultural Laboratory at Virginia Tech for a soil fertility analysis. The researcher concluded that the application of biosolids to a field did not significantly increase the number of soil coliform colonies in comparison to a field that has received no treatment for at least five years after performing a t-test assuming equal variances (alpha = 0.05). The nutrient levels (P, K, Ca, Mg, Zn, Mn, Cu, Fe, and B) had higher levels in the biosolids field than in those of the no treatment field, although Fe is the exception.

2006 - EV065

THE ECOTOXICOLOGICAL EFFECTS OF IONIC LIQUIDS ON AQUATIC LIFE

Neeta P. Kamat
John Adams High School, South Bend, Indiana, U.S.A.

Ionic liquids promise to be the future in green chemistry because they are non-volatile and will not emit harmful pollutants. Although these solvents promise to be safe there is little known about their environmental effects on aquatic life. A closer look at ionic liquids was taken while observing the changes on zebra mussels.

 Mussels of four different sizes were introduced in water and water containing 20mg/L ionic liquid. The number of live mussels was monitored at intervals of one hour, one day, and four days. A majority of zebra mussels present in ionic liquid died within four days, thus pointing out the possible toxicological effect of ionic liquid.

 Another set of experiments was conducted to probe how ionic liquids affect the ability of zebra mussels to intake algae. Zebra mussels (10-15mm size) were placed in concentrations of zero, one, five, ten, twenty, and forty mg/L of ionic liquids containing equal concentrations of algae in each cup. The filtration rate of zebra mussels was monitored by sampling the water at 1, 2, 3 and 4 hours. A preservative was added to each of these samples and was then placed on a slide for microscopic analysis. The algae count indicated that the presence of ionic liquids significantly slowed the mussels' filtration rate and their ability to survive for more than four days.

 From this investigation it was concluded that, although they are held as promising, the harmful effects of ionic liquids on zebra mussels could be part of a much larger picture.

2006 - EV066
USING DRACAENA SANDERIANA AS A VEHICLE TO HYPERACCUMULATE INDUSTRIAL WASTEWATER

Amanda DeLyn Forbis
O'Donnell High School, O'Donnell, TX 79351, USA

Industrial wastewater is a major environmental concern. It contains heavy metals and other toxic chemicals such as sulfides. Removing heavy metals from the soil and water is difficult and very expensive. We must find cost-effective, environmental-friendly methods to remove heavy metals from our water and soil. Can Dracaena sanderiana effectively hyperaccumulate industrial wastes, such as chromium and sulfide? Dracaena sanderiana is a hardy, water-loving plant that has characteristics indicating that it will be a successful hyperaccumulator of industrial wastes, such as chromium and sulfide. There are four test groups with exposure: to chromium; to sulfide; to chromium and sulfide; and the control group using distilled water. Each plant had a hydroponics set-up, with a burette delivering the test solutions. Each plant was exposed to 150 mL of the test solution each day, 50 mL every 8 hours. The plants were carefully monitored and measured. Measurements of height, weight, roots, leaves, and branches are taken periodically. Each run-off water sample is tested using UV visible photospectroscopy and atomic absorbance. Results show plants exposed to the chromium responding the best, with more new leaves. The plants exposed to the sulfide suffered significantly. Since sulfides tend to precipitate out metals, the sulfide could have precipitated out the trace metals, leaving the plants deficient. Dracaena sanderiana is a hardy, water-loving plant that is a successful hyperaccumulator of industrial wastes, tolerating the chromium exposure well. Vehicles such as Dracaena sanderiana will allow us to successfully clean up industrial wastewater from sources such as tanneries.

2006 - EV067
REMOVAL OF ESTROGENIC COMPOUNDS IN DAIRY WASTE LAGOONS BY FERRATE(VI): OXIDATION/COAGULATION

Jarrett Renn Remsberg
Middletown Senior High School, Middletown Maryland, USA

This project investigates the use of Ferrate(VI) oxidation-coagulation as a means of breaking down and/or removing steroidal estrogens (SE) from dairy waste lagoon effluent (DWLE), so as to minimize the amount of SE entering groundwater/watersheds. To assess the initial estrogenic content (EC) of DWLE, dairy lagoon sites were sampled and uniformly mixed aliquots assayed using High Performance Liquid Chromatography (HPLC) fractionation. The SE present were quantitated by atmospheric pressure ionization mass spectrometry (API-MS). Specifically API operated in the electrospray positive ionization (+ESI) mode, utilizing a LC-Quattro Micromass Triple Quadrupole Mass Spectrometer. Effect of Ferrate(VI) or ferric chloride treatment of DWLE on EC was subsequently analyzed by LC-MS-MS. DWLE contained measurable amounts of estrogenic compounds. Initial total concentration of extractable estrogenic compounds in DWLE was 27.70 micrograms/L. Estradiol, 19.67 micrograms/L, was the most prevalent estrogenic form and estriol, 2.10 micrograms/L the least prevalent form. A paired t-test showed a significant decrease in estradiol content ($P < 0.05$) when DWLE was treated with a high concentration (0.84%) of Ferrate(VI). Ferrate(VI) treatment of DWLE decreased the concentration of extractable estradiol logarithmically with increasing concentration of Ferrate(VI). The logarithmic relationship [$y = -5.75\ln(x) - 20.52$] ($R^2 = 0.97$) can be used to estimate the amount of Ferrate(VI) necessary to remove this compound from a given amount of DWLE. Treatment of DWLE with increasing amounts of Ferrate(VI) (0.07-0.84%) caused a significant increase in progesterone ($P < 0.05$). Ferrate(VI) treatment of DWLE may be an environmentally sound method for reduction of estrogenic compounds.

Awards won at the 2006 ISEF
Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2006 - EV068
FLY AWAY CHEMICALS: THE EFFECT OF INHALING DEEP

Kelsey Ann Holkesvik
Central High School, Aberdeen, South Dakota, United States

The objective was to study the effects inhaling fumes had on wild type flies, or Drosophila melanogaster. The hypothesis was that there would be a negative effect on the flies from the airborne chemicals; affecting their behavior and shortening their life spans. The experiment was set up by gassing the flies in tubes for eight hours with different chemicals; studying their behavior changes and the death toll. Materials used include a glass funnel, gauze, parafilm, and 4ml of each chemical. This was repeated with five different chemicals including Febreze, Protect All, Windex, Scrubbing Bubbles, and Nail Polish Remover. All of

these chemicals are known inhalants that have a negative effect on humans, and hopefully a parallel can be seen in experiment. The experiment's results show that there is negative effect with fume inhaling with a drastic change in some of the fly's behaviors such as a decrease in activity and changes in flying patterns. Also, it was evident with the high death rates of most of the chemicals, especially Protect All.

2006 - EV069

THERE'S SOMETHING IN THE WATER NITRATE LEVELS THROUGH THE SEASONS

Robert Allen Manduca
Century High School, Rochester MN, USA

The purpose of this experiment was to establish a relationship between temperature and nitrate uptake by plants. It was also hoped that the experiment would confirm the generally held belief that wetlands are the most effective natural filters of nitrates. The hypothesis was that as temperatures decreased, the level of nitrate in groundwater would go up due to the dormancy of filtering plants during winter. In addition, it was hypothesized that wetlands would show lower levels of nitrate than other types of ground cover.

Data was collected at six sample sites in the US Geological Survey sampling array north of Century High School. Two sample sites were in wetlands, two in grassland, and two in woodlands. Each site was outfitted with a Thermochron, a device that measured groundwater temperature every hour for two months. During this time, three water samples were taken at each site, near the beginning, middle, and end of the sampling period. These samples were analyzed by the Olmsted County Water Lab.

The results showed that groundwater temperatures decreased gradually over the sampling period by about 15 degrees Fahrenheit. The levels of nitrate present in the groundwater increased over this same period, also gradually. Additionally, the wetland samples consistently had lower amounts of nitrate than either of the other two types of ground cover. The results supported the hypothesis that nitrate levels would increase with lower temperatures, and that wetlands would have the least nitrate present.

Awards won at the 2006 ISEF

Award of \$200 - National Ground Water Association

2006 - EV070

BIOREMEDIATION USING SOIL BACTERIA IN HYDROCARBON DEGRADATION

Kylie Mae Phillips
Timber Lake High School, Timber Lake, South Dakota, United States

The purpose of this experiment was to perform bioremediation using soil bacteria in the degradation of hydrocarbons found in crude oil.

Four treatments and their duplicates were created. Equal amounts of water from an underground well were added to eight vessels. Three grams of topsoil from a fallow field were added and mixed thoroughly. Two vessels were left as controls. To the next group of vessels, slow-release fertilizer was added. In the third experimental group, fifteen drops of crude oil were added to create a thin film on the water's surface. In the final treatment, both oil and fertilizer were added to the water and soil. Serial dilutions, from 10-1 to 10-10, were made with 1ml of water extracted from each sample vessel. Using the spread plate technique, a 1ml sample from each dilution was cultured on nutrient agar. After 48 hours, each plate was measured for bacterial growth. After 10 days of exposure, serial dilutions were again performed, spread plating was done, and a final bacterial count was taken.

From the data collected in this research, there was over a 300% increase in the number of bacteria found in the treatment given fertilizer compared to its control. Microscopic images confirmed that bacteria in the soil were feeding off the hydrocarbons, degrading the crude oil.

2006 - EV071

RAISING CANE TO REDUCE HYPOXIA IN THE GULF OF MEXICO

Caleb Andrew Lampert
Hahnville High School, Boutte, Louisiana, USA

Scientists believe that excess nitrogen is spilling into the Gulf of Mexico from sewage treatment plants and farm lands along the Mississippi river. This nitrogen is killing marine life in a 7000 square mile area in the northern Gulf of Mexico by consuming the oxygen required for life. The main source of the nitrogen is urine from residential areas and chemical fertilizers from farms.

For this project, urine was applied to sugar cane seedlings after it was diluted 9:1 with water. There were eighteen (18) sugar cane plants; six in the first control group (water only), six in the second control group (chemical fertilizer), and six in the test group (urine solution). The urine mixture was applied to the test group once per week for fourteen weeks. Chemical fertilizer was applied twice (week 1 and week 11). Data was gathered every two weeks.

The test group showed the best growth. The results are shown below after 31 weeks:

Description	Water / Chemical / Urine	Height (inches)	Diameter (inches)	Weight (oz.)	Sugar Content (%)
1	Water	53	0.75	14.5	20.6
2	Chemical	62	0.88	21.0	22.2
3	Urine	88	0.94	29.0	23.0

The results of this project show that urine can be an effective fertilizer. It could be used on farms, which would eliminate the need for chemical fertilizers on crops. This would result in a reduction of nitrogen to sewage treatment plants and run-off from farms. Therefore, there would be less nitrogen entering the Gulf of Mexico, and a positive impact on the hypoxic zone.

2006 - EV072

THE SILENT PASSENGER; CARBON MONOXIDE, CARBOXYHAEMOGLOBIN, AND THE COMMUTER

Jordan Daniel Bowman
St. Marys, Hamilton Ontario, Canada

This project consists of new research and comparison of the air quality experienced by Hamilton/Toronto commuter groups in a manner which has not yet been considered in other studies by studying the air quality of the microenvironment inside of various commuter vehicles travelling through this busy corridor, and the

effect that this air quality had on the vehicle's occupants.

 Carbon monoxide (CO) levels were measured as an indicator of air quality and Carboxyhaemoglobin (COHb) blood levels were measured in participants as an indicator of health effects.

 Four different travelling groups were compared: those who commute in an automobile through the Hamilton/Toronto transportation corridor, those who commute through a local transportation corridor, those who work out of a vehicle continuously throughout the day, as well as those who travel the Hamilton/Toronto transportation corridor via commuter train.

 After extensive testing, it was found that the highest levels of CO exposure and COHb were found in the Hamilton continuous drivers, followed by the Hamilton/Toronto drivers, the Hamilton/Toronto train commuters, and finally the local Hamilton drivers. Additionally, it was found that carbon monoxide exposure and carboxyhaemoglobin levels were proportionate to each other.

 By examining groupings of commuters in this unique manner, this experiment defined important correlations between CO, COHb and commuters. These results provide valuable insights and a stepping stone for further research into the safest modes of transportation and how they affect human health and our global environment.

2006 - EV073

EARTHWORM-PRODUCED HUMUS ACCELERATES THE GROWTH OF COFFEE PLANTS UNDER LABORATORY CONDITIONS

Abdiel Jose Ortiz
Radians School, Cayey, Puerto Rico

The purpose of this research is to test the effectiveness of a natural organic fertilizer against one chemically produced. As the organic fertilizer, earthworm produced humus was chosen. Specifically, the species Eudrilus eugeniae was farmed during ten months, after which the humus produced was extracted and used for the experiments.

Coffee plants (Coffea arabica) were used as experimental subjects since our goal is to find a feasible alternative for the commercial growth of these plants in already nutrients-deprived soils. Plants were divided into two groups, one exposed to the chemical fertilizer and the other to the humus. Soil pH and humidity were monitored through the experiments. After four months of data, the results show that the organic fertilizer was more effective than the chemical one in accelerating the growth of the coffee plants (X = 20.2 cm for humus Vs X = 19.6 for the chemical). There were no significant differences in the amount of leaves and neither in the diameter of the stems. The application of humus as a bioremediation strategy in nutrients-deprived soils is discussed. The economic impact of the use of natural organic fertilizers is also addressed.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV074

EVALUATING THE IMPACT OF TRIVALENT ARSENICALS ON SELENIUM METABOLISM USING E. COLI AS A MODEL SYSTEM

Daniel Kenneth Cook
Lake Highland Preparatory School, Orlando, FL, USA

ent arsenicals, genotoxic forms of arsenic, are known carcinogens. They contaminate tap and ground water, posing a great environmental risk to humans. This research provides an understanding of the effects of trivalent arsenicals on selenium metabolism and modes of detoxification in living organisms using Esche richia coli (E. coli) as a model system. The selenium metabolism pathways of E. coli are analogous to those in humans and can provide insight into the effects of arsenicals in humans. Since selenoproteins protect against oxidative stress, it is hypothesized that reduced amounts of selenoproteins caused by trivalent arsenicals lead to increased levels of reactive oxygen species, contributing to the development of arsenic induced cancer.

 The toxicity of arsenite in the mutant strain of E. coli, WL400 (selD), was compared to that of its parent strain, MC4100 (wild type). The mutant strain does not undergo complete selenium metabolism because of a mutation in the selD gene and thus has an availability of selenide, the metabolized form of selenite. A spectrophotometer measured the growth of cultures treated with varying concentrations of arsenite and selenite. The mutant strain exhibited a greater resistance to arsenite than the wild type, thus proving the hypothesis that trivalent arsenicals block selenium metabolism and the biosynthesis of selenoproteins by draining the cell's supply of selenide. Additional research of these molecular interactions using radioactive isotopes could lead to the discovery of the type and amount of selenium needed by cells to detoxify arsenic and produce selenoproteins.

Awards won at the 2006 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV075

UNDERWATER STRUCTURES AS A MEANS OF MITIGATING WAVE INUNDATION

Eric Lee Keeling
La Veta Junior/Senior High School, La Veta, Colorado, United States

In 2004-2005, tsunamis and hurricanes, worldwide, were responsible for over 284,000 deaths. Inundation is a key factor in determining the damaging effect of a tsunami or hurricane. The engineering goal of this project was to design and construct a wave tank with a beach slope and wave generator in order to determine if underwater structures were capable of mitigating inundation.

Wave tank dimensions and design were determined, and a ¼ scale model wave tank was built. The ¼ scale model served as a guide for the large wave tank (8ft by 2.75ft). A slope was constructed at one end of the tank, while a wave generator consisting of a spring operated flap was constructed at the opposite end of the tank. Four underwater structures were designed and constructed. Twenty-five trial runs were conducted with and without structures. Data on wave run-up and inundation was collected via video imagery.

Trial runs with no underwater structure served as a control. Results for inundation/wave run-up, respectively, are reported as an average for all trials: Control - 21.7 cm /10.7 cm, solid straight wall- 11 cm/10 cm, solid porous wall -13.2 cm /10.2 cm, curved wall -14.7 cm /10.4 cm, and 90° angle wall -13.5 cm /10.3 cm.

The engineering goal was accomplished according to design criteria. In this experiment, data gathered from trial runs indicated underwater structures were capable of mitigating wave inundation. No significant difference was noticed in wave run-up. This project would be applicable to coastal areas susceptible to wave

inundation.

2006 - EV076
BRICKLAM: BUILDING TO CONSERVE

Josue Roberto Murillo Fernandez
Colegio Gregorio Jose Ramirez Castro, Alajuela, COSTA RICA

The purpose of this project is to promote a solution to solid waste pollution through the recycling of tetra brick packages to produce a laminate called Bricklam. This material is a substitute for diverse construction materials such as wood and cement board. It is also a new alternative offering financial income for persons with few resources. Bricklam was created with a view towards the conservation of nature because its aim is to recycle in order not to waste such valuable material and thereby reduce the pollution produced by this type of solid waste.

Materials: Tetra brick packages, a conventional oven, a mold with a top. 4 inch screws, scissors, a buillotine and two sheets of aluminum foil.

Procedure: First, place a sheet of aluminum foil over the surface of the mold, over this, place strips measuring 29cmx20cm cut from the packages, forming layers, then place the other sheet of aluminum foil on top and bake. For each ton of tetra brick there is a savings of 100,000 liters of water, 1,500kg of wood, 3,000kw of electrical energy.

Conclusions: 1. Panels of materials can be made from waste tetra brick material by baking layers of strips cut from the packages at a particular temperature. 2. Bricklam is a laminate made from recycled tetra brick packages; with low production costs, it's easy to make and does not require adhesives or formaldehydes, nor sophisticated machinery or large buildings. 3. Bricklam is an inexpensive material and an alternative for families with few resources, to work in a family based industry. 4. Bricklam could be a substitute for other materials such as wood, it is easy to handle and can be used to make tables, chairs, non weight bearing walls, desks and home made products.

2006 - EV077
ECOLOGICAL AND ENVIRONMENTAL STUDIES OF THE TAR CREEK SUPER FUND SITE.

Jason Allen Cossey
Dove Science Academy, Tulsa Oklahoma, United States of America

The area of the Tar Creek site is in northeast Oklahoma by the Kansas-Oklahoma border.

 The site has been used for mining purposes, extracting zinc and lead from the ground. Not only the waste products of the mining area over the years have caused the accumulation of lead and as well as some other heavy minerals threatening the health of the residents of the area, but also according to the Environmental Protection Agency and Oklahoma State agencies the mining of lead and zinc ore left miles of underground tunnels, drill holes and open mine shafts.

 In this project I am investigating how this site has been affected ecologically and environmentally as well as its effect to the residents of the site area.

 The research area was visited and some water samples from the Tar Creek (a major river runs through the area) were collected to be analysed in Tulsa Health Department Laboratories. During our trip to the area we interviewed some of the local residents to get a better idea of the Ecological & Environmental pollution of the area.

According to the Tulsa Health Department Laboratories, the three samples of water that we took from the Tar Creek had hazardous amounts of lead and zinc. But the sample that we took from a convenience store had average amounts of lead and zinc. Our research has shown that the area is still contaminated by heavy minerals and puts not only human life in danger but, animals and plant life as well.

2006 - EV078
ELECTROCHEMICAL REMEDIATION OF THE ENVIRONMENT (PRODUCTION OF FERRATE)

Mario Roberto Velarde Rodriguez
High School COBAES #42 Escuinapa Sinaloa Mexico.

Objective:To produce ferrate by means of electrolysis reaction as contamination remover in the water.

To put 6M NaOH production is really high and soluble.The battery works as an electricity fountain of power. When you connect the cables, it produces potential difference.Making the electrons travel towards the clove connected as electrode.When you introduce the clove they start to produce ferrate,they start with effervescence, then after 20 minutes, the NaOH will become purple.The anode indicates that there is ferrate.In electrolysis the cathode produces the reduction making the sodium ions come towards itself.The Fe oxidation occurs in the anode.The anode attracts the OH's oxygen and the water's oxygen,and it produces ferrate.

The ferrate is a powerful oxidizing.The most common Fe oxidizing number are 2,3 it works with 6,that's why is not that much stable and it can be reduced.This will make reason you use coagulating-floculating to purificate water,because it is able to remove contamination.It destroys organic contamination and virus.

Test: You separate the ferrate,put 5-10 dots in a test tube,add .5ml of ethanol(organic contaminant)when you add it,the ferrate loses color because the ethanol's oxidate and ferrate's reduction.

Conclusion: By means of this experiment we proved that the production of ferrate and we demonstrated that is an oxidizing able to remove contamination.

2006 - EV079
WHAT LIES IN THE RIVER

Markie Michelle Dohrenwend
OHS, Owensboro KY, USA

First I collected water samples. Then I used a microscope on 100X total magnification to examine the water samples. Then I used a spectrophotometer in order to measure the %Transmittance and absorption of each sample in order to compare the river water to the other samples.

2006 - EV080

THE IMPORTANCE OF SALINITY, PH AND TEMPERATURE OF SEAWATER FOR THE SURVIVAL OF THE HAWKSBILL (ERETMICHELYS IMBRICATA) IN THE BEACHES OF PUERTO RICO

Alba Nydia Rosado-Soto
Aurea E. Quiles Claudio High School Guanica, Puerto Rico

The purpose of this investigation was to establish the relationship between the seawater quality and the nesting of tortoises. The problem was: Will the salinity, the pH and the temperature of seawater affect the nesting of Hawksbill (Eretmochelys imbricata) in some beaches of Puerto Rico? The hypothesis under study was: If the salinity, the pH and the temperature of the seawater of several beaches of Puerto Rico varies then the Hawksbill nesting will be affected due to changes in water quality. Reported data about the nesting of Hawksbill in the beaches of the town of Guanica and in the island of Puerto Rico during the months of October, November and December were studied. Then samples of water from each beach were taken to analyze their salinity, pH and temperature. The results of these analysis for the different beaches were compared in tables and graphs. It was concluded that the salinity has a significant importance for the tortoises' nesting. The higher the salinity of the seawater the more common were the Hawksbills nesting events. There was a relationship between seawater salinity and the beaches that are known as nesting places for Hawksbills in Puerto Rico.

2006 - EV081
BIOELECTROMAGNETISM II: OPTIMIZATION OF CONDITIONS FOR SUSTAINABLE CURRENT AND POWER OUTPUT IN A MICROBIAL GENERATOR USING MAGNETOSPIRILLUM MS-1

Kartik Madiraju
Centennial Regional High School, Greenfield Park, Quebec, CANADA

The need for alternative energy sources has led to the discovery of various renewable bio-resources. The hypothesis is that under optimal growth conditions and cell concentration, magnetic bacteria (Magnetospirillum) can be exploited as an energy source in a scale-up generator in order to produce a sustained current and power.

 The project's focus was to measure current and power generation using magnetic bacteria in microbial generators, to determine the cell concentration that yields the highest electricity output, to conduct growth curve analyses on Magnetospirillum and to use this information to build a scale-up generator.

 The optimal cell concentration of Magnetospirillum for electricity production was determined by diluting a stock culture. The current and power generation were derived from voltage measured at different resistances. The growth curve was conducted at 21 and 30 C by plotting Colony Forming Units and Optical Density over time. The scale-up generator was built using two concentric copper cylinders as electrodes, with 20 ml volume between them.

 Current and power were sustained at 25 microamps and 5.5 microwatts, respectively, beyond 48 hours at a resistance of 10kohms. At higher resistances, the current and power were not sustainable. The optimum cell concentration was 3 to 6 x 10^7 cells/ml for high, sustained voltage production.

 The growth of Magnetospirillum at 21 and 30 C was comparable.

 Underwater power plants employing magnetic bacteria could be built

in the future. This novel invention has the potential for use in nanotechnology as micro power generators and as an alternative energy source.

Awards won at the 2006 ISEF
First Award of \$3,000 - Environmental Sciences - Presented by Ricoh
Mathematica software package for all Intel Grand award first place winners. - Wolfram Research, Inc.

2006 - EV082
EXAMINING THE FEASIBILITY OF UTILIZING DINOFLAGELLATES (PYROCYSTIS FUSIFORMIS) AS A BIOASSAY TO TEST METAL TOXICITY LEVELS

Nicole Khezri
Great Neck North High School, Great Neck New York, United States of America

metal contamination has become a major environmental issue. Chemical means exist to determine metallic concentration, however, chemical analysis does not demonstrate the biological effects of heavy metal toxicity. Bioassays, which evaluate the effect of toxicity on a target organism, can provide low cost alternatives to chemical analysis. As a commercial bioluminescent bioassay, Microtox uses the marine bacteria Photobacterium phosphoreum, coupled with a photometer or luminometer instrument, for the measurement of light emission. This form of light production, known as bioluminescence, is a chemical reaction that requires two chemicals; a luciferin that produces light and a luciferase that catalyzes the reaction. Although Microtox is an effective bioassay, the Photobacterium phosphoreum is not sensitive to all metals and chemical. The purpose of the present study is to determine if the dinoflagellate Pyrocistis fusiformis may also serve as an effective bioassay for toxicity measurements. Ten different metallic salt solutions were added to dinoflagellates in 96 well plates. Decrease in light emission was measured at metal concentrations of .0001mM, .01mM, .1mM, 2mM, and 6mM and at time periods of 1 hour, 3hours, 6 hours, and 24 hours. Bioluminescence activity was measured with a fluorometer and observed with the use of fluorescence microscope. Eight samples were measured for each metal at each concentration at each time condition. Results were analyzed using a 1 one-way ANOVA and SPSS. Results indicate that the luminescence of the control samples show a large range of values limiting the effectiveness of the bioassay. The bioassay revealed significant differences with the control groups in just a few of the metals such as NaCl, but there was no pattern that was consistent over several concentrations at several time intervals.

Awards won at the 2006 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by Ricoh

2006 - EV083
ENVIRONMENTAL FACTORS AFFECTING THE FILTRATION RATE OF CUMBERLANDIA MONODONTA

Michael Logan Musser
Gleason School, Gleason, TN, U.S.A.

The purpose of this experiment was to test how well *Cumberlandia monodonta* could filter water under the influence of different factors. It was hypothesized that a greater salinity would have a negative effect, that filtration would be less in darkness, and that larger specimens would filter more.

Four one-gallon tanks were filled with 3 L of room temperature water. Three tanks had .5 g, 1.0 g, and 1.5 g of salt dissolved in them respectively. The fourth tank was a control. Three 3 cm to 6 cm *Cumberlandia monodonta* were added to each tank. A solution of .5 g of kaolin powder to .25 L of water was added to each tank. After 24 hours, biodeposits were collected. This process was repeated twice more as shown and then three times with 6 cm to 10 cm *Cumberlandia monodonta*.

Two tanks were then filled with room temperature water. Three 3 cm to 6 cm *Cumberlandia monodonta* were added to both tanks. The kaolin solution was added to both tanks. One tank was placed in total darkness while the other was left in light. After 24 hours, biodeposits were collected. This experiment was then repeated twice more as shown and three times using 6 cm to 10 cm *Cumberlandia monodonta*.

In conclusion, the hypothesis was supported because greater salinity had a negative effect; the testing with 1.5 g of salt killed six specimens. Larger specimens filtered more due to size. However, light and darkness had no effect on filtration.

2006 - EV084
MAKING METHANE

Elizabeth Louise Bosworth
White Lake School District 1-3, White Lake, SD, USA

This experiment explored methane as an alternative fuel, specifically methane, produced by anaerobic bacteria in cattle, hog, and turkey manure. Those in rural third world areas without electricity or fuel could use manure-created methane to cook food and boil water. To test production of methane by these manures, slurries were made by mixing 1.89 liters of each manure with 0.95 liters of water. The slurries were put in jugs. Tubes containing colored water were attached. As the water rose, its height determined the amount of gas produced. Hog manure and cattle manure produced 7.8525 cubic centimeters and 8.2425 cubic centimeters of gas, respectively. Hog manure produced gas in eight days; cattle took ten. Slurry was put into 100-gallon tanks to produce methane large-scale. Every day a sealed air compressor pumped the gas into an air tank. Forty-seven pounds per square inch of gas powered a twenty-kilowatt generator for twelve seconds. Such combustion produces carbon dioxide and water.

It could be argued that the carbon dioxide aggravates global warming through the "greenhouse effect". However, the methane consumed traps twenty-one times more heat per molecule than the carbon dioxide produced. So, even though methane accounts for 9 percent of greenhouse gasses, it traps more heat than its 84 percent counterpart, carbon dioxide. By consuming methane, we alleviate global warming and some of the need for harmful fossil fuels.

Awards won at the 2006 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV085
DEADLY WATERS: A TWELVE MONTH WATER QUALITY STUDY OF A NEWLY ERUPTED SULFUR SPRING AND ITS LONGITUDINAL EFFECT ON DIAMOND FORK CREEK, PHASE IV

Shannon L. Babb
American Fork High School, American Fork, Utah, U.S.A.

Focus of study was to research effect of newly erupted sulfur spring on water quality of Diamond Fork Creek. Evaluations were conducted at six sites once a month for a period of twelve months, January through December 2005. Site 1 was one mile upstream of where spring entered Diamond Fork Creek. Site 2 was located where spring erupted from hillside. Site 3 studied effect of spring at its confluence with Diamond Fork Creek. Sites 4, 5, and 6 were 1.3 miles, 2.5 miles, and 5 miles downstream from the confluence.

Each site was tested chemically, physically and biologically using standardized evaluation tools. Chemical testing included dissolved oxygen, sulfide, pH, ammonia, and nitrate. Physical evaluation included temperature, turbidity, cross-section, flow rate, and riparian zone surveys. Biological evaluation included two macroinvertebrate surveys.

Results demonstrate the spring is having a negative impact on Diamond Fork Creek. According to Utah EPA standards and/or guidelines for cold water fisheries, water quality significantly deteriorates and a dead zone was created. Sulfide levels at confluence reach toxic levels every month during study period and dissolved oxygen levels drop below acceptable levels for six months.

Water quality begins to improve chemically and physically within 1.3 miles, due to additional streams entering the water course. Unfortunately, the diversity of macroinvertebrates -- a key indicator of biological health -- has not rebounded.

The only way to remediate the damage is stop the sulfur spring and allow water upstream to cleanse toxins from area and transport biological life back.

Awards won at the 2006 ISEF
Award \$750 - Geological Society of America
First Award of \$3,000 - Environmental Sciences - Presented by Ricoh
Mathematica software package for all Intel Grand award first place winners. - Wolfram Research, Inc.
Award of \$200 - North American Benthological Society
Award of \$500 - National Ground Water Association

The SIYSS is a multi-disciplinary seminar highlighting some of the most remarkable achievements by young scientists from around the world. The students have the opportunity to visit scientific institutes, attend the Nobel lectures and press conferences, learn more about Sweden and experience the extravagance of the Nobel festivities. - Seaborg SIYSS Award

First Award of \$500 - Society of Environmental Toxicology and Chemistry

2006 - EV086
THE BIODEGRADATION OF CRUDE OIL BY A NOVEL MARINE BACTERIAL COMMUNITY

Jordan Singer

Ephrata Senior High School, Ephrata, Pennsylvania, USA

Waste water produced during crude oil exploration and production is characterized by extremely saline conditions (2-3 times that of sea water) and is contaminated by a range of organic wastes. Such conditions prove detrimental to bacterial propagation and thus limit biodegradation. While many stable hydrocarbons are easily degradable, more complex structures are recalcitrant. One factor that limits degradation of Total Petroleum Hydrocarbons (TPHs) is the availability of the hydrophobic carbon substrate to the bacteria in liquid suspension. Various methods have been employed to bring bacteria into contact with the oil substrate; these have resulted in increased degradation rates ranging from 40-60%. This study focuses on another possible degradation-enhancing method: natural selection. By selecting for bacteria that exhibited the shortest growth rate on crude-oil medium, a culture was obtained which could utilize the entire spectrum of crude oil. Upon the formation of visible colonies, bacteria were transferred over a period of several months onto new plates containing crude oil medium. The data showed a significant increase in the growth rate ($p < 0.001$) suggesting the cultures selected for affinity toward growth on previously recalcitrant carbon sources.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV087

THE EFFECT OF DIFFERENT MONTHS ON THE SOIL'S PH IN AN APPLE ORCHARD

Logan Russell Douglas

James Wood High School, Winchester, Virginia, United States

Soil samples were collected from an apple orchard to determine the effects of seasonal rainfall on the pH of the soil. Availability of nutrients in the soil, which is necessary for maximum apple yield, is restricted if the soil's pH is too low when caused by conditions such as acid rain. Therefore, soil pH should decrease following significant amounts of rainfall. Samples from six different locations in the orchard were collected weekly, and the pH was measured and recorded, and then compared with the rainfall during the same period. Soil pH of the samples ranged from 5.35 to 7.47. The pH at each sample site varied either up or down weekly with no apparent correlation to amounts of rainfall.

2006 - EV088

DANGER IN THE AIR! HOW DAMAGING IS PARTICULATE MATTER?

Jared Keith Willis

Wetumpka High School, Wetumpka, AL, USA

This project involves the study of the effects of air pollution particulates. Wood and nylon frames in groups of five were mounted at the following sites: 1) highway, 2) concrete plant, 3) wooded, 4) paper mill/brake plants (paper), and 5) neighborhood to collect emitted pollutants. A designated frame was collected biweekly over a ten week period. My hypothesis was that the nylon frames at the highway would contain the most damage from the pollutants. A grading template was established using criteria based on weave fraying, gapping, and matting, nylon color, the number of trapped particulates, nylon elasticity and site odor. My hypothesis again proved correct. The highway site consistently contained the most damage. By the tenth week all frames contained many particles with the concrete plant having the highest count. All contained gapping and matting with the highway and paper sites having the largest coverage. The highway nylon color was almost black. Only the highway and paper site had fraying. The paper site had the strongest smell. Leaf burning contributed to the neighborhood frame containing the highest number of black areas. The least damaged nylon was at the wooded site. However, it should be noted that emissions from the paper site would mostly be in the form of secondary gases (sulfur dioxide) and therefore not captured. This project exhibited how damaging particulates can be especially near highways due to a concentration of vehicle emissions (hydrocarbon and nitrogen oxide) coupled with forced wind from traffic.

Awards won at the 2006 ISEF

Second Award of \$100 - Showboard, Inc.

2006 - EV089

BIOENERGY PHASE III PLANTS C3 AND C4. WHICH WILL BE THE BEST ENERGY PRODUCER?

Nataly Soto

Luis Munoz Marin High School, Barranquitas, Puerto Rico

The purpose of this project is to determine if C4-type plants are better energy producers than the C3-type and to determine if more than a pair of electrodes can be used simultaneously in the same plant stem. The C3- type plant has a moderate efficiency in the photosynthesis process while the C4- type plant is highly efficient. Two C3- plants were used: the quenepa tree (*Melicoccus bijugatus*) and the Neem tree (*Azadirachta indica*) and three *Echinoreus merkeri* of the C4- type. Cuprous oxide and galvanized steel electrodes were inserted in the plant stems and were sealed with paraffin tape. Voltage measurements were then performed using a digital voltmeter to determine the energy production level of each plant. The plants fluids are contain electrolytes that allow the plant to work as a living battery. Single-pair electrode tests have shown that C4- type plants produce up to 50% more energy than C3- type plants. It was also found that it is possible to connect more than one pair of electrodes to C3- type plants. Their energy production level can be enhanced by this technique. Tests were also done on a plant (a palm tree) that had the electrodes for more than a year. Results show that the plant continues producing energy. This demonstrates that the procedure described in this project uses renewable energy sources that can be sustained, thus providing an alternative for energy production.

2006 - EV090

UTILIZING ULTRASONIC ACTIVATION TO PREVENT THE ADHESION OF THE BALANUS GLANDULA WITHIN THE MAX- IMUM RADIUS

Ryan John Clark

Hilton Head Preparatory School, Hilton Head Island, SC

pose is to determine the maximum radius that a twenty-five kilohertz magnetostrictive ultrasonic transducer can prevent the adhesion of the Balanus gland ula, and to develop designs for a prototype that could be sold to mariners.

 The ultrasonic transducer was bonded to a gel-coated fiberglass box and placed in saltwater with pieces of gel-coated fiberglass placed approximately every meter away, up to 10 meters away from the box. Another piece was placed approximately 1600 meters away, for a control. The numbers of barnacles were recorded each week for twenty-one weeks on each of the pieces.

 The results are that the fiberglass pieces 1 to 3m away had no barnacle growth. The fiberglass pieces 4m and 5m away had 1 and 9 barnacles. Barnacle growth increased from 84 at 6m to 96 barnacles at 10m. The ultrasonically activated box had no barnacle growth. The piece 1600m away had 172 barnacles.

 The ultrasonic transducer prevented barnacles within a four meter radius. One significant result was that the transducer was able to reduce the number of barnacles at 10m away by 50%. A design that was created from the results of this experiment is a floating buoy system. A floating capsule made of fiberglass with a flotation ring surrounding it would be placed every eight meters from one another. The entire capsule would be chained to a concrete weight resting on the sea floor. Initial research indicated that ultrasonic activation can also be used to prevent the latest threat, a specific Didemnum species.

Awards won at the 2006 ISEF

Third Award of \$1,000 - United States Coast Guard

2006 - EV091

ARE YOU SURE YOU WANT TO DRINK THAT? PART II: WHAT'S REALLY IN YOUR WATER?

Emily Nicole Termotto

Hilton Head Preparatory School, Hilton Head, SC, USA

The purpose of this experiment is to test the nitrate, pH, phosphate, coliform, and bacteria levels of the water from the Savannah River, using ultra violet sunlight rays.

 The predicted outcome of this experiment is that by using ultra violet light the water is purified of the bacteria and coliform, phosphates and nitrates, and thus will bring the pH level down.

 The materials needed are nine new plastic water bottles, black paint, sunlight, bacterial, coliform, phosphate, nitrate, and pH level testing kits, three one- gallon jugs, and Savannah River water.

 Water should be collected from the Savannah River, in three one-gallon jugs. The water taken from the river should be tested first. The water bottles (three bottles to each group, one group with black paint on the bottom, one group with one side painted black, and one group clear) are filled, set out in direct sunlight for six hours, and then retested. The testing kits used were a LaMotte Project testing kit and the LaMotte Water Monitoring kit. Each sample kit had a control (regular river water) and three group bottle tests.

 The outcome differed from the hypothesis, since the results were not very consistent. In the majority of the tests, the clear bottles did the best, having the least amount of contamination. The two different painted bottles had approximately the same amount of contamination, instead of all of them being uncontaminated, as predicted.

2006 - EV092

POND SCUM: POWER PLANT OF THE FUTURE

Jamilee Kae Lightfoot

Central Lee Community High School, Donnellson, Iowa, United States

As one sits fishing on a warm day and become annoyed by the green scum clinging to the sides of the pond, you need to realize that pond scum could be tomorrow's power plant. Algae could be the answer to the energy crisis. Is algae a possible energy source of the future? Do different types of pond scum (algae) make a difference in the amount of hydrogen produced?

 I believe that algae can produce hydrogen as a viable energy source and that different types of algae will generate different amounts of hydrogen.

 I cultured different varieties of algae in prepared bottles of water, some marine algae and others freshwater algae. The algae strains I tested with included: freshwater algae- Chlamydomonas reinhardtii, Vaucheria sessilis, Oedogonium foveolatum; and marine algae- Sphacelaria and Acrochaetium. The cultures were grown under grow lights in an area at constant room temperature. After a significant concentration of algae was grown, I transferred the cultured algae strains to a sulfur free water bottle with a vent hose attached to the top. After three days the algae depleted any remaining sulfur, producing hydrogen as a byproduct. The vent hose attached to the top of the culture bottle was connected to the hydrogen input of a proton exchange membrane (PEM) fuel cell. I measured the electrical output of the PEM cell and compared each algae strain to determine which of the strains would produce the most hydrogen. The tests were repeated six times with each algae strain.

 All the algae tested did produce hydrogen.The Chlamydomonas reinhardtii freshwater algae was the most proficient in generating hydrogen. The marine algae, Sphacelaria, produced the least amounts of hydrogen.

 Pond scum is a viable Power Plant of the Future.

2006 - EV093

PRODUCING ALTERNATIVE ENERGY FROM SUGARBEET PROCESSING WASTEWATER

Austin James LaFromboise

Turtle Mountain High School Belcourt, ND USA

Every year we become more and more aware of our dependency on oil. More effort needs to be placed on finding alternative sources for fuel. The purpose of my project was to see if I could build a filter that could not only clean up wastewater from sugar beet plants, but use the sugar in the waste water to produce ethanol, an alternative energy fuel.

 My procedure was to isolate yeast cells and form them into a filter. The sugar beet wastewater was passed through the filter and the sugar combined with the yeast cells. The yeast produced ethanol and the water is cleaned. I used several different types of yeast and

several different processes to make the filters. I found that using cell entrapment worked the best for the filters. I also found when I collected the gas produced from filtrate it was in fact ethanol that was produced. In order to increase the amount of ethanol produced, I tried added another waste product, molasses, to the sugar beet waste water and I found that it produced more ethanol than just the plain sugar beet water.

2006 - EV094

BIOGAS OPTIMIZING METHANOGENIC BACTERIA IN AN ANAEROBIC DIGESTER

Adan Lopez

James Pace High School, Brownsville, Texas, United States

The purpose of my experiment is to see the effects of nitrogen (in the form of urea) and phosphorus (in the form of bonemeal) on methanogenic bacteria count, for use in an anaerobic digester that converts water hyacinth to biogas.To provide optimal growing conditions for the methanogenic bacteria, I built a 4 reactor incubator, and 4, 250 ml anaerobic reactors. The incubator was made of an aquarium, insulated with home insulation and bubble wrap and heated with 1 aquarium heater. The reactors are airtight and made of glass. This is to provide convection heating (the incubator is filled with water) so that the reactors are constantly at a mesophilic temperature range. The nitrogen and phosphorus was as aforementioned provided as urea and bonemeal. The ratios of carbon to nitrogen, and carbon to nitrogen were, 25:1 for C:N and 137.5:1 for C:P. The urea and bonemeal, only 46.7% nitrogen, and 14% phosphorus were both recalculated to give 100% nitrogen to one, and 100% phosphorus to the other. The 2 halves of testing go on for 23 days, to provide more than sufficient time for the methanogenic bacteria to reproduce and grow. The results gathered have supported the hypothesis made earlier, both nitrogen and phosphorus produced more biogas than the control, in fact phosphorus had higher biogas yield than the control.

2006 - EV095

QUANTIFICATION, REMOVAL AND RECOVERY OF APFO FROM CONTAMINATED DRINKING WATER WITH A CONCOMITANT ENDOCRINOLOGICAL AND EPIDEMIOLOGICAL ASSESSMENT

Kelydra Elizabeth Welcker

Parkersburg South High School, Parkersburg, WV, USA

Ammonium perfluorooctanoate - also called APFO, PFOA or C8 - is a surfactant associated with the production of Teflon®. APFO does not hydrolyze, photolyze, or biodegrade and is biologically additive with highest concentrations occurring in individuals whose drinking water has been contaminated.

 The presence of a surfactant in water lowers surface tension. Agitation of water containing a surfactant generates foam with foam height proportional to surfactant concentration. Contaminated drinking water contains parts per billion APFO. High heat evaporative sample reduction 1000-fold is required to concentrate APFO into foaming range. A sample containing APFO is concentrated, agitated, photographed and compared by imaging software analysis to spiked control foam heights. Statistical analysis indicated foam height testing was 92% accurate when compared to confirmed APFO concentrations. In addition, APFO may be removed and recovered from water by electrosorption through the diffuse electrical double layer to the positive electrode of a basic electrolytic cell.

 Endocrinological testing indicated APFO decreased mosquito developmental time potentially increasing the risk of West Nile Virus(WNV). Epidemiological analysis of Center for Disease Control and Prevention WNV data from 2002-2004 from APFO-contaminated counties across the United States compared to control counties was statistically significant at the P= 0.002 level for summed data of all positive reports. Positive APFO reports in birds from the same areas were statistically significant at the P = 0.0004 level.

Awards won at the 2006 ISEF

First Award of \$200 - Patent and Trademark Office Society

Student Membership in SETAC - Society of Environmental Toxicology and Chemistry

2006 - EV096

WHAT GOES IN, MUST COME OUT: DOES THE USE OF CHICKEN LITTER AS A FERTILIZER CAUSE INCREASED ARSENIC & PHOSPHORUS LEVELS IN SOIL?

Megan Lydon Snyder

Grove High School, Grove, Oklahoma, USA

Arsenic is used in chicken feed, and as a result arsenic concentrations as high as 15 to 35ppm are found in poultry litter, and studies have proven that as much as 5100 tons of poultry litter is produced daily, which was calculated to contain a median of 136.08 kg of arsenic. Also, arsenic and phosphorus are chemically very similar, since phosphorus is more abundant than arsenic in agricultural soils, it crowds arsenic off binding sites, increasing the solubility and mobility. Arsenic is a known carcinogen, however, from a health perspective; phosphorus is not hazardous to humans. The problem with phosphorus stems from nutrient buildup when spreading chicken litter. Phosphorus can wash off into streams causing excessive algae growth and ultimately, the impairment of surface waters. This eventually causes habitat degradation in the streams and also causes problems for water treatment facilities.

 The experiment is designed to explore how much arsenic and phosphorus is present in soil treated with chicken litter compost, and the compost itself. Also to determine what happens to the arsenic and phosphorus over time.

 Several soil samples were taken from sites that had been treated with chicken litter and then tested for arsenic and phosphorus. The same was done with the litter compost. A field that had never had any litter applied to it was used as the control.

 It was concluded that arsenic is in chicken litter compost and in the treated soil. Time, however, played a key role in determining how much arsenic and phosphorus were in the soil.

2006 - EV097

CONTROL OF SEED GERMINATION BY CORN GLUTEN MEAL SUPPLEMENTATION

Rachel Ann Schoenian
Northwestern High School, Kokomo, IN, USA

The purpose was to examine the ability of corn gluten meal to inhibit the germination of *Taraxacum officinale*. One hundred dandelion seeds were planted in order to measure the effects of each of the different treatment variables. These treatments included Isoxaben chemical herbicide, a corn gluten meal concentration equal to that of the herbicide, the recommended corn gluten meal concentration, the doubly recommended corn gluten concentration, and the control. The hypothesis stated that the lowest germination rate would occur with the Isoxaben treated plants and the germination rate would decrease as the gluten concentration increased. After experimentation, Isoxaben was the most significantly effective at reducing the number of seeds germinated compared to the control plants. In a chi-square (χ^2) statistical analysis, $\chi^2 = 13.550 > (0.05) = 3.84$. Height and width of the chemically treated plants were also significantly affected: $t(\text{width}) = 2.04 > t(0.05) = 2.036$; $t(\text{height}) = 2.04 > t(0.05) = 2.036$. The corn gluten concentration equal to that of the herbicide was ineffective at blocking any type of dandelion growth. The recommended gluten concentration was only significantly effective at reducing the number of leaves on the plants: $t(\text{number of leaves}) = 2.41 > t(0.05) = 2.0155$. Corn gluten at the doubly recommended concentration was also only effective at reducing the number of leaves: $t(\text{number of leaves}) = 2.14 > t(0.05) = 2.022$. In conclusion, corn gluten meal is not as effective as the chemical herbicide, Isoxaben, in blocking the growth of *Taraxacum officinale*.

2006 - EV098
SOMETHING SMELLS FISHY: THE RESPONSE OF MEDAKA EMBRYOS TO DAVIS CREEK

Kristan Marie Conlon
Coalfield School, Coalfield, Tennessee, United States of America

While walking a trail on a spring day, the scent of a fresh breeze and the sound of a rippling creek. The only thing preventing the residents of Coalfield, Tennessee from experiencing this walk is Davis Creek. The creek has a murky appearance and often a foul smell. These characteristics are the basis of the research performed in this project. In order to assess the possibility of pollutants, Medaka embryos' kill:live ratio was observed using three Davis Creek water samples compared to the control, an unpolluted stream at Frozen Head State Park. Water was analyzed at each site to identify pollutants and possible pollution sources. Medaka eggs were harvested from fish maintained by standard methods at Coalfield School. Harvested eggs were placed in water which was changed daily and maintained at a temperature of $24 \pm 2^\circ\text{C}$. Embryo development was monitored daily for thirteen days, using a microscope. Resulting data found survival and hatching were 100% for the control site. Site 1 samples resulted in 30% of the embryos surviving and 0 hatching. Site 2 resulted in a hatch and survival rate of 20%. Finally, Site 3 samples had 70% hatch and 1 embryo that was living but did not hatch. A total 17 of 40 embryos were dead and 21 of 40 hatched. All results considered, there is evidence of a possible source hindering the survival of Medaka embryos at Davis Creek. Through further in-depth research and possible cleanup solutions, a better walk may be experienced in Coalfield.

2006 - EV099
BLAST FROM THE PLAST: USING PROTOPLASTS TO DETERMINE THE LOCATION OF THE METAL-BINDING PROTEIN AGNT84

Savannah Jay Ramey
Jefferson County High School, Dandridge, Tennessee, USA

The glycine histidine- rich protein AgNt84 is of interest for possible use in phytoremediation. Plants expressing high levels of AgNt84 could be used to sequester toxic metals, removing them from contaminated soil and water. Tobacco plants transformed to express AgNt84 fused to Green Fluorescent Protein (GFP) were used to determine the subcellular location of AgNt84. Subcellular targeting programs predicted an approximate probability of 80% that this protein is exported from the cell. If AgNt84 is secreted from the cell, then the metal absorbed during phytoremediation would not kill the cells making AgNt84 an attractive candidate for phytoremediation. In preliminary experiments, AgNt84-GFP protein could not be visualized within intact leaf tissue due to the high level of cell wall autofluorescence. As an alternate approach, the cell wall was removed creating protoplasts. The protoplasts were incubated for twenty-four hours for production of the AgNt84-GFP protein. Protoplasts and medium were collected and independently analyzed using gel electrophoresis and immunodetection. The lack of the control protein ATPase in the gel lanes containing medium demonstrates the integrity of the protoplasts during processing. The lanes probed for GFP show a large number of small protein fragments suggesting that the AgNt84-GFP protein may be targeted for degradation. In conclusion, further experiments must be performed to verify the presence of intact AgNt84-GFP protein and to increase the level of protein expression in order for AgNt84 to be useful for phytoremediation. Furthermore this research demonstrates the advantages of using protoplasts for the analysis of protein expression.

2006 - EV100
A SPHAGNUM SOLUTION FOR SAFE WATER

Arielle Garrett
Stelly's Secondary School, Saanichton, British Columbia

Sphagnum moss could be used as a cheap, reusable filter for poor families with water contaminated by heavy metals. I examined where Sphagnum stores metals it absorbs with cation exchange, using the SEM Microscopy and an Energy Dispersion X-Ray. Is it possible to remove metals from Sphagnum cristatum after absorption? I placed Sphagnum in an acid solution after allowing it to absorb copper. I wanted to know if Sphagnum could be used to filter trace amounts of arsenic, which I tested with the ICP-MS. Finally, I applied it as a filter for contaminated water, using our own metal rich well water. I found that the copper bound both on internal and external hyaline cell walls. A low pH solution like vinegar can effectively remove up to 76% of bound copper. Drying the moss significantly increased copper removal, thus enhancing reusability. Sphagnum removed only 12% of the arsenic from a solution, and so is not effective with that metal. It does, however, perform very well with other metals in well water. Sphagnum lowered 3 below drinking water standards. Sphagnum appears to have an elemental preference series. Sphagnum is cheap and transportable, and by showing that Sphagnum is reusable, it makes it even more

cost effective; a single filter could last for years. Possibly, people who need filters but cannot afford them could use Sphagnum to improve their lives.

Also, proving that Sphagnum is reusable means if applied as a filter, people would not need to continually harvest and harm the environment.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV101
THE EFFECTS OF NUTRIENT ENRICHMENT (N AND P) ON THE CYANOBACTERIA GENUS, ANABAENA

Nicole Christina Corbett
Abington High School, Abington MA, United States

In freshwater systems, many "alga blooms" are due to cyanobacteria. These organisms, also referred to as blue-green algae, can grow excessively when fueled by nutrients, particularly nitrogen and phosphorus. These cyanobacterial blooms can affect the appearance, odor, and taste of the water. Their presence quickly degrades aquatic habitats. The ability of many species of cyanobacteria to produce toxins, which affect animals and humans, is of great concern. The purpose of this experiment was to investigate the effects of nitrogen and phosphorus enrichment on the common bloom forming cyanobacteria genus, Anabaena. Samples of the species Anabaena sp. were exposed to a range of dosages of NH4Cl, NaNO3, and Na2HPO4. Anabaena cell counts were monitored using a hemacytometer and turbidity measurements were made using a colorimeter. Observations of cell's appearance, mainly heterocyst production, were also noted.

The data showed that at concentrations of 10 ppm and higher of phosphorus enrichment the Anabaena showed significant cell growth, which can lead to the formation of blooms. Many species of cyanobacteria, such as Anabaena, have the unique ability to "fix nitrogen" in specialized cells called heterocysts. In this experiment, it was also noted that the Anabaena enriched with phosphorus showed strong heterocyst activity. The results indicated that Anabaena was more affected by phosphorus enrichment than nitrogen enrichment. The results of this study are useful in helping to understand and prevent Anabaena blooms, which are a recurrent problem in a local drinking water source, Great Sandy Bottom Pond.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV102
LICHENS AS INDICATORS OF AIR POLLUTION II: A FLUOROMETRIC ANALYSIS OF HEAVY METALS IN FLAVOPARMELIA CAPERATA COLLECTED IN AREAS SURROUNDING A COAL BURNING POWER PLANT

Angela Devi Shrestha
Saginaw Arts and Sciences Academy, Saginaw, Michigan, USA

This continuation experiment expands on Lichens as Indicators of Air Pollution I: Potassium Ion Leakage and Discoloration in Crustose and Foliose Lichens Due to Increased Sulfur Dioxide and Carbon Dioxide Concentrations, in which lichens were exposed to sulfur dioxide and carbon dioxide and measured the health response of the lichens. The goal was to prove that lichens could be used as passive indicators for air quality by showing that as air conditions change so does their state of health. This experiment expands by examining the foliose lichen species Flavoparmelia caperata which were collected outside of a coal burning power plant at one, two, and five mile radii, ground in a ball mill, and subjected to x-ray florescence spectroscopy. The data was analyzed for heavy metals such as titanium, chromium, iron, and cobalt. It was found that the lichens collected surrounding the coal burning power plant were highest in the concentrations of the aforementioned elements and had a lower concentration of potassium and magnesium, two elements essential for lichen function. The highest concentrations of heavy metals were found at close radii to the power plant. As the distance from the power plant increased the concentration of heavy metal contaminants increased. The lowest concentrations of the essential elements potassium and magnesium were found in samples closes to the power plant and concentrations increased to the concentrations found in the control at farther distances from the plant. Samples to the east and the south differed the most from the control, most likely because of the prevailing north and west winds. This shows that lichens do accumulate heavy metal contaminants present in their environment. Because of this trait, lichens make ideal indicators of air pollution.

2006 - EV103
ESCHERICHIA COLI AS AN INDICATOR OF HUMAN WASTE

Katherine May Coury
Port Huron Northern High School, Port Huron Michigan, United States of America

Currently, health authorities often make decisions about the safety of water for human use based on the assumption that positive E. coli tests indicate the presence of human waste, which may contain pathogens dangerous to humans.

I studied levels of E. coli in sediment samples along the Black River. The goal of the experiment was to test the extent to which the presence of E. coli reliably indicates the presence of human waste.

I hypothesized that other sources of E. coli, such as other mammals waste and sediment, would skew the results. I hypothesized that, as I progressed up the Black River, the levels of E. coli would remain constant despite the lower human population density.

To test my hypothesis I tested water from diluted soil samples at varying points in the river for their E. coli levels.

Results showed that there was no meaningful correlation among the samples. The E. coli levels in the samples taken at the highest point in the Black River were almost the same as those taken at the lowest point in the Black River. However, the E. coli levels varied greatly in between, with no clear cause of the variations.

My hypothesis was not supported by my results but neither was the traditional theory that E. coli is a reliable an indicator of human waste. I believe that the lack of a meaningful trend in the E. coli levels was due to the many uncontrolled variables.

2006 - EV104

WHAT CONDITIONS BEST AID THE REPRODUCTION RATE OF LEMNA MINOR?

Rebecca Grace Dolan
Taunton High School, Taunton, MA, USA

The purpose of this experiment was to see what types of runoff had the greatest effect on accelerating the reproduction rates of Duckweed (Lemna Minor). The types of runoff in order that they were hypothesized are: Fertilizer, Road Salt, and the control. They are placed in the order that is believed to have the greatest effect on the Duckweed's reproduction rate. Each substance was combined with distilled water and filtered. Then it was added to a specified amount of water, soil medium and Duckweed plants. Observations of the Duckweed had been made prior to the experiment's start and observed at the conclusion of the procedure. The results were that the plants in the control group exhibited normal growth tendencies, which include the formation of buds. The control plants also remained green and had roots growing. The plants exposed to the Fertilizer began to die off. They lost their pigmentation and their roots, not to mention that the rate of reproduction was dramatically slowed and the majority of the buds that formed died before separating from the parent plant. The plants that were exposed to the Road Salt exhibited extremely accelerated growth tendencies with multiple buds forming off of one parent plant at a single time. The plants in the Road Salt also turned a dark green shade that was unexpected. In conclusion the Road Salt had the greatest effect on accelerating the Duckweed's reproduction rates. It was followed by the control; coming in last was the sample containing the Fertilizer.

2006 - EV105

THE EFFECT OF PARTICLE SIZE ON CELLULOSE CONVERSION RATES

Manraj Singh Rangi
duPont Manual High School, Louisville, Kentucky, United States

The research is to be conducted for the benefit for agriculture and economics. This experiment focuses on one of the steps used to produce ethanol. This step is enzymatic hydrolysis: the process in which cellulose is converted into glucose. If not done right, this process can be very costly. One way to shorten the time and cost of this step is to find the best particle size of the substrate for the enzyme to bind to. The purpose of this experiment is to determine if the particle size of the substrate has an effect on how much glucose is produced. Through the research it was hypothesized that the smaller the particle substrate size, the more the glucose will be produced at a faster rate.

Two trials of four different red oak substrate particle sizes were tested for their glucose production efficiency in intervals of 24 hours for a total of 72 hours. The results from the experiment almost wholly supported the hypothesis, with slight discrepancies. Also, a viscosity test for the mixtures showed that the smaller particle sizes were thinner, meaning that energy will be reduced for heating and mixing the wood substances. The results of this experiment have shown that if ethanol is to be produced in great bulks, time and cost will be reduced if smaller particle sizes are used. As wood residues (Red Oak) are getting in the way of homes and sawmills (especially in Kentucky), they can now be used efficiently in the production of ethanol.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV106

BIOLOGICAL IMPLICATIONS OF SEDIMENT MERCURY NEAR A CHLORALKALI FACILITY

Lauren Wooten Smith
John S. Davidson Fine Arts School, Augusta, GA, USA

There have been fish consumption warnings for many years because of high mercury (Hg) levels in the Savannah River, which forms the border between GA and SC. While there are many potential sources for this contamination, a chloralkali facility in Augusta that produces chlorine by electrolysis, using Hg electrodes may be an important contributor. Samples of sediment were collected from the river above and below the facility and from the channel leading to the river from the facility. Total mercury concentrations in sediment were measured, and the toxicity of sediments to a model invertebrate (the amphipod Gammarus) was evaluated.

Sediment mercury concentrations in the chloralkali discharge channel (CDC) were very high, with median values of 22,000 and 51,000 ppb (air dried and freeze-dried, respectively). Upstream and downstream of the CDC, mercury concentrations of dried sediments ranged from 3 to 130 ppb. Other studies have suggested a toxicity threshold of 560 ppb for Hg in sediments. Given the high concentrations of Hg found in the facility channel, significant toxicity was expected. Channel and downstream sediments significantly reduced survival of amphipods after 24, 48, and 72 hour exposures as compared with upstream sediment samples.

The very high Hg concentrations of the CDC sediment samples may contribute to high toxicity when exposed to invertebrates relative to upstream samples. Mercury may also have a toxic effect downstream of the CDC. However mercury concentrations are not significantly different between the upstream and downstream regions thus other factors probably contribute to sediment toxicity downstream. The CDC is a navigable waterway, continuous with the Savannah River. Mercury in sediments from this area may be entering food webs, and may threaten anglers who consume fish caught in the area.

Awards won at the 2006 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh
Honorable Mention Award - North American Benthological Society

2006 - EV107

IS PRECIPITATION PICKLING THE ENVIRONMENT?

Breanne Nicole Anderson
Academy of Math, Engineering and Science, Salt Lake City, Utah, USA

This study considered the impact of sulfur and nitric oxide emissions from a coal-fired power plant on the pH of snow in the surrounding area. The researcher hypothesized that: Pollutants such as Nitric Oxides (NO) and Sulfur Oxides (SO), exist in the form of "acid snow" in regions downwind from this coal-fired power plant. Three regions for snow collection were mapped. Control sampling sites represented locations upwind from the power plant while experimental sites were downwind. The upwind and downwind regions were each broken down into 3 distinct sampling sites. Ten snow samples were collected from each of the 3 upwind sites and from each of the 3 downwind sites. The pH of these 60 snow samples was evaluated, at room temperature, using a pH meter. Data was analyzed in Excel Spreadsheets, using the Student's T-test. Analyses compared region one upwind to region one downwind, region two upwind to region two downwind, and region three upwind to region three downwind. Upwind region one and downwind region one were significantly different. The pH of the downwind sample was higher than expected and did not represent "acidic precipitation". This difference is most likely caused by vegetation or fertilizers used on the grounds adjacent to the power plant. In addition, the overall average pH of snow samples for regions 1-3 upwind and 1-3 downwind were compared. The data was not significantly different. The data was not sufficient to support or refute the hypothesis.

2006 - EV108
A POLYMERIC TREATMENT FOR REMOVAL OF HEAVY METAL CONTAMINATES FROM WATER

Tyler Matthew Keck
Monte Vista High School, Monte Vista Colorado

To determine if an anionic flocculent polymer (Ecolab 6850) and an acrylic polymer (LB 88-HS) will lower the cocentrations of copper II+, iron III+, nickel II+, lead II+, manganese IV+, zinc II+, and arsenic V+ in real water samples contaminated as a result of both natural geology contamination and mining.

It is believed the polymer will lower the concentration of metals in all of the contaminated solutions by at least 75% and will lower the concentration of Iron the most (80 to 95%) and lower the concentration of Arsenic the least (5 to 20%).

Samples were collected from the upper Alamosa River, Bitter Creek, Whiteman Creek, Willow Creek, Iron Creek, the Summitville mine inflow, and from the Rio Grande River. Samples were collected in sealable glass jars and were stored in a laboratory within 24 hours of collection. pH was tested at each of the collection sites. Samples were made to 1% nitric acid by volume as well as a DI water control. pH was raised to 9 to help the metal ions precipitate. Samples were tested in a laboratory for metal concentration using an Atomic Absorption instrument. The flocculent polymer was hydrated and made into a solution by dissolving 0.001 grams polymer in 10mL of DI water. 1mL of the polymer solution and 100mL of collected solution were added to eight 250mL beakers. Beakers containing the polymer solution were placed on magnetic stirrers for 10 minutes. Polymer was filtered using a fine grade paper filter. After filtration the remaining water solution was tested for pH and metal concentration to determine the change.

 found that the sodium based polymer (LB 88-HS) was much more effective in lowering concentrations of heavy metals in real water environments. Out of the six metals tested the polymer lowered the concentration by 77% compared to 57% for the flocculent polymer.

Awards won at the 2006 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Ricoh

2006 - EV109
WAS THE ELIMINATION A SOLUTION?: THE PERTINENT AFFECTS OF LEAD-BASED PAINT ON THE ENVIRONMENT-- A CONCLUSION

Sarah Michelle Cole
Demopolis High School, Demopolis, AL 36732, USA

Last year, I tested six homes that had been painted with lead-based paint. Results proved that high amounts of lead were present in the soil. This year I experimented with the two homes that contained the highest amount of lead. I sought to determine that the lead found in the soil of my previous year's project came from the lead-based paint on the homes. It was hypothesized that elevated amounts of lead will be found in the soil, but no lead will be present in the plant samples.

 Experimentation dealt with: 1) collection of 32 soil samples from Gaineswood, Lyon Hall, and my control site. The samples were collected at 12", 36", 48", and 60" from the home. 2) collection of 18 plant samples from around each home 3) collection of 32 more soil samples from each home after it had rained 4) preparation and testing of all samples.

 My hypothesis was proven to be accurate, in a way. High amounts of lead were found in the soil. From the correct procedures on this year's project, we can now determine that the lead-based paint from the homes is posing as a major health threat. However, the samples collected after it had rained did not show significant changes. From experimentation on the plant samples, it was discovered that some plants did absorb lead from the soil. Therefore, the soil and plants surrounding the homes pose as a health concern. In conclusion, lead-based paint persists as a problem in today's society.

2006 - EV110
CONTAMINATION MIGRATION

Tara Janae Elkins
Grants High School, Grants, NM, United States of America

Hype rages from all sides of debate concerning contamination and Homestake's Milan Uranium Mill. The purpose of this investigation is to determine if there is a trend in the migration of contaminants in the alluvial aquifer south west of Homestake's Milan tailings pile. Because of the base of the alluvium's gradient, it is speculated that if contaminants in the aquifer are flowing, they are flowing in a general south west direction.

 To accomplish this, data of four constituents at 16 wells over a nine year period were collected from Homestake Mining Company records. The concentrations of uranium, selenium, total dissolved solids, and sulfate were analyzed and average yearly change in concentration was calculated. Once the average amount of change at each site was established, the results were plotted by GPS on maps, which were then observed in search of a general trend in contamination flow. To better understand Homestake's data sources, water samples were collected from four of the analyzed plots. Following State of New Mexico and Homestake procedures these

samples were filtered, preserved, and tested for concentrations of the four constituents at hand. Small correlations hinted toward a south westerly routed contamination flow, but no cumulative trend in migration of uranium, selenium, TDS or sulfate was observed.

 Because it is possible that plotting more data points and further research of the idea could present a more apparent trend, it's believed that the data observed at this time is insufficient to determine the authenticity of the hypothesis.

2006 - EV111

A STUDY OF LEAD IN DRINKING WATER

Miram Rayzel Gleiber

Lakeshore High School, Stevensville, MI, USA

Lead contamination of drinking water from lead piping and soldering is a health hazard in homes built before 1974, when it was outlawed by the EPA Safe Drinking Water Act. Through this study I determined if homes in Berrien County, Michigan are still at risk of having lead in drinking water. Water samples were collected from 21 homes and each was then prepared for lead analysis using Atomic Absorption Spectrometry. Levels in the samples ranged from <1 ppb to 15.8 ppb. The maximum level recommended by the EPA is 15 ppb. One sample (15.8 ppb) with lead above this limit presents a high risk. An analysis of mean values for age of home and types of pipe indicated that the oldest homes sampled resulted in the higher levels, as did those with types of piping that were metal (mainly copper and iron). These levels were due to the increased possibility of lead in the piping and soldering due to age. Residents of homes at such a risk should take precautions when consuming water possibly contaminated by lead.

2006 - EV112

WATER PURIFICATION USING MAGNETIC PARTICLES

Adria Katrin Schwarber

Notre Dame Academy, Park Hills, KY, USA

The most commonly found pollutants in natural water are dyes used by textile industries. The current methods of disposing of these dyes are inadequate. The residues from copper mines are also an abundant source of heavy metal pollution in natural waters. The purpose of this experiment was to study magnetized particles, such as sodium alginate and zeolite, which may be capable of adsorbing and removing Strong Orange Dye and Cu (II) ions. Procion Strong Orange dye at concentration 0.05 g/L served as the dye-simulated wastewater solution. Another stock of CuSO4 with a concentration of 25 g/L served as the metal-polluted solution. The concentration of the dye solution and CuSO4 solution were measured using a spectrophotometer. Many attempts at creating magnetized beads were carried out. The most promising bead was one made from sodium alginate and iron powder. The beads were put into test tubes containing 10 mL of each solution. These agitated on a vibrator. At intervals of 2 hrs, the absorbance of each solution was read. The experiment demonstrated that the beads removed the dye and copper (II) ions from the solutions. Since the beads are magnetic, this efficient way of removing dye and copper (II) ions will be quick and inexpensive.

2006 - EV113

SATELLITE REMOTE SENSING APPLIED TO INLAND WATERS PART 2: THE MODEL

Christopher Michael Strait

Licerpool High School, Liverpool New York, United States

Satellite data of the oceans has been used for the assessment water quality. Models allow for an easier calculation of data using few measurable variables and empirical relationships. We intend to adapt a pre-existing model (Strombeck and Pierson 2000), used on large inland lakes in Sweden, for use on smaller inland waters in New York. This model will be used to calculate some key components of water quality (values of inorganic and organic particulate, color dissolved organic material etc.). Since the concentration and distribution of dissolved matter and particulates are very different between water systems, especially those in different areas of the world, an assessment of data is necessary to determine if the same equations can be used. These parameters represent the absorption component of the larger model. Using these parameters we can then find the corresponding total absorption value. Using total absorption, and its constituents it is possible to begin to determine the quality of a water body. By adjusting the model to site-specific information, a higher degree of accuracy can be achieved. These adjustments are checked using a root mean square error statistical analysis. Preliminary results indicate that the model's results correspond well with lab data. We hope to show that this model can be used on a small inland water body, specifically Onondaga Lake.

2006 - EV114

RESCUING OUR NATURAL WATERS: FIGHTING EUTROPHICATION GLOBALLY THROUGH THE ELECTRICAL ATTRACTION OF NITRATE AND PHOSPHATE

Miguel Angel Bustos

Uniondale High School, Uniondale, New York, United States of America

Currently, pristine natural bodies of water are being destroyed by the process of eutrophication. It's a condition in any body of water where excess concentrations of phosphate and nitrate promote excess algal growth. Human activities are accelerating this natural process. Nutrient rich conditions promote algal blooming and the decomposition of these same algae. Dissolved oxygen depletion due to decomposition ultimately leaves the water in an anoxic state, lethal to oxygen dependent organisms.

 The natural negative charge of these nutrients led this study to use positively and negatively charged electrodes as a method of attraction, reduction and collection. A modified electrolysis apparatus was used to create such a natural attraction. This study treated both eutrophic fresh and saltwater environments for 30 days. Control and experimental environments were established. To test the effect of the electric field created by the electrodes, invertebrates such as arthropods, chordates, and echinoderms were introduced at the beginning of the study and left there

throughout the research. Nutrient concentration, dissolved oxygen, and algal biomass testing done before and after electrode treatment proved that for the experimental environments there was a significant decrease in nutrient concentrations, increasing dissolved oxygen, and a decrease in algae blooms within two days of treatment. Control environments ultimately reached anoxia. Overall, the electrodes proved to be excellent nutrient reducers in eutrophic waters. Later research led to the development of two buoys that gave the electrodes sustainability in any body of water and that were powered by two, 1 volt solar panels.

Awards won at the 2006 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2006 - EV115

EFFECTIVENESS OF STROBE LIGHTS, SOUND FREQUENCY AND LASERS IN REDUCING SALMON ENTRAINMENT THROUGH HYDROPOWER TURBINES

Alexa A. Carey

Gold Beach High School, Gold Beach, Oregon, United States

If turbine related fish mortality can be reduced, production of renewable, inexpensive hydropower energy could be pushed to a higher level. Attempts to make turbines safer for fish passage tend to reduce turbine efficiency/power production, and solid barriers are outside of a turbine intake are damaged by objects in the river current and are ineffective at preventing fish entry. Rather than changing the turbine to accommodate fish, my approach relies on preventing the fish from entering the turbine through the use of lasers, a strobe light, sound, and/or electrical current. Tests used a tank with a pump placed at one end to generate a stream current and a barrier on the opposite end with an opening below to emulate a turbine. Diverting fish by these methods is somewhat novel and untested. In particular, these diversion techniques have not been combined, and they have been evaluated primarily under daytime conditions, even though many fish smolts are known to move primarily at night. The most effective treatments were electric current at 6, 4.5 and 1.5 volts, which was 93-100% effective. A clear (uncolored) strobe light operating at 372 pulses/minute had the next best performance of any method tested, diverting 64-76% of smolts.

Awards won at the 2006 ISEF

Tuition Scholarship of \$5,000 per year for four years - Oregon State University

First Award of \$3,000 - Environmental Sciences - Presented by Ricoh

Mathematica software package for all Intel Grand award first place winners. - Wolfram Research, Inc.

A fully paid summer internship at a NOAA research lab, an opportunity to work with researchers on a NOAA vessel at sea OR a research field experience at a National Marine Sanctuary. - National Oceanic and Atmospheric Administration - NOAA

2006 - EV116

THE EFFECT OF ACTINOMYCES, OPHIOSTOMA PILIFERUM, AND PROPICONAZOLE ON THE GROWTH OF OPHIOSTOMA MINUS

Katie Elizabeth Termer

Clay High School, Green Cove Springs FL, United States

This project was a continuation to discover if there was a new chemical free way of stopping the growth or killing Ophiostoma minus by using other fungi and bacteria: Ophiostoma piliferum, Propiconazole, and Actinomyces.

The sterile water, Ophiostoma piliferum, Propiconazole, and Actinomyces grew by themselves on wood chips in individual petri dishes for 5 days, then a disk of Ophiostoma minus was put in the center of every wood chip to grow for 16 days.

The Ophiostoma minus was measured every day to see how well the fungi and bacteria were preventing its growth.

All the fungi and bacteria were kept in an incubator at 21 degrees celsius so everything would be able to grow, but the Actinomyces bacterium never grew even before it was put in the incubator.

It turns out that if Ophiostoma piliferum completely covered the wood chip before Ophiostoma minus was put on, Ophiostoma piliferum would prevent Ophiostoma minus from growing at all. Ophiostoma minus completely covered the wood chips that had the sterile water and Actinomyces, so the hypothesis was incorrect because it stated that Actinomyces would be able to stop Ophiostoma minus the best. The fungicide, Propiconazole, only prevented Ophiostoma minus from growing for 6 days, and then it took over.

2006 - EV117

AQUATIC PLANTS...TODAY'S SOLUTION FOR INDUSTRIAL POLLUTION

Krissandra Genevieve Jentz

Hankinson High School, Hankinson, ND, USA

Purpose: To analyze the quality of river water obtained from three rivers in southeastern North Dakota through testing samples for levels of various chemical components and bacterial content. Also, to determine the effectiveness of three aquatic plants at purifying two industries' waste waters.

Procedures: Water Analysis: Collected weekly water samples from five different river locations for a period of five weeks in the summer and five weeks in the winter, and determined the amounts of carbon dioxide, dissolved oxygen, total hardness, ammonia, sulfate, and turbidity, lead, mercury, nitrate, phosphate, pH, total dissolved solids, and conductivity through various testing methods. Bacterial Colonization: Collected water samples from the various river locations and would impregnate EMB agar plates with the water samples and observed the bacterial growth. Coliscan: To identify the presences and number of coliform bacteria in the water implementing the use of Coliscan Easygel kits. Contaminated Water Analysis: Analyzed the purification ability of aquatic plants on two factories' waste waters.

Conclusion: Some of the pollutants, such as nitrates, seemed to increase as the rivers passed by industrial locations. From the microbiological aspect, it seemed that samples taken near the industrial sites contained the least bacterial growth. Overall, I feel that industries do slightly affect river water quality in my area, but I believe that the use of aquatic plants can be used as a natural way to purify water to make it healthier, more economical, and more environmentally friendly.

2006 - EV118
AQUATIC ASSAILANT

Bridget Rae Rekow
Ellendale High School, Ellendale North Dakota, United States

What affect do bovine fecal materials have on aquatic vegetation?

 Variable group will have increased dissolved oxygen (DO), later dissolved oxygen will decrease.

 Place 3/4c rocks in 8 jars. Fill with 2c of distilled water and plant 3 Elodea plants in each. Fill 4 jars with 1c distilled water. Fill 4 jars with 1c water and .5g fecal materials. Place equal amount of Lemna in jars. Heat jars to constant 19 degrees Celsius. Wait 1 day for aquatic environment to stabilize. Test DO of each jar and find average DO for each group. Repeat step 9 every 4 days. Every 8 days, fill control goup with distilled water; fill variable group with .5g fecal maters/1c water mixture.

 Test 1, average DO of control group(CG) was .505mg/L. Average DO of variable group(VG) was .59mg/L. Test 2, average DO of CG was .5075mg/L. Average DO of VG was .69mg/L. Test 3, average DO of CG was .515mg/L.Average DO of VG was .67mg/L. Test 4, average DO of CG was .51mg/L. Average DO of VG was .5075mg/L. Test 5, average DO of CG was .51mg/L. Average DO of VG was .22mg/L. Test 6, average DO of CG was .49mg/L. Average DO of VG was .155mg/L. Test 7, average DO of CG was .475mg/L. Average DO of VG was .0975mg/L. Test 8, average DO of CG was .475mg/L. Average DO of VG was .0625mg/L. Test 9, average DO of CG was .4725mg/L. Average DO of VG was .0625mg/L. Test 10, average DO of CG was .46mg/L. Average DO of VG was .055mg/L.

 Fecal materials added nutrients to the aquatic environment, initiating the growth of algae. The vegetation gave off more oxygen, increasing the DO of the water at first. Algae then used up nutrients needed by the vegetation. The dissolved oxygen level dropped and the plants began to die from lack of carbon dioxide and nutrients.

2006 - EV119
PYRETHROIDS AS ENDOCRINE DISRUPTORS: THE EFFECT OF RESIDUAL PYRETHROID LEVELS AS FOUND IN L. ESCULENTUM (TOMATOES) ON THE ABNORMAL PROLIFERATION OF MCF-7 HUMAN BREAST CELLS
Graham William Wakefield Van Schaik
Spring Valley High School

The number of individuals diagnosed with breast cancer grows yearly. Previous research has indicated estrogen and estrogen-mimicking compounds may signal breast cells to grow and divide, sometimes resulting in cancerous tumors. These estrogen-mimicking compounds may include a class of commonly-used pesticides called pyrethroids, which recent research has suggested are capable of inducing the expression of estrogen-regulated proto-oncogenes. The purpose of this research is to determine if concentrations of pyrethroids, analogous to levels that could potentially be ingested through consumption of common fruits, vegetables, and meats, are enough to induce abnormal cellular proliferation of American Type Cell Culture MCF-7 breast cells. For phase 1, two pyrethroids, lambda-cyhalothrin and permethrin, were applied to Lycopersicon esculentum (tomatoes) in levels that conformed to agricultural standards, and, upon harvest, the tomatoes were analyzed for residual pesticide by gas chromatography. The hypothesis that the tomatoes treated with permethrin would retain more pesticide than tomatoes treated with lambda-cyhalothrin was supported. For phase 2, the pesticide concentrations found in the tomatoes were extrapolated to mirror human fruit and vegetable consumption, these concentrations (2, 10, 20, 50 µM) were applied to the MCF-7 human breast cells, and cell counts were taken after 24, 48, 72, and 96 hours. An ANOVA supported the hypothesis that permethrin-treated cells would have higher cell counts than controls ($F_0 = 9.23$; $F(4,22) = 2.82$, $p < 0.001$); a Tukey test revealed that the 10 and 20 µM samples were statistically different from the controls ($\alpha = 0.05$). A second ANOVA did not support the hypothesis that the lambda-cyhalothrin-treated cells would have higher cell counts than controls ($F_0 = 2.30$; $F(4,23) = 2.80$, $p > 0.05$).

Awards won at the 2006 ISEF
Scholarship Award of \$5000 per year for four years - Albany College of Pharmacy of Union University
Second Award of \$500 - Endocrine Society
Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh
First Award of \$3,000 - United States Air Force

2006 - EV120
PRAWN POND SLUDGE AS AN ORGANIC FERTILIZER :PHASE II
Larry Ellee Nyanti
SMK Batu Lintang, Kuching, Sarawak, Malaysia

In many parts of the world including Malaysia, prawn farming is an important agricultural activity. Prawn pond sludge is an environmental polluter and needs to be managed properly. However, there is a possible danger of heavy metals in prawn pond sludge and in vegetables fertilized with it. In this research, the characteristics of pond sludge were determined. To investigate the possibility of pond sludge to replace chicken manure as an organic fertilizer in growing three leaf vegetables (Brassica sp.) A, B, C, and tomato (Lycopersicum esculentum), an experiment with four treatments (T1, chicken manure + NPK, T2 (chicken manure + sludge + NPK), T3 (sludge + NPK), T4 (sludge + sludge + NPK) was conducted in commercial vegetable farms in Beratok, Sarawak. The vegetables harvested were analysed for heavy metals. It was found that the prawn pond sludge contains nitrogen (1.1%) and phosphorus (0.7%) for plant growth. Heavy metals (Cu, Zn, Cd, Pb, Ni, Cr) concentrations of sludge did not exceed the Malaysian DOE and European Legislation of maximum permissible level. T3 yielded significantly higher harvest than T1 for vegetable A and there was no significant difference in harvest between T3 and T1 for the remaining vegetables. T2 and T4 harvest were not significantly different from T1 for all leaf vegetables. The concentrations of heavy metals (Cu, Zn, Cd, Pb) in all vegetables did not exceed the maximum permissible level of Malaysian Food Act. Therefore, pond sludge has the potential to safely replace chicken manure as fertilizer for the types of vegetables studied.

2006 - EV121

RECYCLING OF PAPER BY FLOTATION DE-INKING

Michelle Heather Lucier

Burkburnett High School, Burkburnett Texas, United States

The Purpose of this experiment is to find if Floatation De-inking is an effective process to recycle paper. Newspaper, Printer paper, and magazines will be compared to see which is the most effectively "cleaned" by the process. I hypothesized that the printer paper would recycle the best.

 This experiment is tested by cutting the pieces of paper. The paper is blended with water, and soap is added to the mixture. The solution is divided in half into two separate beakers, one half being labeled Feed and the other Accept. The Accept solution is air diffused with a fish pump and the foam that is produced is paced in another beaker. The water is added with the foam to mix the paper and toner flecks. This solution is label the Reject sample. All three samples are filtered, counted for toner flecks, and dried. The samples are then weighed with the filter paper. The data is used to calculate fiber yield, cleanliness and reject efficiency.

 I observed that the printer paper was the easiest to run through the de-inking process because of the visibility of the toner flecks, while the newspaper and magazines were not as visible.

 I concluded that the de-inking flotation process was fairly effective because over half of the paper came out of the process and that printer paper had the best results of cleanliness and reject efficiency of the fibers proving my hypothesis correct.

2006 - EV122

DO OFFICE MACHINES EMIT DANGEROUS LEVELS OF OZONE?

Alicia Kristine Novoa

Hart County High School, Munfordville, Kentucky, United States of America

Nowadays with technology being so prevalent in our lives, we're using office machines more and more. I wondered if there were negative effects to what the machines give off when in use, so I thought of a procedure to test if the amount of ozone given off was dangerous. To do this I had to find an indicator of ozone. I used the Schoenbein method, which consisted of heating potassium iodide, water, and starch, and brushing the paste onto filter paper. These were my indicators. Once exposed to a specific area, they would show how much ozone was present in that specific area. I had four different data collection sites; two rooms with ample office machinery, and an average classroom. My control was a weight room with no windows, machinery, etc. I found after running the test twice, that ozone was present in the rooms with office machines, but not enough to have concern for health reasons. Uses for this information could have been, if it were dangerous, how do we reduce it to healthy levels?

2006 - EV123

RELEASING SEAWATER FROM SALT BY MULTIPLICATION OF SOLAR RAYS

Maritza Esquivel

Eagle School, Antofagasta, CHILE

 This project in its present form has as purpose to release the seawater from salt by using solar rays. Knowing that the lack of water for human purposes is a world problem the idea of distillation came up to my mind and also because the region where I live in is known as one of the most arid regions of the world, so drinkable water is really hard to get, but we can take good advantage of our Pacific shores.

 The idea was to design and build up a prototype to distillate water by using the sun radiation. This prototype consists on a metallic base, a glass dome in "A" form, metallic device, a water container and six magnifying glasses. Because of sunrays, salt water inside the metallic container starts to evaporate and salt stays at the bottom of the black box, getting, then, distillate water.

 The design used in this process is the most adequate. It can be also mentioned that there's a direct relationship between the environmental temperatures. It is necessary to say that the black walls help to produce a higher concentration of warm.

 The contribution of this project is to help the world population in the recollection of enough water to survive, especially in arid regions.

Awards won at the 2006 ISEF

90% paid tuition scholarship award - Instituto Tecnologico y de Estudios Superiores de Monterrey

2006 - EV124

THE EFFECT OF HERBICIDE ON POND ORGANISMS

Drew Jared MacDonald

Valley High School, Hoople ND, USA

The purpose of this project was to determine whether daphnia, amphipods, copepods, earthworms, and red worms are affected by herbicides in runoff through soils. All organisms were placed in an environment that was comfortable and they were fed appropriate food. Soils were obtained from this previously cropped beet, wheat, corn, soybean, and potato fields. Soils were sprayed with Curtail and Gly-Star at the average field rate. Runoff was obtained by filtering water through the soils. The runoff was placed in the organism's environment for one week and then the organisms were observed. The organisms were placed under a high powered microscope to observe. For the phosphoresce test, 10 Daphnia were placed in a cell and allowed to be in diluted herbicide for 45 minutes. The Daphnia were allowed to ingest the phosphorescent food for 15 minutes. Observations were completed in a darkened room with a UV light to determine the number of healthy Daphnia.

 The conclusion of this project was that there was little difference in results of number of healthy earthworms. Addition of Curtail decreased the number of live red worms. Average heart rate of all three macro invertebrates increased after the addition of herbicides. Daphnia in wheat soil runoff maintained highest level of health. There were more healthy Daphnia in water without herbicide in the phosphorescence test.

2006 - EV125

TOXICITY AND ECOLOGICAL IMPLICATIONS OF NANOMATERIALS TO PHYTOPLANKTON

Jingyuan Luo

Hamilton High School, Chandler, Arizona, United States of America

Nanotechnology is a growing technology that concerns the creation and application of objects that range between 1 and 100 nanometers. The very features that give nanoparticles versatility can also be the features that make nanoparticles dangerous to organisms. This research project investigated the effects of titanium (IV) oxide on Chlamydomonas reinhardtii, a species of green algae. From a population analysis, observations and a genetic test the experiment concluded that titanium oxide nanoparticles were more harmful to C. reinhardtii than regular sized particles. The population data was taken over a period of five days and modeled with logistics functions to find the carrying capacity of each population of algae. By comparing the population curves, I concluded that the algae with nanoparticles grew not only slower, but also in fewer number. The carrying capacity data concurred with this, clearly showing a decrease when C. reinhardtii were placed in an environment with nanoparticles. A genetic evaluation testing for expression of 18s, HSP70, and CaM provided a possible explanation for this toxicity. The levels of the two latter stress genes generally increased with a greater concentration of nanomaterials in the C. reinhardtii growth medium. In addition, the nanoparticles in the medium tended to aggregate, binding to themselves and to C. reinhardtii. Through possible bonds between the nanoparticles and the glycolipids or glycoproteins on the surface of the alga, the nanoparticles immobilized C. reinhardtii. Such toxicity of nanoparticles does not condemn their development, but advises industrial development to proceed with caution.

Awards won at the 2006 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Ricoh

2006 - EV126

COPPER CLAD BOARDS RECYCLED

Jonathan Bacci

Escuela Tecnica Catalina Harriague de Castanos, Salto, URUGUAY

The purpose of our project is to re-use, or recycle copper clad boards from non used appliances.

We know that our project is important because it can help to reduce the environmental pollution caused by copper clad; because of its composition, which is high polluted. It is made of carbon and glass fiber in different proportions due to its application. To clean our electronical copper clad we use, sodium hydroxide and the waste is neutralized with acetic acid. Another method to clean is to use iron perclosure which is neutralized using a base.

Then the next step is to stick a thin metal of bronze or copper. The used sticker resists high temperatures.

After the test me did the copper clad boards becomed new. We managed to re-use a copper clad boards without pollution the environment and reducing the waste.

2006 - EV127

DECONTAMINATION OF PUNO BAY IN TITICACA LAKE AND TREATMENT

Guillermo Minaya

Gran Unidad Escolar "San Carlos", Puno PERU

Our investigation is carried out to define the location of the lagoon of oxidation, in Puno city, the one that is in an inappropriate and aggressive place for city ecology, it is also a threat that attempts against population's health, producing many illnesses. I consider that this lagoon has completed its functions according to the population of that time, at the present time and with a disproportionate population growth, it becomes inadequate for the treatment of the served waters.

Objective: To transfer the lagoon of oxidation to Paucarcolla's pampas, to improve the ecosystem and to foment the development of the tourism at the same time.

Importance - Benefit. We have been searching for more than 40 years the cleanness of the bay waters, to achieve that it could be support of its Flora and Fauna which is unfortunately disappearing, the tourist feel a horrible scent in waters and observe the miasma abundance, let's remember that these people come to Peru, just to visit our like and Machupicchu. That's why the important cleaning the waters, to improve the ecosystem that will allow to bring tourist and to improve our Flora and Fauna; don't let's neglect our lake because shortly it will give us water for consumption.

Results and Conclusions: The project will allow to reduce the contamination in Puno's bay with a low investment cost. This project can be applied to other similar or equal relatives with effectiveness for it's low cost.

2006 - EV301

DECLINE OF THE NORTH AMERICAN LESSER SCAUP: PHASE 2- CHROMIUM AND SELENIUM CONCENTRATIONS IN FOODS

Mitch Dale Weegman, Matt Moraco Weegman

Winona Senior High School School, Winona, Minnesota, United States of America

The lesser scaup (Aythya affinis), once one of the most numerous waterfowl in the United States and Canada, is experiencing a potentially inexorable decline. The lesser scaup, or bluebill population has steadily declined from an average of 7.5 million breeding birds in the 1970's to an all-time low of 3.5 million in 2003. Bioaccumulation is widely understood as the means of elevated levels of toxins in lesser scaup. The goal of this study was to find a contributing factor to the lesser scaup decline by identifying waterways that contain dangerous concentrations of chromium and selenium. It was hypothesized that the zebra mussel would contain the highest concentrations of selenium and chromium because it is a filter-feeder, while freshwater shrimp would contain the lowest concentrations because of their short life span. Zebra mussels, fingernail clams, blood worms, snails and freshwater shrimp were collected on randomly selected traditional lesser scaup staging/breeding waterways. Chromium concentrations found in zebra mussels from Iowa were statistically different than in zebra mussels from Wisconsin (p=.0074). Selenium concentrations in zebra mussels from Wisconsin were much higher than those found in Iowa (p<.0001). Developed land surrounding waterways resulted in higher selenium concentrations in freshwater shrimp. Chromium concentrations in Iowa were the highest

among the majority of the species examined, while they were the lowest in Minnesota. Lesser scaup accumulate the highest concentrations of selenium on Lake Onalaska, WI, while they accumulate the lowest in Iowa.

Awards won at the 2006 ISEF

First Award of \$1,000 - American Veterinary Medical Association
Fourth Award of \$500 - Team Projects - Presented by Science News

2006 - EV302

ASSOCIATION OF FUNGI FOR REMEDIATION OF OIL POLLUTED SOIL

Alina A. Baliuta, Lubov V. Makuta
Gymnasium #1 named after F.Scarina, Minsk, Belarus

ys pollution of soil with oil and oil compounds has become urgent problem. Traditionally for bioremediation of oil polluted soil hydrocarbon-utilizing bacteria are used. Fungi are less studied in spite of the greater potential by virtue of their aggressive growth, greater biomass production and extensive hyphal reach in soil. Filamentous fungi are not so sensitive to the environment conditions (soil acidity, humidity, temperature etc.) as bacteria.

The aim of this project lies in selection of fungal association able to clean soil polluted with diesel fuel and crude oil in conditions, unfavorable for hydrocarbon-utilizing bacteria: high soil acidity and low temperature.

For the investigation the most known hydrocarbon-oxidizing fungus *Cladosporium resinae* was chosen. Besides, white-rot fungi able to decompose lignin and other aromatic compounds and use them as a source of carbon were studied. Fungi were cultivated on liquid media in submerged conditions and on solid substrates. To estimate soil toxicity cress-salad, radish and oats have been used.

It was found that association of *C.resinae* and white-rot basidiomycetes is able to degrade oil compounds and decrease the soil toxicity significantly. Chosen white-rot fungi produce great amount of biosurfactant which emulsify hydrocarbons and accelerate their assimilation by microorganisms.

As the result of our investigations multi-component fungal biopreparations has been elaborated. The biopreparations consist of granules from peat and molasses containing *C.resinae* biomass mixed with sawdust or straw overgrown by white-rot fungi mycelium. Substrate overgrown with Oyster mushroom mycelium after fruit-bodies gathering may be used as a component of the biopreparation.

Awards won at the 2006 ISEF

Third Award of \$100 - Society of Environmental Toxicology and Chemistry

2006 - EV304

FIFTY-PERCENT MORE EFFICIENT ENVIRONMENTALLY CLEAN WIND ENERGY SOURCE

Roman Evgenovich Levin, Yevgen Zaytsev, Maxym Dmytrenko
Zaporizhzhya City Council Gymnasium 28, Zaporizhzhya, Ukraine

 Considering growing energy prices and worsening environmental situation, the problem of using alternative environmentally safe sources of energy has become crucial at local and global levels. It is especially topical in Ukraine; thus development of new, inexpensive and efficient wind energy sources is especially promising for southern Ukraine and other areas with sufficient wind energy resources. Wind energy machines usually consist of a wind engine, electric generator, and control devices. Each part of wind stations has following disadvantages. We propose to eliminate some disadvantages in new design of wind motor, inductor generator and two control devices: wind engine rotation frequency control device and alternative current electric generator voltage stabilizer.

 The proposed wind engine design allows:

- more than 50%-pick-up power of wind engine;

- reducing significantly resistance of blades moving against wind direction;

- reducing crucial wind speed to 3-4 m/s, and reducing load on the main frame.

Advantages of the invented inductor generator are:

- relatively low nominal frequency of rotor rotation;

- absence of current-relieving device allowing to avoid additional power consumption in contact devices and preventing TV-radio interference caused by arcing during current relieving;

- avoiding of magnetic flow continuous element through operation wrapping and high operational reliability.

Awards won at the 2006 ISEF

Award of \$1,000 - Sigma Xi, The Scientific Research Society

2006 - EV305

AN ENVIRONMENTALLY FRIENDLY CLEANING POWDER

Kwai-Yan Wong, Chun-Kit Chu, Kwok-Chung Yau
South Tuen Mun Government Secondary School, Hong Kong China

This project aims to ascertain the possibility of using dry fish bile powder as a substitute for liquid detergents in cleaning glass-ware. Detergent is consumed tremendously. With phosphate as a builder, detergent causes environmental problems, such as algal bloom which causes economical loss.

 Bile, emulsifying lipid in small intestine, contains bile salts that are similar to detergent molecules. They contain a hydrophobic end and a hydrophilic part. Fish bile smells and decays over time. To overcome these, dry fish bile powder was thus manufactured. Through cleaning oily colored glass rod, it was found that the powder could provide a similar cleaning effect as detergent.

 The cleaning power and pollution effect of the powder were compared with detergent. The cleaning power was measured by the number of oily colored glass rod cleaned by a fixed amount of cleaning agent in 60 ml distilled water, while the pollution effect is measured by Biochemical Oxygen Demand and dissolved oxygen content in sea water using oxygen sensor of data logger. It was found that 0.5 g of powder was equivalent to approximately 5 g of detergent and the pollution effect was reduced with the powder.

 In conclusion, the powder can be used to reduce the consumption of detergent which is one of the sources of water pollution. Moreover, the powder can be applied extensively as a cheap, environmentally-friendly, effective cleaning agent when petroleum, the raw material to make detergent, is exhausted in future, and in developing countries,

where market detergents are not readily available.

Awards won at the 2006 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2006 - EV306

DISTRIBUTION OF NITROGEN, PHOSPHORUS, AND ALGAE IN WATER ALONG TEN MILE CREEK

Anthony Joseph Stoffella, John Wilmot Mann IV

John Carroll Catholic High School, Fort Pierce, Florida, USA

The purpose of this investigation was to determine the distribution of nitrogen (N), phosphorus (P), and algae (chlorophyll a) concentrations in water along Ten Mile Creek, Saint Lucie County, FL. High nutrient concentrations in rivers have been associated with algae 'blooms'. Algae blooms maybe toxic to marine life and result in lesions on fish or deplete dissolved oxygen concentrations that can attribute to a fish 'kill'.

 Water samples were collected in three sites east and three sites west of Gordy Spillway. Each water sample was measured for dissolved oxygen concentrations (mg/L), electrical conductivity (EC; uS/cm), pH, turbidity (NTU), nitrogen (TKN, NO3 and total N; mg/L), phosphorus (PO4 and total P; mg/L), and chlorophyll a concentrations.

 Sites east of Gordy Spillway had higher dissolved oxygen content, pH, and generally had higher turbidity (less clear) than west of the spillway. EC was higher at Gordy Spillway than at sites further from the spillway. At each site, total N and total P but not chlorophyll a concentrations were higher than the Florida Department of Environmental Protection (FDEP) critical concentrations.

 These results suggest that Ten Mile Creek had a high accumulation of P, N, and algae and a dissolved oxygen concentration lower than 5 mg/L, regardless of site. Therefore, the river's marine life maybe adversely affected by nutrients originating through surface water via agricultural farming areas and/or septic tanks. A retention area under construction, associated with Ten Mile Creek, may facilitate reductions of nutrients into the river.

2006 - EV307

GLOBAL WARMING ON ZOOXANTHALLE

Nicholas S. Azadian, Michael A. Flegiel, Mario A. Simoes

Center for Advanced Technologies, St. Petersburg, Florida, U.S.A.

Since the industrial revolution the amount of greenhouse gas has increased yearly at an unprecedented rate. As the global greenhouse gas concentration increases, a two fold effect is observed. First, heat, in the form of light entering the atmosphere, which is typically reflected off of the surface of the planet, is instead contained by the greenhouse gases. Second, the carbon dioxide concentration of both the atmosphere and oceans increases from the combustion of fossil fuels. This experiment was designed to observe the effect of increased temperatures and carbon dioxide concentrations on Zootaxanthalle oxygen production. For data collection, oxygen probes were attached to airtight environments inhabited by Zootaxanthalle. The initial experiment contained three groups exposed to three different temperatures. The control emulated tropical waters at 28 degrees centigrade, while the experimental groups were held at 26 and 30 degrees centigrade. The results from this experiment suggest that an increase in temperature has a positive effect on Zootaxanthalle oxygen production. With the groups being significantly different and a confidence of 95 % and a probability of 99.99%, this supports the hypothesis. In a second experiment, carbon dioxide was bubbled into the experimental groups' sea water, supersaturating the samples to four times and eight times current oceanic carbon dioxide levels. The results of this second experiment indicate that there is an increase in Zootaxanthalle carbon dioxide consumption coupled with an increase in Zootaxanthalle oxygen production. With the groups being significantly different and a confidence level of 95%, this second experiment also supported the hypothesis.

2006 - EV308

IMPACT OF DROUGHT ON HYDROLOGIC ECOSYSTEMS

Colin R. Sears, Caitlyn R. Sears

Alma High School, Alma, Arkansas U.S.A.

Thirty-one water test sites from Army Corp of Engineer impounds and tributaries were sampled over a two month period to assess water quality during the second worst Arkansas drought on record, 2004-2005. Water from Beaver Lake, Lake Ouachita, and their tributaries was analyzed from sites associated with forest, agriculture, urban, and recreational environments. The results were compared to previous non-drought situations. It is hypothesized that water quality will improve as drought conditions become more severe because of reduced runoff.

 Coliform bacteria, dissolved oxygen, biochemical oxygen demand, phosphates, conductivity, turbidity, pH, water temperature, and nitrates were tested. Biotic indexing was conducted in sample tributaries.

 Coliform bacteria tested positive at all Beaver Lake test sites with Most Probable Number (MPN) >18/100 ml. Lake Ouachita sites tested at 5/100 ml MPN. Dissolved oxygen levels were below 50% saturation at 75% of Lake Ouachita test sites and 33% of Beaver Lake sites. Phosphate levels were slightly higher in Beaver Lake sites. Conductivity was below acceptable standards at all locations. Turbidity decreased as the drought intensified at all test sites. Levels of pH were alkaline in all Beaver Lake test sites and acidic in twelve of the thirteen Lake Ouachita sites. Nitrate levels of both basins were insignificant.

 Lake Ouachita tributaries' biotic index reflected a healthy environment for invertebrates. Biotic indexing suggests that not all invertebrates could survive in Beaver Lake tributaries. All tests, except turbidity, consistently suggest decreased water quality during the study period.

2006 - EV309

ALTERNATIVE MEANS OF DISPOSING BIOMASS(WASTE PAPER)

Obi Chuks Ike-Nwosu, Ogieva Osarenogae, Igbinsa Cynthia Osafamwen

Igbinedion Education Centre, Benin Ciity, Edo State, Nigeria.

This project in its present form is a result of experimentation on effective means that can be used to dispose of biomass (paper) rather than destroying the paper through burning. It provides a useful, environment-friendly substance. The initial idea was to focus on coconut and palm kernel shells. We say the quantity of waste paper that was burnt every day in our school and focused our work on paper that is pure cellulose. Through literature review, we were able to come up with destructive distillation as a clean alternative to burning. The procedure was carried out by heating the paper in an air-tight or limited supply of oxygen. The heat caused the paper to decompose into pure carbon in form of charcoal. The adsorbent nature of the activated charcoal meant that it could be used as an air purifier so we were able to manufacture clean, non-toxic air fresheners. To use this air freshener only required the charcoal to be heated in a close container or over steam to activate. The activated charcoal is then anywhere to remove bad odor.

2006 - EV310

THE EFFECT OF ANTIBIOTICS ON AQUATIC ECOSYSTEMS

Kyle Abney Hunninghake, Reginald Bentley
DuPont Manual High School, Louisville, Kentucky, United States of America

In recent years, scientists have discovered growing numbers of antibiotics in streams and ponds across the United States. A U.S. Geological Survey, which studied different pharmaceuticals, hormones, and other drugs, was taken in 1999 and 2000. The purpose of the project was to test the effect of the drugs, rather than its presence in streams. To obtain accurate results, a full aquatic ecosystem was prepared. A whole range of life, from single-celled organisms, to plants, to invertebrates, was created. The cyanobacteria was specifically *Eucapsa* and *Gloeocapsa*. *Spirogyra*, a form of algae, was tested, along with duckweed as the plant. Apple snails represented the invertebrates. Research showed that the average concentration for antibiotics found in streams is 3 µg/L. So, two separate tanks (or tubes, depending on size of specimen) were set up for each specimen, one which contained no drugs (control), and one which contained precisely 3 µg/L of three different types of antibiotics, specifically Ciprofloxacin, Augmentin, and Oxytetracycline. Also, two tanks were set up which included every organism tested, to provide an accurate estimate of a natural aquatic ecosystem. The hypothesis was that the antibiotics would affect the organisms negatively, that is, with the algae and cyanobacteria, there would be a high mortality rate amongst the cells, and with duckweed and snails, weight would decrease. However, the results showed that the antibiotics positively affected the larger organisms (snails), although the drugs did indeed cause a decrease in weight with the plants, and caused high mortality rates with the smaller organisms.

Awards won at the 2006 ISEF
\$5000 per year for four-year scholarships. - Indiana University-Purdue University Indianapolis

2006 - EV311

LIVESTOCK ANTIBIOTIC EFFECTS ON NITROGEN CYCLING BY SOIL MICROORGANISMS

Laura Elizabeth Steinmetz, Greg Artiushin, David Wang
Paul Laurence Dunbar, Lexington Kentucky, USA

The objective of this study was to determine the effects of nine antibiotics commonly used in the livestock industry on the microorganisms involved in processes of the nitrogen cycle. Livestock are fed antibiotics to prevent the spread of disease and promote growth, but 25 to 75 percent of the antibiotic that the animals ingest is excreted in their waste in its original form. This could be responsible for a number of negative effects to the ecosystem. To determine the effects of the antibiotics we broke down the nitrogen cycle into three main steps, nitrification, ammonification, and denitrification. We isolated soil microorganisms and applied the antibiotics to them in seven concentrations. We analyzed the effects by measuring the nitrogen species available that corresponded with each process under investigation. Each process of the nitrogen cycle was inhibited by at least two antibiotics. Some of the inhibitory effects of the antibiotics could have been decreased if a soil mineral like montmorillonite was present for the antibiotics to be sorbed to. This would decrease the microorganism's exposure to the antibiotics and protect them. To determine the effect of the soil mineral montmorillonite, we added 0.1 g of soil mineral into the strongest antibiotic concentration. This did mitigate inhibition in the denitrification step, but not nitrification. The antibiotic concentrations used in the industry may need to be reevaluated, and methods of control involving the soil mineral montmorillonite could be implemented.

2006 - EV312

A TOXICITY ASSAY TO UNDERSTAND THE EFFECTS OF GLOBAL WARMING

Brenna Nelson Heintz, Kevin Crossland Heffern
Juneau-Douglas High School, Juneau Alaska, United States

We developed a toxicity assay that allowed us to identify the potential effects of global warming on marine food webs. The assay is based on the idea that changing climate will alter the nutritional qualities of phytoplankton at the base of the food web and these changes will influence the sensitivity of zooplankton to environmental contaminants. We theorized that increasing water temperatures will lead to decreased amounts of polyunsaturated fatty acids in phytoplankton and the zooplankton that consume them. In addition, we theorized that decreased amounts of polyunsaturated fatty acids in the tissues of zooplankton will make them less sensitive to oxidizing pollutants because polyunsaturated fatty acids are more easily peroxidized than saturates. We tested these ideas by feeding two species of phytoplankton, one of which was grown at two temperatures, to *Artemia* and exposing the *Artemia* to copper dichloride. We also did additional analyses to verify that *Artemia* suffered oxidative stress and the phytoplankton diets were adequate for raising *Artemia*. NOAA chemists provided us with data describing the fatty acid composition of the phytoplankton. We observed that diets with increased levels of polyunsaturated fatty acids led to increased sensitivity to copper dichloride in *Artemia*. In addition, we found increasing temperature led to increased amounts of polyunsaturated fatty acids in a commonly available diatom. Our data indicate that increased water temperatures may make diatom-consuming zooplankton more sensitive to environmental contaminants and suggests the nutritional quality of phytoplankton may mediate zooplankton abundance.

2006 - EV313

A SIMULATIVE STUDY OF THE EXXON VALDEZ OIL SPILL AND ITS DETRIMENTAL EFFECTS ON MARINE ORGANISMS AS DETERMINED BY THE BIOLUMINESCENT CAPABILITIES OF THE DINOFLAGELLATE

Cole Thomas Streiff, Matthew Aaron McKinney
Oregon Episcopal School, Portland OR, USA

Marine dinoflagellates bioluminesce due to the chemical reaction in which luciferin is oxidized, releasing a large amount of energy in the form of light. Bioluminescent dinoflagellates are an excellent toxin indicator because they are both sensitive to their environment and produce light in amounts directly proportional to their state of health, representing the health of their entire ecosystem. This project was designed to determine whether the dinoflagellate, *Pyrocystis noctiluca*, could be used successfully as an indicator of toxin levels over time after an oil spill. To test this hypothesis, multiple cultures of *P. noctiluca* were raised, allowed to reproduce, and subsequently divided. The control group remained untreated, except for the addition of growth medium to maintain constant volumes, while each of the other groups was administered varying concentrations of crude oil (0.25mL, 0.50mL, and 1.00mL). After each solution was added, light intensity was measured and recorded. Over the testing period (ten days), only the control group cultures increased in brightness (by an average 80.43%). The cultures to which crude oil was added decreased in light intensity as follows; 38.63% (0.25mL), 96.84% (0.50mL), and 100.00% (1.00mL). Further statistical analysis (frequency diagrams and ANOVA tests) indicates that these values are significantly different from each other. These data suggest that *P. noctiluca* is an excellent indicator which can be used effectively to evaluate the damage to oceanic ecosystems caused by oil spills. This promising discovery provides a convenient new method by which the general health of a post-oil spill environment can be measured.

Awards won at the 2006 ISEF

Tuition Scholarship of \$5,000 per year for four years - Oregon State University
Scholarship Award of \$20,000 - Department of Homeland Security, University Programs Office
Third Award of \$1,000 - Team Projects - Presented by Science News

2006 - EV314

THE EFFECT OF WATER-SOLUBLE AND LIPID-SOLUBLE EXTRACTS ON PLANT CELLS

Doha Hashim Ali , Buena Chan
Bayside High School, Bayside, Queens, United States

There are more than four thousand chemicals present in tobacco smoke, many of which have been shown to be toxic to living cells. The purpose of our study is to use geranium leaves as a model to study which types of tobacco chemicals, the water-soluble or the lipid-soluble, are more toxic to plant cells. Our hypothesis was that the lipid-soluble smoke extract will be more toxic to cells and can adversely affect the wound healing of geranium leaves (genus *Geranium*). This experiment was conducted on geranium leaves (gently scratched with a nail file), which were divided into the control and two experimental treatment groups. The control group was applied with a 0.9% saline solution. The 2 experimental groups were applied with water and acetone tobacco extract, respectively. This application process was done on 4 cm² area twice daily for 2 weeks. Our results show that both types of tobacco extracts have adverse effect on plant cell healing, whereas the leaves of the control group treated with saline all recovered from the gentle scratch. These results suggest that tobacco chemicals can damage plant cells in a way similar to animal cells.

2006 - EV315

IS THERE A COST-EFFECTIVE WAY TO REDUCE THE RISK OF NEW ORLEANS FLOODING AGAIN?

Stephanie Lynn Miller, Sarah Marie Smith, Mary-Anne Kim Anh Nguyen
Saint Joseph's Academy, Baton Rouge, Louisiana, United States of America

Hurricane Katrina hit and flooded New Orleans late in August 2005. Many people died, many citizens' houses and possessions were destroyed, and famous historical places were inundated with water. The water that destroyed New Orleans poured into the bowl-like city through a break in the levees that surrounded it. Accordingly, a study was instigated to offset a recurrence of the catastrophe. The following ideas were explored: moving the pumping stations to the lakefront to seal off eighteen miles of outfall canals, replacing the levees with pipes with that same intent, raising individual properties throughout the city, dividing the city into a series of subbasins to contain damage, rebuilding improved levee system, diverting a portion of the Mississippi River in order to build up sediment in the depleted coastal marshes, closing the Mississippi River Gulf Outlet (MRGO) to protect the city from storm surges, placing windmills along the coast to act as a source of power for pumps, and building floodgates to hold back flood waters. After creating a design, estimating for cost, and determining risk reduction for each, it was recommended to implement the following: move the pumping stations to the lakefront and close the MRGO.

2006 - EV316

A NOVEL BIOABSORBENT OF "YA-PLONG" AS AN OIL SPILL REMOVAL

Pirachula Chulanon, Chitsachee Sichanugrist, Takphet Lekavijit
Bodindech (Sing Singhaseni) School, Bangkok, THAILAND

This project studied the petroleum oil absorbability of the piths of *Hymenachne acutigluma* (locally named "Ya-Plong") and its absorption mechanism. Crude oil, fuel oil, diesel oil, and lubricating oil were separately absorbed by the piths comparing with the non-woven polypropylene absorbent web. The piths could absorb these oils at 54.6, 87.7, 51.3, and 80.1 g/g, respectively, while the web could do at only 5.7, 7.0, 6.2, and 6.1 g/g, respectively. The former was considered 10 times more effective than the latter. However, these two absorbent materials were not much different in their absorbability of water (0.8 g/g vs 0.3 g/g). It was also found that in the presence of 1:1 by weight of each oil and water mixture, the piths can still absorb oil to water ratio at 5.4:1, 34.8:1, 10.2:1, and 17.1:1, respectively, whereas the synthetic web absorb at 4.6:1, 13.1:1, 4.1:1, and 14.6:1, respectively. Based on the optical microscopic images,

the absorbed oil was found in the intercellular spaces of aerenchyma tissue, a component of piths. The SEM micrographs of this tissue showed their porous structures which could cause the "capillary action" of oil absorption. The contact angles of oils on the surface were less than 50 degrees and the water contact angle was 124 degrees. Therefore, the pith surface can be wetted by the oils but not water because its surface is non-polar and it is thus compatible with non-polar liquid. This is confirmed by FT-IR spectrum exhibiting mostly the non-polar functional groups.

The piths of "Ya-Plong" can be used efficiently in oil spill removal, moreover it is a biodegradable material and low cost.

Awards won at the 2006 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News
UTC Stock with an approximate value of \$2000. - United Technologies Corporation

2006 - EV317
THE EFFECTS OF THE MIGRANT COMPOUND OF USED MOTOR OIL ON THE VITALITY OF DAPHNIA MAGNA

Ben James Roark, Danny Miller
North Toole County High School, Sunburst Montana, U.S.A

The purpose of this experiment was to determine the effects of used motor oil on the vascular contraction rates, mortality rates, and general movement of daphnia magna. We hypothesized that the oil would have a negative effect on the heart rate, mortality rate, and general activity of daphnia magna. To test this, we gathered a blended mix of used motor oil from a variety of vehicles. This oil was then added to spring water and later introduced daphnia magna. For five days we tested the heart rates, mortality rates, and general movement of the daphnia magna. We found that the oil had a significantly negative effect on vitality of daphnia magna. Mortality rate significantly increased when compared to the control group. Heart rate was significantly lower rate when compared to the control group.

2006 - EV318
BIOREMEDIATION AND DEGRADATION OF CCA TREATED WOOD IN LANDFILLS

David William Charles, Patrick Chase Brown
Salpointe Catholic High School, Tucson AZ, USA

Within 10 years, billions of tons CCA treated wood will be deposited of in unlined landfills. Exposure to arsenic, copper and chromate has serious health consequences. The purpose of this experiment was to determine the consequences of CCA treated wood in landfills and if a wet aerobic bioreactor could bio-remediate and degrade the toxic wood in a simulated landfill. We created four simulated landfills: #1 Dry tomb; #2 a host wet aerobic bioreactor; #3 a recipient wet aerobic bioreactor with CCA treated wood; and #4 a wet aerobic bioreactor containing CCA treated wood with re-circulating leachate. We tested for indicators of degradation and stabilization. The #1 landfill had no leaching of chemicals or indication of degradation. The #2 landfill had a 40% increase in microbe colonies and the leachate was used to remediate the #3 landfill which had a 3% increase in microbe colonies but arsenic concentration in the leachate increased by 8300% and in the wood by 997%. The #4 bioreactor had a 315% decrease in microbe colonies and the arsenic in the leachate increased by 2181% and in the wood by 674%. This experiment proved that the chemicals in CCA treated wood do leach into water at rates significantly higher than the E.P.A. standard of 10 ppb: Bioreactors do increase the microbial activity in landfills containing CCA treated lumber thereby accelerating the degradation of waste but the microbial process may lead initially to higher rates of arsenic leaching through the process of the arsenic/arsenite becoming soluble.

2006 - EV319
THE EFFECT OF IRON, COPPER, AND ZINC CONTAMINATION ON CORN AND SOYBEANS

Zachary Ryan Schulz, Lucas James Heintzman
Aberdeen Central High School, Aberdeen South Dakota, United States

The Effect of Iron, Copper, and Zinc Contamination on Corn and Soybeans
Heintzman, Lucas
Schulz, Zachary
Central High School, Aberdeen
The purpose of the project was to determine the effects of heavy metals, particularly iron, copper, and zinc; on corn and soybeans. The project entailed planting corn and soybeans in soils contaminated with metals of the following concentrations: 75 and 150ppm of iron and copper, and 150 and 300ppm of zinc. Ten plants of both corn and soybeans were grown under each condition with a control of each as well. The plants were grown for four weeks. At that time, heights were taken to determine the effect on plant growth. Statistical analysis was carried out with t-tests. The first trial showed that a significant difference existed between all corn samples and the control, and between the two soybean samples grown in zinc. However, in trial two, the t-test results were all greater than 0.05, meaning there was no difference, and thus refuted the findings of trial one. The metals had no significant effect on corn and soybeans. This shows that crops can grow in low-level contamination by heavy metals, which is useful to farmers. Also, further research is warranted to determine whether any longer term effects would be present, such as effect on overall health and yield of the crops.

2006 - EV320
THE DOMESTICATED PRODUCTION OF METHANE BY USING ECONOMIC AND ENERGY EFFICIENT APPARATUS TO OBTAIN THE PUREST FORM OF METHAN TO BE USED FOR BOTH RURAL AND URBAN USE: YEAR 2

Berhanemeskel Alemu Nida, Nathan Abay Kebede, Filmon Berhe
The Piney Woods School, Piney Woods, MS 39149, USA

The scarcity of energy resources in the world has become one of the major problems of this century. Due to the depletion of sources of energy

throughout the past millennium, mankind is in the verge of facing a huge energy crisis, which is prevalent in economical and political wars that are all over our planet.

 For this, we looked into methane and methanol that we produced from environmental waste the previous year. We designed a fuel cell system that uses methanol instead of gasoline in cars. The methanol is injected into the car where it will be stored in holding chamber. When the car is started, the methanol moves into a reformer where it is decomposed into hydrogen and carbon dioxide with the help of nickel as a catalyst. The initial energy to start up this process comes from the car battery. Then, the hydrogen goes into a hydrogen fuel cell where each hydrogen molecule releases two electrons that produce electricity and then combine with oxygen (air) to form water as byproduct.

 The fuel cell system can also be used to produce electrical energy for household use in both rural and urban areas. We also calculated the amount of electricity produced and money saved from our apparatus. Our project recycles environmental waste and produces energy by using cost effective method. The byproducts produced from our apparatus are water and heat; therefore, it solves the current problem of environmental pollution and energy crisis.

2006 - EV321
WATER QUALITY MAINTENANCE BY CONTROLLED RELEASE OF SODIUM HYPOCHLORITE FROM BIOPOLYMERIC GELS

Mariana Tomaz Cunha, Luciana Maria Arcanjo Frota
Colegio Christus, Fortaleza, Ceara, Brazil

The semi-arid region of the Brazilian Northeast is a critical scenery in the water subject. This region is considered one of the world poorest locations regarding water distribution. In order to solve this problem, the Brazilian government has invested in reservoirs to collect rain water on winter and used it on summer by small communities that do not have a water distribution system. This governmental program, known as "One million of reservoirs for Brazilian semi-arid", has already built around 19 000 of such reservoirs. Nevertheless, the program was not followed by any instruction to these communities, like some procedures that should be taken to keep the water under adequated microbiological conditions. This project intends to offer an alternative way to keep the water quality on these reservoirs by keeping the chlorine residual longer than usual. In this sense, it was used biopolymeric gels (made with chitosan and cashew gum, which are regional substances abundant on Northeast) that contains the sodium hypochlorite and releases it very slowly, keeping the standard quantities of residual chlorine (0,2 mg/L) on water within acceptable levels. The tests for product optimization were made in laboratory scale and showed good results, within 15 days of observation period. Experiments were carried out using different gel masses in a volume of 0,5 liter of water, being monitoring the following parameters: pH, residual chlorine, turbidity and water temperature. Data obtained showed that the mass of 0,03 g of gel-hypochlorite was the one that exhibited the best performance during the observation period.

2006 - EV322
GEOCLEAN SYSTEM FOR CLEANING POLLUTED LAKES

Berhat Bildirir, Beray Bildirir
Private Fatih High School, Ystambul, Turkey

Environment, is specially becoming less smitable for life , due to population increase and rapidly developing technology.Countries with abundant lakes and water sources can unfortunately neither make use of these sources nor protect them, as a result of which we have to fight to regain these valves which our technology falls short of preserving.In other words, we have to first keep our lakes, which are our only water reserves, clean, and if polluted we have to clean them right away.

It isn't always enough to install collectors in order to purify a lake or a water source.Instead the lake needs a total arrangement together with its surrounding.

We filtered samples taken from a contaminated lake and sent them for analysis and we received positive results, upon which we developed a device accordingly.In that device, we used the same filters as in the mechanism.And we created a three-layer, self ,- cleaning drawing which can carry out filtration at three steps.This device is capable of receiving energy from a generator even in the middle of the lake, and of ventilating the water through water pumps.The accumulated polluted wastes are pumped out to the islet, where they gather in a reservoir, and the matters sedimented by use of chemicals release methane gas.The methane gas released, according to our findings, meet 89% of the energy the system need to function .

Geoclean will offer a fresh new technological to countries facing the challenge of keeping their lakes and water sources clean.

2006 - EV323
A REVERSAL OF PHOSFATE: SAFELY REINTRODUCING PHOSPHATES INTO CLEANING AGENTS

Joseph Kent Henry, Maureen Williams
Bishop Moore Catholic High School, Orlando , FL, United States

The purpose behind this experimentation was to determine a way to safely reintroduce phosphate detergents and cleaners to home and industrial use. Though phosphates are known to cause algal blooms, they are among the most efficient and cost effective substances that clean clothes and other surfaces. The negative impacts of phosphate use and subsequent ban of phosphates in cleaning agents have caused many households and businesses to resort to the use of multiple, expensive cleaners when one phosphate cleaner could do a better job.

A device was constructed using ferric chloride to create a precipitation reaction in the waste water. The water source could truly be anything; from a standard washing machine to drainage systems from bathroom floors to water drainage systems of hospitals. The precipitate, FePO4, is collected in a water filter at the end of the process. The device removes about 82.15% of phosphates with a standard deviation of only .414%. The experiment has yielded plentiful data, all supporting the process developed, on the serious economic, environmental, and chemical issue of phosphate use.

Awards won at the 2006 ISEF
Second Award of \$1,500 - Team Projects - Presented by Science News

2006 - EV324

DEGRADATION OF COMPACT DISKS BY THE FUNGUS GEOTRICHUM CANDIDUM

Diego Guillermo Ulate Segura, Jose Pablo Jimenez Trigueros, Olga Yuts Valerievna
Colegio Cientifico Costarricense de San Pedro. San Jose, Costa Rica.

The principal objective of this project is to develop an inexpensive and ecologically viable method for the degradation of compact disks. The method proposed for the elimination of compact disks is biodegradation through the use of Geotrichum candidum fungus; as a result the CD's will not be a dangerous contaminant. During the collection campaign, 318 CD's were gathered in five days demonstrating the high quantity of waste that they represent.

As part of the methodology, an analysis of the components comprising CD's was made and it revealed mostly hydrocarbons. Subsequently pieces of disk were placed in several fungal cultivation media, earth and rice previously inoculated with Geotrichum candidum. Within two weeks fissures and swelling were observed on several of them as a result of colonization by the fungus under study. It was further observed that the growth of Geotrichum candidum is more favorable in the presence of benzene.

Likewise, secretion of laccase by Geotrichum candidum was determined and in identifying the subproducts of biodegradation of the compact disks in different cultivation media, acids, alcohols, ketones, carbohydrates and amines were mainly found.

In conclusion, there is at least one organism with the capacity to biodegrade compact disks. Also the residue from biodegradation can be used for diverse purposes. As a practical application of the project, an economically feasible, ecological bioreactor was designed to degrade large volumes of CD's.

Awards won at the 2006 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2006 - EV326

"BIOGAS... A HOPE TO THE YURIRIA'S LAGOON"

Susana Rangel, Carlos Alejandro Perez Rojas, Maria Teresa Chimal Frias
CBTis No. 172, Cortazar, Gto., Mexico

The Yuriria's Lagoon, is used as a deposit of sewage result by farmers, cattlemen and domestic-urban activities since more than two decades, generating an excess of organic material, which facilitates the growth of aquatic weeds, like the calla lily, also mentioning the damage to the fauna of this place.

The anaerobic digestion products are translated to ecologic solutions: economic combustible, fertilizer, removing the undesirable material and sanitary control of water and ground.

Our goal is to evaluate the Biogas production applying an anaerobic process to the calla lily combined with organic trash, analyzing the process of the kinetic behavior. To identify the organic material that generates the major quantity of Biogas, and compares its performance, are handled 3 inoculated merges, with fresh manure. The Biogas production is measured through the water displacement and time of burning. Other variables to control are: humidity, temperature, pH, H2S y CO2. According of the obtained results, after finishing the fourth run, we concluded that the merge of calla lily chopped up – grinded and manure with an interval of humidity equal to 70 –75% is the one that provides the best methane production with a performance of 0.3163 m3/ kg.

Additionally, this merge presented the best fertilizer properties, even varying its humidity, this was already proved with the biofertilizers obtained from the previous runs. The combustible can be used in homes of rural communities which production substitute the monthly consumption of one gas LP cylinder of 20 kilograms.

2006 - EV327

INTEGRAL PLAN OF MANAGEMENT AND CONSERVATION ON A SUSTAINED BASE THAT IMPROVES BIODIVERSITY AND WATER QUALITY IN LA PLATA ESTUARY, THE OJO DEL BUEY WETLAND AND THE CORAL REEF.

Linoshka Oliveras, Michelle-Noelis-Nieves-Diaz, Alexander-Roman-De-Jesus
Jose Santos Alegria, Dorado, Puerto Rico

La Plata Estuary is located in the northern coast of Puerto Rico. It is formed by more than 3,200 km of wetlands, meadows of Thalassia and related reefs. La Plata Watershed discharges 173 million gallons of water daily into the estuary. This maintains a great biodiversity of fauna and flora, some of which are in danger of extinction. The purpose of this research was to identify the factors that reduce water quality and the biodiversity in the La Plata Estuary and the ecosystems that surround it. The hypothesis under study was, if La Plata Estuary, the Ojo del Buey Wetlands and the coral reefs receive discharges of bacteriological and chemical contaminants, sedimentation and solid wastes, then their quality and the necessary parameters for life of the aquatic and marine species will be affected and they will die. The water quality analysis evidenced that there were high concentrations of fecal coliforms (450,000 col/mL), eutrophication, a low concentration of dissolved oxygen, anthropogenic inferences, house construction in the La Plata Watershed and a high sedimentation index (1,500 tons/mi2). All those factors are killing the coral reefs in this area. A plant catalogue was done from this wetland. An Integral Plan of Management and Conservation was developed on a sustained base that improves biodiversity and water quality. This management plan included the reforestation of some areas of La Plata Watershed with special trees that will help to control erosion and sedimentation. The trees will also help to sustain the wildlife in this area.

2006 - EV328

THE LEVELS OF NITRATES AND PHOSPHATES IN FRESHWATER SYSTEMS.

Shala Ann Hawes, Haley Marie Burgess
Central Lee High School, Donnellson, Iowa, United States of America

The level of nitrates and phosphates can vary in freshwater systems. There are many variables that contribute to the fluctuation of nitrates and phosphates in water systems.

This study was conducted to determine how various surrounding variables, such as combining waterways with field runoff, affect nitrate and phosphate levels.

The levels of nitrates and phosphates in freshwater systems, Lick Creek, Sugar Creek, Devil's Creek, and Crooked Creek, were investigated and conducted at our school, Central Lee High School.

From this experiment we can conclude that Sugar Creek had the highest level of nitrates and phosphates of all the four creeks tested, due to the fact that there are many creeks that join Sugar Creek and the combined water

becomes that of Sugar Creek. Crooked Creek had the lowest amount of phosphates due to the fact that it is located near Wilson Lake and the watershed is lined by many forested areas.

2006 - EV329

EFFECT OF LAND USE ON WATER CHEMISTRY AND MACROINVERTEBRATE IN THREE WATERSHEDS

Christine Weizer Li, Richard C. Lee
Cookeville High School, Cookeville, TN, USA

Three watersheds in Cookeville, TN area were selected to conduct chemical and biological assessment of watershed quality. Streams from 1st, 2nd and 3rd orders were chosen to compare the effect of urbanization on water quality. The ion chromatograph was used to analyze chloride, nitrate, sulfate and phosphate in water samples, and macroinvertebrate samples were collected from three watersheds. More than 100 analytical and biological samples were processed, integrated, analyzed and presented in the study. Duplicates and replicates were collected and analyzed to ensure quality assurance and quality control. Results show that a higher level of dissolved oxygen were found in urbanized watershed, while other indicators such as total dissolved solids, nitrate and chloride were also found with higher concentration in urban area. Sulfate was found in all 1st order streams. That suggests that naturally occurring element may play a role in water measurements. It is hypothesized that sulfate may come from geology sources. Analysis of variances (ANOVA) showed that three watersheds had different water quality in terms of dissolved oxygen, turbidity, chloride and nitrate. The biotic index score (BIS), integrated from individual macroinvertebrate BIS number, shows a negative correlation of turbidity, nitrate, chloride and a positive correlation with dissolved oxygen. Compared with EPA's nutrient regional measurement, turbidity, sulfate, nitrogen, and conductivity level found in these three watersheds are much higher. This suggests that water quality from these three watersheds dose not meet current ambient water quality measurements from EPA's database. Percent oligochaetes and chironomids (%OC) and percent EPT were found to have positive and negative correlation, respectively, with percent urban area. One urban watershed was found to have deteriorated water quality after compared diversity and population of macroinvertebrates community.

Awards won at the 2006 ISEF

First Award of \$3,000 - Team Projects - Presented by Science News

2006 - EV329

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Richard C Lee, Christine W. Li
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First Award of \$3,000 - Team Projects - Presented by Science News
Mathematica software package for all Intel Grand award first place winners. - Wolfram Research, Inc.

2006 - EV329

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Awards won at the 2006 ISEF

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Honorable Mention Award - North American Benthological Society

2006 - EV329
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Awards won at the 2006 ISEF

Honorable Mention Award - North American Benthological Society

2006 - EV330
POLLUTANTS AS PREDICTORS: MONITORING PARTICULATE MATTER AND OZONE AS INDICATORS FOR EMERGENCY ROOM VISITS

Elizabeth Wells Busdicker, Rachna Beeravolu Reddy
Port Huron Northern High School, Port Huron, Michigan, USA

Our objective was to find a relationship between PM2.5 and ozone and emergency room visits (ERV) for cardio-respiratory problems, and develop a model to predict cardio-respiratory ERV in four Michigan hospitals using data from September 1, 2004 to August 31, 2005. We believe we will find a relationship between the pollutants and ERV for cardio-respiratory problems, and develop a model which predicts the daily cardio-respiratory ERV. ERV were recorded by chief complaint from each hospital. Pollutant levels were obtained from corresponding EPA monitoring sites. Pollutant levels were averaged weekly. Weekly totals of cardiac and respiratory related ERV were charted separately. Respiratory related ERV were charted with a two-day lag. A Pearson Coefficient of Correlation test did not show a significant relationship between total weekly ERV (cardiac or respiratory) and average weekly level of PM2.5 or ozone for each site. Data was separated into quartiles by average weekly levels of each pollutant. Weekly totals of cardiac and respiratory related ERV were averaged separately for each quartile. A student t test showed no significant differences between quartiles. The multiple linear regression model used the equations: Cardiac ERV or Respiratory ERV = 0(Site) + 2(Ozone) + 3(PM2.5) The model determined daily levels of PM2.5 and ozone did not correlate with the number of ERV. In conclusion, there is no significant relationship between average weekly PM2.5 or ozone levels and ERV for cardio-respiratory problems in hospitals studied. A multiple linear regression model cannot be used to predict ER visits for cardio-respiratory problems.

2006 - EV331
ASSESSING FERRIC RUNOFF IN WATERSHEDS

Shelly Kakar, Lindsy Swenson
Ballard High School, Louisville, KY, USA

Iron is a known hazard for living organisms and is found in many water systems. It is created by the illegal dumping of appliances and other materials. But exactly how much iron exists in our surrounding waters and how harmful is it? Iron can damage all living organisms around and in the water. Illegal dumping creates the source of iron, which eventually becomes rusty leading to the release of iron in ecosystems. This iron causes an imbalance in the chemical reaction in the bio-systems. This study was conducted to find out how high concentrations of iron are in our local water systems. Through sampling and analyzing five major watersheds in Kentucky, it was concluded that the iron levels were found to be highest in most of the samples taken right by the dump area. Higher amounts were seen at samples taken from below the dump area as opposed to above the dump, due to the water flowing downward. Water systems are contaminated with high levels of iron due to illegal dumping. Action must be taken to prevent this from continuing.

2006 - EV332

RICE STRAW, A FRIEND OF THE ENVIRONMENT

Aya Mohamed Attaby, Nawal Hossam El Boghdady
Dar El-Tarbia American School, Cairo, Egypt

In Egypt, during the monthes of October and November every year, when rice farmers harvest their crops and burn the leftover straw to clear their lands for the winter planting season, black clouds form resulting in a great environmental and health problems, due to the great amounts of carbon monoxide they carry.

The main objective of our project is to find a save way to overcome this problem and to make use of the rice straw instead of burning it.

We found that:

1) We can produce biogas (methane) by the fermentation of rice straw by anaerobic bacteria.

- The optimum temperature required is 35oC - 37oC.

- The optimum pH value is 7.8 - 8 and is maintained by adding 2 grams of baking soda to each 250 grams of straw.

- Sttiring will increase the rate of gas production.

2) We can use the produced gas as a source of energy and also in generating electricity.

2006 - EV333

CELLULOSIC ETHANOL FROM CORN BIOMASS

Kody Austin Nelson, Mark Lessen
Delavan High School, Delavan Illinois, USA

Earth's supply of petroleum is a limited resource. Ethanol is being produced from corn kernels in factories all over the country while ethanol production from biomass such as corn stover, is not. The purpose of this research was to determine whether ethanol production from corn stover is feasible, if there is any appreciable difference in ethanol yield among corn varieties, as well as determine whether there is a relationship between corn yield and ethanol yield.

Pre-treatment of 60 10g samples (10 samples from each of 4 varieties and 20 samples from 1 control variety at 2 different field locations, which served as markers) of corn stover was accomplished by addition of 4ml 10M NaOH and 3ml 3% H2O2 to each sample. The samples were agitated and allowed to decompose for 24 hrs. Samples were then washed with distilled water, filtered and allowed to air dry. Samples were then added to fermentation chambers where pH was adjusted to 5 by addition of 100 ml citrate buffer. Cellulase and B glucosidase enzymes were added in 1 ml aliquots each. Samples were massed and allowed to rest for 60 min before 4.38 g Saccharomyces cerevisiae was added. Samples were allowed to ferment for 48 hrs at 25oC. Samples were then re-massed and ethanol calculations were made.

Ethanol production from corn stover is feasible as shown by the results of this research. The protocol used enabled an average efficiency rating of 69% among the marker and other De Kalb varieties, with a slightly lower rating (68.5%) among the Asgrow varieties. Ethanol production increased as corn yield decreased, suggesting as energy was placed into kernel production, stalk production diminished. Using a plant population of 26,000 plants/acre, 1134 L of ethanol could be produced per acre, which would add substantially to ethanol production nationwide.

2007 - EV001

BIOSOLIDS

Mark Andrew Negley
DeSoto County High School, Arcadia, FL, US

This project assessed the effects of long term (>30yrs.) commercial-scale application of Class B biosolids on bio-accumulative metal concentrations in groundwater, plant tissue, and soil. The primary goal of the researcher was to demonstrate whether adherence to current management and application practices were sufficient to prevent adverse contamination.

 In assessing groundwater quality, the researcher collected samples from an existing 4" shallow well and three 2" monitoring wells and had them tested for metals using an ICP-AES. The samples were compared to Maximum Contaminant Levels (MCL) according to DEP Drinking Water Standards and averages of metals found at control monitoring wells. A bahiagrass composite sample of three zones was taken and compared to available guideline values, toxicity levels, and normal ranges for bahiagrass. Surface soil (15 cm) samples were taken in the same three zones and were compared to Soil Target Levels (STL). The tomato leaf samples were not collected by the researcher but were compared to guideline values and contributed to the evaluation.

 The average metal concentrations found in the monitoring wells and the soil were far below the MCLs and STLs, but the average amount of Pb in the 4" well exceeded the MCL by 32%. The concentrations in the bahiagrass were normal for grasses but posed nutritional problems for ruminant animals. The very high Cu levels in the tomato leaves questions the safety of growing food crops on previous long-term (>20yrs.) application sites. The researcher believes these analyzes have only set a precedent for further research.

2007 - EV002

WHAT ARE THE EFFECTS OF TEMPERATURE AND SALINITY ON OYSTER HEMOCYTE ACTIVITY?

Gene Bonnette Rodrick
Oak Hall High School, Gainesville, Florida, US

Oyster production represents an important global economic resource threatened by sporadic increases in oyster deaths. The causes of oyster mortality outbreaks are unknown but are hypothesized to relate to impaired immunity to bacteria contaminating oyster estuaries. The primary defense mechanism in invertebrates is phagocytosis of bacteria by hemocytes, blood cells exposed to environmental influences in the open circulatory system of oysters. The goal of this research was to investigate the effects of salinity, temperature, and non-cellular serum on oyster hemocyte activity. Flow cytometry was used to monitor the in vivo hemocyte mortality and phagocytosis of E. coli and V. vulnificus in eastern oysters (C. virginica) acclimated at 4 OC, 25 OC and 37 OC in 1 o/oo, 15 o/oo, or 32 o/oo salinity for 0, 3, 5, and 7 days. Hemocyte mortality was reduced (p<0.01) and phagocytosis of E. coli and V. vulnificus increased (p<0.01) in oysters acclimated in 15 o/oo compared to 1 or 32 o/oo salinity regardless of temperature. Phagocytosis of E. coli by oyster hemocytes was significantly higher (p<0.01) than that of V. vulnificus regardless of temperature or salinity. In vitro studies demonstrated that normal hemocyte activity is dependent on serum. In conclusion, these results indicate that the salinity of the oysters' estuarine environment and serum components may significantly influence oyster hemocyte

immune response and related oyster mortality. Preferential phagocytosis of *E. coli* by oyster hemocytes provides an explanation for the observed high levels of *V. vulnificus* in oysters which are a threat to human health.

Awards won at the 2007 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2007 - EV003

EVALUATING THE IMPACT OF TRIVALENT ARSENICALS ON SELENIUM METABOLISM USING *E. COLI* AS A MODEL SYSTEM: PHASE II

Daniel Kenneth Cook

Lake Highland Preparatory School, Orlando, FL, United States

Trivalent arsenicals are toxic forms of arsenic found in the environment, contaminating our drinking water and posing a significant environmental risk. This research examines the effects of trivalent arsenicals on selenium metabolism using *Escherichia coli* (*E. coli*) as a model system. Selenium metabolism pathways of *E. coli* are analogous to those in humans and can provide insight into the effects of trivalent arsenicals. Selenoproteins, products of selenium metabolism, are required for human cell viability and thus are vital to human health. Since studies show that selenoproteins protect against oxidative stress, it is hypothesized that reduced amounts of selenoproteins caused by trivalent arsenicals can lead to increased levels of free radicals and other reactive oxygen species (ROS). Growth curve studies in phase I suggested that arsenic interrupts selenium metabolism. In phase II, hydrogen gas production was used as an indicator for selenium metabolism activity to further support previous data because the production of hydrogen gas via the formate hydrogenlyase(FHL) complex requires the selenoenzyme formate dehydrogenase(FDHH), a product of selenium metabolism in *E. coli*. When *E. coli* strain MC4100(wild type) was grown with increasing concentrations of arsenite, the amount of hydrogen gas produced decreased proportionally. Additionally, benzyl viologen was used as an indicator because it acts as an artificial electron acceptor in the FHL complex to measure FDHH activity and changes color as it accepts electrons. It was found that *E. coli* cells grown in increasing concentrations of arsenite experienced a proportional decrease in FDHH activity. The data collected supports the researcher's hypothesis that trivalent arsenicals block selenium metabolism and the biosynthesis of selenoproteins. This research is critical in developing a selenium drug treatment that targets the detoxification of arsenic, reducing the risk of arsenic induced cancer in the human body.

Awards won at the 2007 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel Foundation

2007 - EV004

CHATTAHOOCHEE RIVER: DO DEVELOPED AREAS HAVE HIGHER PHOSPHATE LEVELS THAN UNDEVELOPED AREAS?

Joy Ann Choi

Peachtree Ridge High School, Suwanee, Georgia, United States

This project tested Georgia's Chattahoochee River for phosphate at 4 different sites – Site 1: McGinnis Ferry, Site 2: Settles Bridge, Site 3: Paces Ferry, and Site 4: Medlock Bridge. Sewage leaks, detergents, fertilizers, and industrial wastes are sources of increased phosphate levels in rivers, which can cause problems like eutrophication (excessive algal growth). Thus, the objective of this experiment was to find a correlation between phosphate levels and area development. Twenty-five water samples were tested for phosphate levels at each of the river sites using Lamotte's Low Range Phosphate in Water Test Kit. It was hypothesized that water from the developed areas would contain higher levels of phosphate than that of the less developed areas. This hypothesis was supported by the experiment because higher phosphate levels were present in the more developed areas, Medlock Bridge and Paces Ferry. After experimentation, the 25 data points were averaged and the mean values were calculated to be 0.04, 0.028, 0.076, and 0.164 ppm for Site 1, Site 2, Site 3, and Site 4, respectively. The data was found to be statistically significant because the calculated t-values were more than the critical values, meaning the null hypothesis was rejected. The strong relationship between the independent and manipulated variables indicates the viability of the experiment's hypothesis. However, inaccuracies in data may have been caused by ambiguous testing equipment and limits on the experimentation period. Further modified and extended studies can be conducted in order to corroborate the experiment and find a quantifiable correlation between urban development and water quality.

2007 - EV005

WAGING WAR AGAINST ANNIE, FANNIE, AND MIKE

Leighton Marie Norvell

Lincoln Park Academy, Fort Pierce, Florida, USA

The purpose was to determine if the algae species *Microcystis aeruginosa*, *Anabaena flos-aquae*, and *Aphanizomenon flos-aquae* can be biologically controlled by isolating viruses from the environment, including the MA-1 virus found in last year's project. These species, known as "Annie," "Fannie," and "Mike," release toxins and use up oxygen in the St. Lucie River needed by aquatic creatures. To conduct this Second Year Study, I began by allowing stock Annie, Fannie, and Mike to grow with the MA-1 virus I previously isolated from the river and named. I found that this virus is specific to Mike and will not kill Annie or Fannie. An Elisa Test was conducted to validate these observations. An Algae Lawn was created and eight samples were collected and combined with the three algae species. Bacteria transfer loops were used to scrape up eight plaques of dead algae (viruses). Each of the 8 isolated viruses were combined with all three algae species and observed to determine which algae species the viruses killed. All viruses were named according to their known hosts. The hypothesis was correct; the MA-1 virus did not kill Annie or Fannie. Eight new viruses were found: 3 targeting *Microcystis aeruginosa*, 3 targeting *Anabaena flos-aquae*, and 2 targeting *Aphanizomenon flos-aquae* They are known as putative viruses (considered new until proven otherwise). They should be added to the St. Lucie river in controlled amounts following a rise of nutrient levels so the algae can be killed before it has a chance to excessively multiply.

Awards won at the 2007 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel Foundation

2007 - EV006

FILTERING PM10 FROM AGRICULTURAL DUST: CYCLONE EFFICIENCY A THIRD YEAR STUDY OF AGRICULTURAL AIR POLLUTION

Tara Ellen Gloyna

Temple High School, Temple, Texas, USA

ulate matter are fine solid or liquid particles that are too small to overcome normal air currents. PM can penetrate deep into the human respiratory system, causing adverse heart and lung conditions. Due to this health concern, the EPA regulates the amount of PM10 that can be emitted by agricultural operations. One PM abatement technique involves the use of metal cyclones that filter the air by centrifugal forces and vortexes, but cyclones are perceived to be inefficient compared to more costly bag filters. The purpose of this research is to evaluate the efficiency of a plexiglass 1D3D cyclone when used to filtrate PM10 from agricultural dusts. The experimental setup, constructed by the researcher, included a consistent loading apparatus, 1D3D cyclone, filter box, orifice meter and vacuum system. Each dust sample was tested 3 times and each sample filter weighed 3 times with a standard deviation no more than 5 micrograms. The cyclone is considered efficient for PM10 filtration because the cut point, the particle size where 50% of the particles are collected, was smaller than the target 10 microns for all dust samples and averaged 2.77 microns. While efficiency at collecting particles 10 microns and smaller was calculated 3 different ways, the most accurate representation of PM10 filtration was the linear efficiency model. Poultry PM10 was the most effectively filtered at 99.62% ± 62%, followed by road, feedyard, milo, corn and cornstarch samples. This research concluded that the constructed plexiglass 1D3D cyclones is an effective air pollution abatement system for PM10.

Awards won at the 2007 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel Foundation

Second Award of \$1,500 - United States Air Force

2007 - EV007

CALCULATING LACTUCA SATIVA UPTAKE OF RESIDUAL HEAVY METALS FROM SEWAGE SLUDGE AUGMENTED SOIL

Jessica Lee Jackson

Eastern High School, Indiana, United States

Heavy metals found in sewage sludge augmented soil can be absorbed by plants, which could affect consumer crops, potentially causing health problems. The purpose of this project was to determine the amounts of residual heavy metals that food crops uptake from soils previously augmented with heavy metals from municipal sewage sludge. It was hypothesized if Lactuca sativa were grown in soil that was augmented with sewage sludge containing heavy metals thirty years ago, then significant amounts would still be found in the plants grown in the soil today. Soil collected from a 1977 EPA studied site was used to grow experimental plants for 6 weeks. The plants were cut at the bottom of the stem and washed with distilled water and blotted dry. The wet mass of the lettuce was found and the plants were ashed. At Indiana University Southeast, nitric acid was added to the ash to draw out the heavy metals. Inductively Coupled Plasma Atomic Emission Spectrometry was used to find the amounts of cadmium and zinc in parts per billion (ppb) of the samples collected. The amount of cadmium found in the experimental samples was 170 ± 7 ppb compared to 13 ± .7 ppb for the control. The amount of zinc in the experimental samples was 17,000 ± 290 compared to 5,000 ± 50 ppb for the control. The cadmium in the experimental soil sample was found to be highly significant when compared to the control soil using Student's t-test. Based on the data collected the hypothesis was supported.

2007 - EV008

AN EVALUATION OF PERCHLORATE EXPOSURE IMPACT ON BRINE SHRIMP MORTALITY

Ashley Nicole Sylvester

Greybull High School, Wyoming, United States

This research will investigate perchlorate's impact on the mortality of Brine shrimp (Artemia franciscana). These small creatures make an excellent indicator species for potential environmental impact of perchlorates. Their position near the bottom of a food chain could have significant consequences to larger organisms if perchlorates prove to be detrimental to survival. This experiment was done by growing a stock culture of the Brine shrimp. This was done using a 5.5% salt solution. These cultures were then exposed to different levels of sodium perchlorate. After being set out for 3 days the live Brine shrimps in the samples were counted. It was found that as the amount of perchlorate increased so did the amount of deaths in the Brine shrimp. It was found that the lowest concentration of the Sodium perchlorate was a tolerable amount. Comparing the numbers of shrimp showed a decrease of only one off giving the concentration a less than a 1% death rate. As the concentration increased, so did the mortality rates in the Brine shrimp. When the concentration reached up to 1 molar perchlorate the percent of survival was down by 78%. The mortality rate increased consistently with increasing concentrations. The results of this experiment show that lower levels of perchlorate don't seem to affect the bottom of the food chain. This is ok as long as the levels that are found in their environment are low. But once the environment is exposed to higher levels of perchlorates it is evident that there may be some problems. It may be very important to monitor perchlorate levels in water supplies. If these begin to increase, the water needs to be cleaned up to avoid damage to the food chain.

2007 - EV009

CLEANING UP OPEN WATER PETROLEUM SPILLS USING MAGNETIC SAWDUST

Raymond Tan
William Mason High School, Mason, Ohio

Oil spill from tankers may cause ecological disasters in the marine environment as well as on shores. The commonly used oil clean-up and collection strategies may not always work well especially if there are waves on the water surface. Sawdust is inexpensive and is available in huge quantities. It is hypothesized that sawdust can be made magnetic to help its collection from the open water after it has been used to absorb oil spills. In this experiment, sawdust was indeed made magnetic with a simple method using iron salts deposition, which was demonstrated easily with magnets. Microscopic images indicated that the dark-colored iron deposits were embedded very well inside the sawdust particles. The oil absorption measurements were conducted on both the untreated sawdust and the magnetically treated sawdust with a 1:1 mixture of engine oil and salt water (3.5% salt) to simulate the oil spill at sea. It was found that the magnetic sawdust maintained almost all of the oil absorption capacity as compared with the untreated sawdust. It was also found that the magnetic sawdust remained magnetic even after oil/water absorption, which demonstrated that the magnetic sawdust containing oil spills could be easily collected with the design of a magnetic device on the clean-up boats.

2007 - EV010
ALGAE: A GROWING PROBLEM THE STUDY OF NUTRIENT LEVEL EFFECTS ON THE GRWOTH OF SCENENDESMUS DIMORPHIS

Jessica Rene Brown
South Terrebonne High School; Bourg, LA, United States

This project was designed to investigate the influence of nutrient level on the growth of freshwater algae. As nutrients levels increase, do algal numbers also increase? Eutrophication, which is considered to be a type of pollution, is caused by the enrichment of chemical nutrients in an ecosystem. Dead zones are hypoxic area's in ocean's cause by eutrophication. Water samples were collected from bayous and drainage ditches throughout Terrebonne and Lafourche Parish and also the Mississippi River. Four replications were taken from each source. Water samples were initially passed through filter paper to remove large contaminants. Next the samples were passed through a 0.45 micron syringe filter to remove any microbes present. Several analyses were performed on each water sample including, pH, conductivity, total dissolved solids, salinity, ammonia, nitrate, and ortho-phosphate levels. 125 milliliters of each water sample was inoculated with five milliliters of Scenedesmus dimorphus and incubated in a growth chamber at thirty degrees Celsius with sixteen hours of light and eight hours of dark. Enumeration of algae was accomplished by measuring sample transmittance at 755 nanometers, and using this as an estimate of turbidity. The rate at which the algae grew was proportional to the nitrate and phosphate levels in the water. As the nitrogen and phosphorus levels increased, turbidity also increased, indicating an increase in algal numbers.

2007 - EV011
THE DEPENDENCY OF BACTERIAL GROWTH ON POLLUTANTS IN BREVARD COUNTY WATERWAYS: YEAR TWO

Margaret Helen Roth
Cocoa Beach Junior/Senior High School, Cocoa Beach, Florida, United States

The project's purpose was to determine the effects of different combinations of varying concentrations of pollutants on bacterial growth in Brevard County waterways. It was hypothesized that E.coli was present in excessive quantities in the waterways, that the concentrations of pollutants has increased, and that there is a direct correlation between the quantity of bacteria and the concentration of pollutants that is most directly affected by the concentration of nitrates. In the previous study, presence/absence of the bacteria and concentration analysis of the pollutants were made. This year, in order to test the hypothesis, water samples were collected from twenty different oceanside and riverside locations throughout the county over a period of several months, quantification of the naturally occurring fecal coliform and E.coli was conducted. Determination of pollutant concentrations of nitrites, nitrates, phosphates, and ammonia in the natural waterways were made. The pollutant concentration data was analyzed as a longitudinal study. These analyses were then combined into an experimental set of E.coli cultures, using every possible combinations of the pollutants at low, medium, and high concentrations. In all parts of the experiment, quantification trays were used to count the number of E.coli and fecal coliform present. The results for the experiment demonstrate that fecal coliform and E.coli are present at moderate to excessive levels in the waterways of every location sampled and that there are hazardous levels of pollutants throughout the county's waterways. In comparison, the pollutant concentrations have increased up to ten times above last year's levels. The experimental results show that bacterial growth generally decreases as the pollutant concentrations increase therefore, not supporting the researcher's hypothesis as the correlation is negative.

2007 - EV012
DO THE CLAYS KAOLIN AND FULLER'S EARTH REMOVE HAZARDOUS SUBSTANCES IN CONTAMINATED SOIL?

Saba Lynn Stovall
Dutchtown High School, McDonough, Georgia, United States

Everyone consumes soil through air, water, and food. Children and adults often ingest dirt which industry, agriculture, or humans may have contaminated and that may cause a health threat. In a northeast to southwest band in the State of Georgia hidden beneath the earth's surface are deposits, rich in two clays used as absorbents. The Researcher selected this project to determine if the clays, kaolin and fuller's earth, can remove hazardous substances from contaminated soil and if so, then they can be used for geo-remediation. Soil samples were exposed to hazardous substances for a period of 29 days. On Day 6, clay filled nettings were inserted for a period of 23 days. Soil samples were obtained on Day 1 and Day 29 and sent to the University of Georgia's Agricultural and Environmental Services Laboratories for a Total Elemental Analysis. Although a reduction of each hazardous substance level was realized in all of the clay-introduced contaminated samples (average reduction: Kaolin 28%, Fuller's Earth 38%), the hypothesis – If the clays kaolin and fuller's earth remove hazardous substances from contaminated soil, then the clays kaolin and fuller's earth can be used for geo-remediation – was not proven because the hazardous substances were not removed. If research is continued, experimentation is required to determine the degree of reduction kaolin and

fuller's earth would have if utilized for geo-remediation and further research of soil chemistry, specifically cation exchange.

2007 - EV013

THE EFFECT OF CAFFEINE ON THE GERMINATION OF SEEDS ATTEMPTS TO CONTROL THE COQUI FROG IN HAWAII

Kara R.H. Dastrup
Kapaa High School, Kapaa Hawaii, United States

An invasive species of frog known as the Eleutherodactylus Coqui has infested parts of Hawaii. In an attempt to eradicate the species, the Hawaii Department of Agriculture sprayed a two-percent caffeine solution on soil and foliage to kill the invasive Coqui frog. The question arose of what the caffeine might be doing to the growth of plants and what effect it might have on the soil.

I designed an experiment in which I observed how “easy to grow” seeds would germinate in solutions with various levels of caffeine. I did this by crushing up Vivarin caffeine tablets and dissolving them in distilled water. The concentrations of caffeine solutions in my experiments varied between 0% and .7% caffeine. I repeated the test multiple times, and each time I got the same results: the higher the concentration of caffeine, the lower the germination rate of seeds.

2007 - EV014

CORRELATIONS BETWEEN DISSOLVED OXYGEN, PH, TEMPERATURE, CONDUCTIVITY AND TURBIDITY, BOTH WITH A TURBIDITY TUBE AND NTU METER, IN THE SOUTH FORK OF THE CROW RIVER.

Lisa Pauline Broderius
Glencoe-Silver Lake High School, Glencoe, MN, U.S.A.

ations between turbidity measured with a turbidity tube, dissolved oxygen, temperature, pH, conductivity, and turbidity measured in NTU's, were examined on the South Fork of the Crow River. If correlations can be confirmed, then the turbidity tube measurements that local citizen stream monitoring groups gather with a tube, can be used to anticipate other water quality measures.

My hypothesis was that there would be a negative correlation between turbidity readings taken with a tube vs. with a NTU meter, a positive correlation between turbidity tube readings and dissolved oxygen, a negative correlation between temperature and dissolved oxygen, and a negative correlation between turbidity tube readings and conductivity.

Eleven sites were chosen from which to gather samples, five on the Buffalo Creek (a tributary of the Crow), five on the South Fork of the Crow River and one after they merged. Vernier meters were used to analyze the turbidity in NTUs, dissolved oxygen, pH, temperature and conductivity.

The results showed an almost perfect negative correlation between the two turbidity readings and a significant negative correlation between temperature and dissolved oxygen. A positive correlation was found between the turbidity tube and dissolved oxygen and little or no correlation between turbidity and conductivity.

The findings also showed that the health of the South Fork of the Crow River is impaired. Future work will involve looking at how the topography of the land and rainfall affect the water quality.

2007 - EV015

LOONS AND LEAD: AN INVESTIGATION OF THE DISSOLUTION OF LEAD IN LAKE WATER

Alyssa Rose Staffki
Perham High School, Perham, MN, U.S.A.

Lately there has been great concern about the number of loons and other water birds ingesting lead or other fishing tackle while obtaining gravel to aid in digestion, resulting in anemia due to lead poisoning. How likely is it that loons and other aquatic birds will consume lead sinkers while diving? How fast does lead dissolve when in an aqueous environment? Heavy metals such as lead may play a role in negatively affecting loon populations. In this experiment it is hypothesized that lead sinkers are easily found by aquatic birds as they pick up gravel from the bottom of lakes to aid in digestion. It was also hypothesized that an average sized lead sinker (approximately 3 grams) will dissolve at a rate of 1 gram per year. The procedures for this experiment included filtering gravel from a lake bottom to find sinkers and measuring the rate of dissolution of lead sinkers. The data collected from this experiment showed that lead is easily found in an aquatic environment occupied by loons and other aquatic birds. It also showed that small lead sinkers dissolve very slowly, at a rate of .5 grams per year. The conclusion drawn from the data showed that it is likely that loons could ingest lead weights lost by fisherman because of the slow rate of dissolution of lead in water.

2007 - EV016

EFFECTS OF P450 INHIBITORS ON FUNDULUS DEVELOPMENT AND CYP1 EXPRESSION

Hallie Louise Freyaldenhoven
Mississippi School for Math and Science, Columbus, MS, US

Benzo(a)pyrene (BaP) is a Polycyclic Aromatic Hydrocarbon (PAH). PAHs are environmental contaminants that are health risks for humans and animals resulting from the incomplete combustion of certain carbon-containing compounds. In moderate amounts, BaP is enzymatically degraded in the body rendering it nontoxic. A battery of inhibitors with BaP were employed to characterize the degradation pathway involving Cytochrome P450s (CYP1C1 and/or CYP1A) and aryl hydrocarbon receptors. The components of this biochemical pathway were assayed using artificially fertilized Fundulus heteroclitus eggs with exposures and observations from 4.5 hours post fertilization (hpf) through 240 hpf. The various permutations of these toxins and inhibitors included the inhibitors alone, each inhibitor with the BaP and a control group with the solvent. The P450 inhibitors were a-naphthoflavone (ANF), 2-aminoanthracene, flourathene and piperonyl butoxide. The eggs developing in the presence of BaP and inhibitors showed abnormalities of a potentially lethal caliber. The embryonic heart became more tubular than a normal F. heteroclitus two-chambered heart. The embryos showed blood clots throughout the egg and swelling of an oil sack under the head and heart causing the head to be elevated and interfere with circulation. The inhibitors alone showed minor defects compared to the

BaP+inhibitor. The BaP+ANF showed the greatest abnormalities suggesting that ANF at the concentrations used is the most potent inhibitor of CYP1. The specific inhibition of the P450 enzymes indicates that this class of enzymes is responsible for the degradation of BaP and alleviation of the abnormalities during the early stages of F. heteroclitus development.

Awards won at the 2007 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation

Third Award of \$100 - Society of Environmental Toxicology and Chemistry

2007 - EV017

E COLI PRESENCE IN THE BIOLUMINESCENT BAYS OF PUERTO RICO

Ricardo Enrique Bertran

Colegio San Ignacio, San Juan, Puerto Rico.

The purpose of this experiment was to determine the different levels of contaminarion by Escherichia coli in the bioluminescent bays of Puerto Rico. It was determined that the bioluminescent bays closer to a populated zone, would have a higher concentration of E coli than the bays in secluded areas. Eq Lab provided sterile sample bottle with preservatives necessary to perform the water samplings in each bay. The samples were kept at cool temperatures in an ice cooler. Analysis of chemical oxygen demand, biological oxygen demand, turbidity, total Coliform and fecal Coliform were performed by the Laboratory. The method used to determine the bacteria level was the fermentation method 9221 B/E. The results of the experiment demonstrated that the bay with the highest amount of coliforms was La Parguera Bioluminescent Bay, with a count of 50 ml of Total Coliform and 30 ml of fecal Coliform. La Parguera's Bio Bay is near populated areas where floating homes have been known to discharge raw sewage in the sea. Fajardo's Laguna Grande had 30 ml of fecal and total Coliform. For Vieques, no evidence of Coliforms was found. In La Parguera, BOD was below detection limits, COD was 130mg/L and Turbidity was 2.92(NTU). In Vieques, BOD was 3 mg/l, COD was 390 mg/L and Turbidity was 1.60(NTU). In Fajardo, BOD was 6 mg/L, COD was 39.0 mg/L and Turbidity was 3.75(NTU). The bays closer to populated zones proved to have a higher concentration of E coli than those isolated from population.

2007 - EV018

WASTE 2 WATER CAN WASTEWATER TREATMENT BE IMPROVED BY MBR TECHNOLOGY?

Alec Ryan Jemison

West Anchorage High School, Anchorage, Alaska, USA

If humans care to survive, they must take care of where they live by managing how they live. Increased water shortages and increased demand for clean water are a projected outcome of global warming and population expansions. A new development is available that will allow us to reclaim our wastewater and recycle it to use for irrigation and landscaping. It is Membrane Bioreactor (MBR) technology, and it combines an aerobic biological treatment process with an integrated microfiltration membrane system.

 I had the opportunity to evaluate MBR technology at the Girdwood Treatment Facility. This pilot plant is part of Anchorage Water and Wastewater Utility and is part of their continuing effort to achieve the highest possible standard of discharged water.

 I compared physical and electrochemical qualities of the MBR influent to the MBR effluent using Standard Test Methods for Water and Wastewater, 2005, 2540 D-E, and a WaterPOINT™ analyzer on five contiguous Saturdays. The results were better than hypothesized, with nearly 100% change in turbidity and suspended solids.

 I then compared the results to the conventional tertiary treatment process currently in use in Girdwood. The MBR effluent has a lower ph, total dissolved solids, alkalinity, ammonia, and turbidity. While the results were impressive, I have some reservations due to an observed 30% increase in temperature of the effluent.

2007 - EV019

EXHALING CO2: PART 2

Joanne Kathleen Heslop

Northern Nevada Home School, Incline Village, Nevada, United States of America

Soil accounts for twenty percent of carbon dioxide emissions into the air, making it an important, and largely overlooked, contributor to global warming. I conducted my experiment with the goal of developing a formula or model to demonstrate the relationship between atmospheric temperature and carbon dioxide release rates from soil.

 I incubated three sets of plastic bottle terrariums in triplicate at three different constant temperatures: 253.8 K, 276.3K, and 293.5 K. All other factors which could have affected the carbon dioxide release rate were kept constant. After a testing period of nine to thirteen days in length, I measured the carbon dioxide levels within the terrarium and used those measurements to calculate the amount of carbon dioxide released per day at each temperature. Each set had four different testing periods, resulting in a total of 36 data readings. I then graphed the data, with the x-axis representing temperature in Kelvin and the y-axis representing the carbon dioxide release rate per day, and calculated the formula of the trend line.

 The model representing the release rate of carbon dioxide from soil in relation to atmospheric temperature reads $R = (1 \cdot 10^{-16}) \cdot (e^{0.1507T})$, where "R" is the approximate carbon dioxide release rate in ppm per day and "T" is the temperature in Kelvin. The model was developed for a temperature range between 253 K and 294 K. This equation is exponential in form, meaning the carbon dioxide release rates in higher atmospheric temperatures are dramatically higher than those in lower temperatures.

2007 - EV020

DESIGN, CONSTRUCTION, AND TESTING OF A NOVEL, RAPID, INEXPENSIVE COLIFORM DETECTION SYSTEM

Dayton T Horvath

Newtown High School, Sandy Hook, CT USA

The presence of a harmful strain of Escherichia coli in various foods has led to ample news coverage of incidents where people have become ill from contaminated foods. Standard methods for detecting E.coli O157:H7 involve culturing the bacteria over a twenty-four hour period for verification of its presence. A rapid method for bacterial detection has been developed using a GFP-labeled lysozyme-inactivated T4 bacteriophage, which infects E.coli cells and transfers the Green Fluorescent Protein (GFP) gene into the bacterial genome. Expression of GFP indicates the presence of E.coli. The typical method to identify the presence of GFP involves using a fluorescence microscope, which is expensive and not common in an environmental or food safety lab. A specialized fluorimeter was developed to suit the specifications of a novel, inexpensive detection system using the GFP-bacteriophage technology. The excitation required for the detection of the GFP-enhanced E.coli was determined to be 395 nanometers hence an inexpensive UV-LED in conjunction with a silicon photodiode was used. The simplicity, cost, and practicality of the device were strongly considered during design. The time for a detection result was greatly reduced from a day to a couple of hours, because of the rapid adsorption of the phage and subsequent expression of the GFP in E.coli. The primary function of the detection method (using the phage and the device) is for a preliminary field test to determine the presence of E.coli. The optimized method and design of the device may help future applications in the detection of harmful pathogens.

Awards won at the 2007 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation
First Award of \$3,000 - United States Air Force

2007 - EV021

THE EFFECT OF PESTICIDES ON BRINE SHRIMP AND DAPHNIA EMBRYO DEVELOPMENT AND REPRODUCTIVE BEHAVIOR

Gillian Caldwell Collins
Hunter College High School, New York NY, United States

The effects of various pesticide concentrations were tested on the embryo development and reproductive behavior of Daphnia magna and Artemia salina. The pesticides used were Atrazine and Carbaryl (Sevin). The investigation included pictures taken three times everyday for days. Observation of the pictures sought to identify abnormalities in growth and structure. Eggs were exposed to three concentrations of each pesticide (1ug/L, 3ug/L, and 5ug/L), plus a control. The hypothesis was that the two pesticides, Atrazine and Carbaryl, would slow the rate of development of Daphnia and Brine Shrimp embryos. Data collected supported this conjecture, in that high concentrations of pesticides led to delayed hatching and progression of development in Brine Shrimp and Daphnia.

 To test the effects of Atrazine and Carbaryl on the reproductive behavior of Brine Shrimp and Daphnia, seven populations of each organism were raised in separate tanks containing the previously tested concentrations of Atrazine or Carbaryl or serving as a control. The hypothesis was that, if the Brine Shrimp and Daphnia were exposed to higher concentrations of pesticides, a smaller percentage of individuals would be able to reproduce by parthenogenesis and more would revert to sexual reproduction. Cysts were collected at three 7-day intervals. The number of hatched eggs and the male-female ratio of the nauplii were recorded. From the data collected, it can be assumed that, if the generations of nauplii were allowed to reproduce in the pesticide-treated tanks, the Daphnia and Brine Shrimp exposed to higher concentrations of pesticide would reproduce mostly by sexual reproduction

Awards won at the 2007 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2007 - EV022

POLLUTED ASPHALT RUNOFF AND ITS IMPACT ON FRESHWATER INVERTEBRATE

Samantha Nicole Gaudette
West Valley High School, Yakima, Washington, United States

The objective of my project was to determine how the polluted asphalt runoff was affecting the life forms in the creeks, streams, and rivers that run near roads or large quantities of asphalt. I poured distilled water onto the chosen sites on Wide Hollow Road, Sarge Hubbard Park parking lot, Cottonwood Canyon Road, West Valley Park parking lot, Randall Park parking lot, and Fullbright Park parking lot. Once I had collected my samples (using sponges to absorb the water while wearing protective gloves) I transferred a small portion of my samples to petri dishes. There I monitored the heart rates of six daphnia that I had placed in each petri dish by placing them under a microscope one at a time and counting their heartbeats for one minute. All of the daphnia in the collected waters from the various sites experienced a noticeable fluxuation and decrease in the overall average heartbeats per minute. This data helped to strengthen my hypothesis that the daphnia would have an adverse reaction to the pollution in the water samples. However, my data disproved my hypothesis of increased heart rates in the daphnia that were exposed to the polluted asphalt runoff. The daphnia's heart rates actually decreased rapidly over the time I was monitoring them. Since the daphnia that were placed in each petri dish had negative reactions to the contaminants in each water sample (except for the Control), one could conclude that other life forms would also have negative reactions to these pollutants.

2007 - EV023

ASSESSING THE LONG TERM POLLUTION IN CAVE SPRINGS BRANCH CORRELATING MACROINVERTEBRATE COMMUNITIES AND SEDIMENT COMPOSITION

Molly Kathryn Steen
Grove High School, Grove, OK, U.S.A.

Two streams in NE Oklahoma, Cave Springs Branch and Honey Creek are the focus of this study. Water and macroinvertebrate analysis has indicated poor conditions in Cave Springs which impacts Honey Creek at and below their confluence. More needs to be known about what is causing these differences.

 Can the methods of macroinvertebrate assessments, sediment chemical analysis and sediment toxicity tests be used collectively to determine the overall health of a stream?

 Site 1 is on Cave Springs closest to a point-source, Site 2 is also Cave Springs downstream from Site 1, and Site 3 is in Honey

Creek above the confluence and will be used as background data. The general hypothesis is that all tests will indicate worst stream quality at CSB1 and best at HC3.

 Sediment and macroinvertebrate samples were taken from each test location. Sediments were analyzed chemically, macroinvertebrate diversity was assessed and a sediment toxicity test was performed.

 Sediment toxicity was greatest at CSB1 and lowest at HC3, although the macroinvertebrate assessment showed the poorest score at CSB2.

 Sediment analysis revealed a nutrient problem at CSB2 of ammonia, phosphorus & TOC. CSB1 showed problems with Cl, Na, Mg, B & K. HC3 had lower levels of almost all chemicals. CSB1 showed the highest conductivity and the lowest pH.

 Sediment analysis also indicated major issues at CSB1 with levels of chemicals much higher than sites 2&3 in almost all chemicals tested.

 Although the hypotheses were not all fully supported, the results of this experiment showed each test provides its own insights into the health of the stream; together, they can be used to completely analyze all aspects of the stream's make-up.

Awards won at the 2007 ISEF

Award of \$500 - North American Benthological Society

2007 - EV024

CARCINOGENIC CAVES RELATIONSHIP BETWEEN RADON LEVELS AND ALTITUDE IN AN EAST TENNESSEE CAVE

Benjamin Ross Quigley
Bearden High School, Knoxville, TN, USA

Radon, a gas released during radioactive decay of radium, is the second leading cause of lung cancer in the United States. Radon is inhaled and breaks down further into harmful radioactive alpha particles that attach to the alveoli in the lungs. Radium results from decay of natural uranium in limestone, the main component of caves in East Tennessee. With sufficient ventilation, radon will disperse and pose less of a health risk. In caves with passages primarily in the vertical plane, ventilation is reduced as altitude decreases. The hypothesis for this study is that as altitude increases in a vertical cave, radon levels will decrease due to increased ventilation. In this study, radon levels, wind speed, atmospheric pressure, and air temperature were compared at two altitudes (302.4 and 357.5 m), both inside and outside of Rock Hill Cave. The temperature was 18.2°C inside the cave, and 16.4 to 16.8°C outside the cave. Wind speed was 0.0 km/h inside the cave, and 0 to 4.5 km/m outside the cave. Atmospheric pressure was 97.3 kPa A at the highest elevation, and 97.9 kPa A at the lowest elevation, both inside and outside the cave. At both altitudes outside the cave, radon was less than 0.3 pCi/L. Inside the cave, near the entrance, at the highest elevation (357.5 m), radon was 160.0 to 188.8 pCi/L. At the lowest altitude (302.4 m), furthest from the cave entrance, radon was highest, ranging from 281.7 to 305.0 pCi/L. Additional research is underway.

2007 - EV025

STUDY OF AQUATIC MACROPHYTES FOR REDUCTION OF EUTROPHICATION AND HEAVY METAL LEVELS IN WATER THROUGH BIOLOGICAL TECHNIQUES

Igor Ogashawara
Colegio Sao Carlos, Sao Carlos, Sao Paulo, BRASIL

The increasing of urbanization and the improper use of the ground has been causing great environmental problems in cities. One of them is the reduction of the water in quality and amount and, consequently, a loss in the quality of life. Diagnosis of the main problems considers possibilities of minimizing environment impacts with solutions based on the sustainable development, involving the community and being able to cause a fast reversion of the process of degradation of the ground and of the quality of superficial and underground waters.

In Brazil, many cities don't have the basic sanitation. This leads to the pollution of underground water of the Guarani's Aquifer - one of the largest in the world. And if we pollute its water, it will take a long time to stabilize itself again.

In this way, the "Study of Aquatic Macrophytes for reduction of the level of eutrophication and heavy metals in the water using a biological technique", must always be a mechanism for the planning and management of the environment, taking into account practising the most sustainable ones.

It was developed at São Carlos' International Institute of Ecology (IIE).

And it used water from the Gregorio River (an important stream that cuts the city of São Carlos). I used 2 water storage boxes with 500 liters of water colleted from the river, which were tested using zinc capsules. Then, 2 species of aquatic macrophytes were put in the boxes, and analyses were made on: Nutrients (phosphorus and nitrogen); Metals; and Properties of the water.

As I had expected, the aquatic macrophytes absorbed the nutrients from the water and they actually absorbed metals as well. One technique which is simple, cheap and of easy access, however very laborious.

2007 - EV026

RETENTION POND CHARACTERISTICS AND WATER AND SEDIMENT LEAD AND MERCURY LEVELS

August James Steigmeyer
Canterbury High School, Fort Wayne, IN, US

Retention ponds are relatively small, man-made excavations designed to contain water flowing from paved surfaces and roofs after heavy rains, preventing sewers from inundation and controlling rapid run-off into streams and rivers. Retention ponds, by definition, are not found in nature and water entering them does not pass into ground water reservoirs or the watershed. Rainwater contains air pollutants, such as heavy metals, and paved surfaces can be contaminated by petroleum products, asbestos and synthetic rubber residues.

This phase of the study was designed to determine if certain characteristics of retention ponds would correlate with sediment concentrations of lead and mercury. A well-developed relationship between a certain parameter and an elevated lead and/or mercury concentration could be used as a determinate for the timing of future pond remediation. Sediment core samples were collected from each of three ponds (two from each pond) as were composite water samples (obtained in Phase I). Lead and mercury concentrations were determined by a commercial laboratory.

All three study ponds demonstrated elevated lead and mercury water levels. Mercury was not detected in sediment samples, but despite some variability between deep and surface core samples, all sediment lead levels exceeded the levels found in pond water. Although water lead levels did show a correlation with pond age and size of surface area drained, no specific relationship could be appreciated

when sediment lead levels were analyzed. Additional study in this area should be considered as a larger number of ponds and greater sampling could demonstrate statistical significance

2007 - EV027

WILL ACID SULFATE SALTS FROM PYRITE OXIDATION AFFECT PLANT GROWTH?

Sara Marie Joseph

Alton High School, Alton, IL, USA

The purpose of my experiment is to see if sulfate salts from the oxidization of pyrite will affect plant growth. The hypothesis is when sulfate salts are added to soil it will lower the pH which will decrease productivity. It is believed that the addition of sulfate salts to soil will have negative effects on soil characteristics and plant growth.

This research looked at how sulfate salts from pyrite oxidation can impact plant growth. Pyrite is common in sedimentary rocks across the United States and through out the world. When these rock materials are disturbed (i.e. construction, mining, and development) the impacts must be known to prevent pollution of the environment.

The experiment was conducted by adding various amounts of sulfate salts to 120 grams of soil. Then Annual Ryegrass (Lolium multiflorum) was planted. All treatments were replicated 3 times. The treatments were watered with 15 milliliters once a week. The plants heights were recorded in millimeters. At the end of the experiment the pH and the EC were tested using standard procedures.

As the amount of sulfate salts increased the pH of the soil decreased from 7.00 to 4.35. The production of the grass decreased from 1.45 grams to 0.00 grams. The treatments that had higher amounts of sulfate salts added began to die or turn brown.

In conclusion the hypothesis was true. Plants that had the higher amounts of sulfate salts added had a much lower pH. This caused negative effects on soil characteristics and plant growth.

2007 - EV028

THE EFFECTS OF CIMETIDINE ON STREAM ECOSYSTEMS

Amatul Aziz Salma

Niles North High School, Skokie, IL 60077 , United States

The purpose of this experiment was to measure the effects of cimetidine (H2 histamine antagonist) on stream ecosystems. This is a pharmaceutical and personal care product and these have been measured in rivers. The effects were tested on algal biomass (chlorophyll a and organic matter) and on mortality and growth rates of Gammarus fasciatus and Psephenus herricki. Thirty artificial streams were prepared with five different treatments. It was predicted that invertebrate mortality would increase and growth decrease which may lead to an increase in algal biomass; this was same for the streams without invertebrates. First, algae was scraped from stream tiles and filtered to obtain organic matter (ashing process) and chlorophyll a (spectrophotometer). For invertebrates, six containers were placed in one stream per treatment group. Each contained one Gammarus and Psephenus (length taken) and one ounce of stream sediment. Containers were removed after 27 days. Then, mortality and final lengths were recorded. Cimetidine had no treatment effect on algal biomass. There was no trend between treatment groups for chlorophyll a and organic matter. Also, cimetidine had a negative effect on growth of Gammarus due to low rates in x1000 stream. The Psephenus growth was non-linear because of decreased rates in low-dose and in medium (x100) streams. Also, none of the Gammarus died, and there was no trend in Psephenus mortality in short term. But, in the long term (week 12), the recovered Psephenus mortality from streams had a treatment effect (x100 stream was highest) and Gammarus mortality was still unaffected.

Awards won at the 2007 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2007 - EV029

HIDDEN DANGERS? THE EFFECTS OF AQUATIC HERBICIDE SURFACTANTS ON DAPHNIA MAGNA

Brittany Lyn King

Tuscumbia High School, Tuscumbia MO, United States

Unwanted aquatic plants are the number one problem for pond maintenance in Missouri. Herbicides are used to kill unwanted plants. A surfactant is a herbicide adjuvant that lowers the surface tension of a liquid. The purpose of this study was to determine the toxicity of three different surfactants. These surfactants are often used with aquatic herbicides. The surfactants investigated in this study included: a vegetable oil surfactant (Amigo), a non-ionic surfactant (Activator 90), and an organosilicone surfactant (Silwet L-77). Toxicity was determined using Daphnia magna as the bioindicator species. Based on this study it was found that Activator 90, the non-ionic surfactant, was the most toxic surfactant. Amigo, the vegetable oil surfactant, was the least toxic.

Awards won at the 2007 ISEF

Student Membership in SETAC - Society of Environmental Toxicology and Chemistry

2007 - EV030

DEVELOPMENT OF A NOVEL METHOD OF ELIMINATING POLYCHLORINATED BIPHENYLS FROM THE ENVIRONMENT

Rachel Elizabeth Stephan

Kings Park High School, Kings Park, NY, USA

Polychlorinated Biphenyls (PCB's) are a group of organic compounds that were commercially produced by major manufacturing companies during the early half of the twentieth century. Polychlorinated Biphenyls (PCB's) are persistent organic pollutants and enter the environment through their manufacture, use, and disposal. A major issue surrounding the pollution of PCB's is their negative health effects. PCB's cause liver damage, reproductive problems, and are reported

carcinogens. Due to biomagnifications these toxic chemicals enter into our food chain and can harm high organisms. All methods of PCB disposal are inefficient and extremely expensive.

In this study a method of sequestering PCB's was developed using nontoxic molecules, known as cyclodextrins. Different techniques like gas chromatography mass spectrometer, spectrophotometry, and isothermal titration calorimetry were utilized to validate the results of adsorption between cyclodextrins and PCB's. Results indicate that cyclodextrins can effectively bind to PCB's. This study and the technique that was developed can have a tremendous impact on environmental cleanup in eliminating these toxic PCB's.

2007 - EV031

REDUCTION OF HEAVY METAL IONS IN PHOTOCATALYTIC REACTIONS: PHASE III

Megan Moulding

Fremont High School, Plain City, Utah, USA

Heavy metal ions, particularly lead, present serious risks to water quality. One promising strategy is use of titanium dioxide for photocatalyzed reduction of ions. The purpose of this phase of an on-going project was to determine the effect of adding a reducing agent to photocatalyzed reactions, thus increasing the efficiency of ion reduction compared to the use of a catalyst alone.

Lead (II) nitrate solution was placed in four conditions and exposed to ultraviolet light: 1) ion solution only, 2) ion solution with titanium dioxide (photocatalyst), 3) ion solution with ascorbic acid (reducing agent), and 4) ion solution with titanium dioxide and reducing agent. Using a graphite furnace, samples from each condition were analyzed after exposure to ultraviolet light for 1, 2, 4, and 8 hours. Trial One used a lead ion solution mixed to approximately 25 parts per billion. The values for the catalyzed solutions fell below the standard curve used to calibrate the graphite furnace and were unreadable. In Trial Two, the solution was mixed to approximately 6 parts per million to fall within the standard curve. It was found that little reduction occurred. Although lead has a standard electrochemical potential that resists reduction it was expected that the photocatalyst and reducing agent would overcome the negative reduction potential. It is possible that Degussa P25 anatase quality titanium dioxide is needed to "drive" the reaction. One critical element of this experiment that needs attention is the measurement error of the graphite furnace for very low concentrations of ions.

2007 - EV032

TOXICITY AND BIOACCUMULATION OF NANOMATERIALS IN AQUATIC SPECIES

Jingyuan Luo

Hamilton High School, Chandler, Arizona, United States of America

With applications in consumer products, medicine, and the environment, nanotechnology is expected to grow into a one trillion dollar industry. Such burgeoning technology has many potential negative effects, as little is known about the toxicity and bioaccumulation of nanoparticles. This project investigated the effects of nano-scale zinc oxide and carbon fullerenes on Chlamydomonas reinhardtii, green alga, and Daphnia magna, water fleas. Tests of nanoparticle toxicity and its bioaccumulation from the alga to the daphnia were conducted. The toxicity tests, in which the particles at various concentrations were directly introduced into the growth media of the organisms, revealed that nano-ZnO and C60 were more toxic to the organisms than regular-sized particles. More alga death occurred at 1ppm of nano-ZnO and C60 as compared to 10ppm of regular-sized ones; similar results occurred with the Daphnia. The alga data also revealed that zinc oxide was more toxic than carbon, a factor probably due to the higher solubility of the former, and that the effects of nanoparticles were greatest in the long-term. At 10ppm of nanoparticles, alga populations were never able to recover. The data from the bioaccumulation test indicated that a transfer of nanomaterials from the alga to the Daphnia occurred. The Daphnia exposed to either nano-treated alga or nano-treated water appeared to have slower heartbeats, but the trend is not conclusive. Modifications in experimental design, monitoring the Daphnia over a longer period of time may result in a better understanding of the bioaccumulation of nanoparticles and their chronic effects on organisms.

Awards won at the 2007 ISEF

First Award of \$3,000 - Environmental Sciences - Presented by Intel Foundation
Second Award of \$250 - Society of Environmental Toxicology and Chemistry
UTC Stock with an approximate value of \$2000. - United Technologies Corporation

2007 - EV033

ALGICIDE RESISTANCE IN THE GROWTH RATE AND TOXIN PRODUCTION OF A COASTAL HARMFUL ALGAL ISOLATE, MICROCYSTIS AERUGINOSA

Yupeng Liu

Academic Magnet High School, North Charleston, SC, US

One of the most widely used methods in controlling the bloom of harmful algal species in eutrophic freshwater systems is the application of copper-containing compounds. When recurrently applied, however, potential resistance to algicide develops. In this research, cultures of the toxic strain Microcystis aeruginosa isolated from a retention pond were inoculated into 0.04ppm to 0.95ppm algicide treatments and tested for its existing or induced resistance. The cultures were selected to ensure its capacity to survive in higher algicide concentrations and to maximize its ability to produce greater resistance. Based on the hypothesis that a resistance to copper-containing algicide would develop at the end of a three-week period, the growth of the cultures was measured in chlorophyll a density with in vitro fluorescence, from which the growth rates were calculated. Relationship between growth rates and algicide concentration during the period was analyzed graphically and statistically. Algicide effects on microcystin production were explored by measuring the toxin concentration of disrupted cells using an enzyme linked immunosorbent assay (ELISA). Analysis showed increasing resistance from week 1 to week 3 especially in higher algicidal treatments. As resistance increases, the toxin level had inversely decreased. In the natural environment, the resistance as well as toxins released upon lyses could be carried into the aquatic environment, disrupting the food chain and creating potential dangers for animal health.

2007 - EV034

GREAT INVADERS: THE EFFECTS OF INVASIVE SPECIES ON MAJOR ECOSYSTEM PROCESSES

Amanda Marie Bennett

Marysville High School, Marysville, Michigan, United States of America

Invasive species can adversely affect major ecosystems and their fragile processes. Many people depend on such ecosystems and processes for resources. This project focuses on the effects of three invasive species on the Great Lakes mercury cycle, specifically round gobies (*Neogobius melanostomus*) and zebra/quagga mussels (*Dreissena polymorpha* and *bugensis*), introduced into the Great Lakes via foreign ships' untreated ballast water. Examining shifts in the Great Lakes mercury cycle can establish a model of drastic changes occurring in a short time as the result of only a few changes. The investigation asked three questions: Do zebra and quagga mussels contain mercury? Does this correlate with previously discovered mercury concentrations of round gobies of the same areas? Are these two findings directly related to the rise in mercury concentrations in fish of higher trophic levels? The theory being mercury clings to particles suspended in water and are absorbed by zebra/quagga mussels through filtration. Since round gobies eat, almost exclusively, zebra and quagga mussels, bioaccumulation occurs. Until recently, the cycle stopped there, as round gobies had no natural predators in the Great Lakes. As the aggressive gobies drove out native fish, they replaced them in many larger fishes' diets, allowing the mercury to accumulate in higher trophic levels. All samples were freeze dried, homogenized, and analyzed using mercury vapor atomic absorption spectroscopy. The results revealed mercury in all mussel samples, the average being 11.69 ppb, and directly correlating with that of round gobies of the same areas; e.g., mussels having 14.88 ppb from the same location as round gobies having 511 ppb, both the highest of their groups. Fish of higher trophic levels known to consume round gobies followed the same trend, having a direct correlation with gobies of their respective locations. The investigation confirmed the hypothesis on all accounts.

2007 - EV035

PERMEABILITY TO OXYGEN AS A TWO POINT SOURCE OF ERROR IN SAMPLE MANAGEMENT PROTOCOLS

Johann Martinez

Colegio Radians, Cayey, (Puerto Rico) United States

Precise measurement of oxygen levels is necessary for water quality assessment in a broad range of scenarios, from ecological studies to governmental regulations and compliance. Permeability to exogenous oxygen could be a source of error from two points of view; firstly, by changing the actual concentration of oxygen in the sample and secondly, by changing the concentration of oxygen in the standards used when the sensing instruments are calibrated.

The guide question for this study is: Are sampling- and storage-protocols subject to errors due to oxygen permeability? To address this problem, anoxic environments were created using a small and a large anaerobic, dry box. Different combinations of storage jars or cell plates were sealed following standard anoxic-protocols. Jars were sealed by using Teflon-, or electric-tape, wax, polypropylene film, parafilm, and stored in triple jars. Cell plates were sealed with thick or thin Kapton tape. Permeability to Oxygen was assessed using reduced forms of methylviologen and indigo carmine as indicators. The results showed that in contrary to the general assumption, double jars sealed with single Teflon tape or polypropylene film stayed anaerobic only for a couple of hours. In respect to the cell plates, surprisingly, samples sealed with thin- or thick-Kapton tape were able to be stored for hours in contrary to the plates sealed with polypropylene film. The order of oxygen permeability was: polypropylene film (1-2 hr) << thin- = thick-Kapton tape (24 hrs). Thus, for overnight shipping and long term storage, jars need to be sealed with wax, covered first with electric tape, then with parafilm, and stored in triple jars. In addition, cell plates need to be sealed with thin- or thick-Kapton tape. The impact to other areas in which critical assessment of oxygen levels is required is also discussed.

2007 - EV036

EFFECTS OF LAND USE ON WATER QUALITY IN THREE WATERSHEDS – YEAR 2

Richard Charles Lee

Cookeville High School, Cookeville, Tennessee, U.S.A.

I conducted a two year study on the impact of land use on water quality in three local watersheds. In the first year, I found that the three watersheds near Cookeville, Tennessee, Blackburn, Spring Creek, and Pigeon Roost, have unique water quality characteristics because of their different land use patterns. I also showed that higher order streams have worse water quality. The results from my first year study prompted the question of consistency of the water quality in this area. I have continued my study to further the findings from previous year. I compared two-year data to show that turbidity level in second year is getting worse. Chemical parameters, such as chloride, nitrate, and TDS showed a significant increase from the year before. More hypotheses and additional tests were added to the study. My findings from both years proved that the water quality in urban settings is getting worse, such as the Pigeon Roost watershed, a 75% urban area. Impact from storm water and highway runoff is evident. ANOVA showed a significant difference among the three watersheds. I established a relationship between turbidity and total suspended solids. Biological assessment using biorecon scores from macroinvertebrate community was performed. The result of the low biorecon score found in Pigeon Roost watershed shows severely impaired water quality. Intolerance taxa, EPT and total richness of macroinvertebrate community in water were analyzed and discussed. Low impact development strategies, such as rain gardens, were proposed to help improve water quality in Pigeon Roost watershed.

Awards won at the 2007 ISEF

Tuition Scholarship Award in the amount of \$8,000 - Office of Naval Research on behalf of the United States Navy and Marine Corps.

2007 - EV037

IMPACT OF THE ANTIDEPRESSANT FLUOXETINE ON EMBRYONIC DEVELOPMENT OF AN AMPHIBIAN

Miles Vincent Barnhart

Greenwood Lab School, Springfield, MO, USA

tine is a widely prescribed antidepressant drug that accumulates in wastewater. The amount of fluoxetine in freshwater has steadily increased since 1989. It is not known whether this drug is dangerous to the health of humans or other organisms. Some studies show that fluoxetine might cause birth defects and premature birth in humans. In freshwater animals fluoxetine can cause disturbance in the reproductive cycle and rate of maturing. For example tadpoles exposed to fluoxetine will slow in their development. It is not known for sure however why fluoxetine has these effects and what its effects are on a wide variety of freshwater animals in different stages of life. I studied the effects of fluoxetine in water on embryonic development of spotted salamanders. I exposed the salamander eggs to concentrations ranging from 0 to 3000 parts per billion for a period of 12 days. I recorded the presence of developmental defects such as lumps and spinal deformities, the stage of development, the egg diameter because it changes as they develop. I found that fluoxetine caused increase in deformities during the development process.

2007 - EV038

THE EFFECT OF CAHABA RIVER SEDIMENT ON ALGAE GROWTH

Lydia Louise McCormick
Jefferson County International Baccalaureate, Birmingham, Alabama, USA

The Cahaba River is a valued Alabama river and home to a diverse ecosystem. Due to erosion, the river is contaminated by sediment. Aquatic ecosystems are dependent upon siltation (the settling of sediment on the waterbed) because plants and animals need certain nutrients in the soil. Conversely, too much silt can devastate a river. Nutrients in sediment, such as zinc, spark prolific algae growth that can smother ecosystems. Furthermore, in lakes, this process is called eutrophication. Although eutrophication usually occurs in still waters, this process could also plague rivers, even though water is flowing. Both algae and excessive sediment have been found on the Cahaba River. This project examines the hypothesis that sediment will stimulate an overgrowth of algae. For this project, clumps of blue-green algae (cyanobacteria) were incubated under a grow light in various sediment concentrations of high, normal, and absent sediment (filtered Cahaba water). In addition, an extension experiment was conducted because of possible effects from dissolved sediments in the river water on algae growth. This experiment used distilled water in place of Cahaba water with the same sediment concentrations and the results were then compared. Results showed in the Cahaba water group that dissolved nutrients were important for algae growth and that an over abundance of sediment decreased algae growth. Moreover, in the distilled group, algae growth was dependent on both sediment and dissolved nutrients. All in all, sediment does have an impact on algae growth and at very high concentrations algae growth is diminished.

2007 - EV039

USE OF EPILITHIC DIATOMS AS BIOLOGICAL INDICATORS OF PHARMACEUTICAL RUNOFF

Ronit Batya Roth Abramson
Canyon Crest Academy, San Diego, California, United States of America

The potential use of epilithic diatoms as biological indicators of pharmaceutical runoff was studied by creating microcosms to simulate the presence of acetaminophen in a slow moving stream containing epilithic diatoms. Concentrations of acetaminophen were introduced into the systems in four ratios of part acetaminophen to part water: one to one hundred thousand, one to ten thousand, zero (control), and one to one thousand. Acetaminophen is one of the most widely used pain relievers worldwide. More than 37,000 metric tons are produced each year (Burton, 2006) and it is estimated that 50% to 90% (Montague, 1998) of an ingested drug is excreted unchanged from both humans and animals. Even the 10%-50% that is used by the organism's body is eventually excreted in the form of metabolites. The presence of acetaminophen in our waterways has the potential to cause harm to eco-organisms. Diatoms are ideal biological indicators due to their narrow optima for environmental loads and diverse range of species able to survive in extreme environment conditions. Diatoms are readily available in almost all water sources and the diversity of these organisms is susceptible to changes in the environment. In this experiment, amphora and navicula species demonstrated direct concentration-diversity relationships, meaning their populations increased within the three hundred cell count as the concentrations of acetaminophen increased, while the nitzschia demonstrated an indirect relationship. The findings indicate that these three species can be used as indicators of acetaminophen runoff based on their diversity in natural bodies of water.

Awards won at the 2007 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation
Honorable Mention Award - North American Benthological Society

2007 - EV040

VISUALIZING THE INVISIBLE: A LONG-TERM WATER QUALITY STUDY OF THE RED RIVER OF THE NORTH AND AN ASSESSMENT OF DATA USING MICROSOFT VISUAL BASIC

Benjamin Chang Sun
Red River High School, Grand Forks, ND, USA

Purpose - Assess the long-term water quality of the Red River with a frequent sampling approach. Hypothesis - Stream discharge, seasonal changes, and urban activities will affect water quality. Procedure - Water samples were collected 2-3 times a week for 12 months. Samples were analyzed for heavy metals and common ions. Water samples collected from storm drains in various locations were also analyzed for heavy metal content. A computer program was created to provide a more comprehensive analysis of the project data. Results/Discussion

- The data showed that during summer and fall, common ion concentrations in the river increased or decreased with daily discharge levels.
- During the spring flood period, however, most common ion concentrations decreased, except for nitrate. The nitrate level exceeded the EPA drinking water limit during flood period. Fall fertilization activities might be a contributing factor of the nitrate spike. The levels of heavy metals in the river were less affected by stream discharge changes than common ions.
- Analysis of the storm drain samples revealed that heavy metal concentrations in city runoff were consistently higher than in river water. This indicated the impact of urban activities on river water quality.
- The computer program created provided an easier and more user-friendly way of

accessing the more than 1700 data points generated, and had extra features that Microsoft Excel could not provide, such as a heavy metals concentration assessment, USGS and project data search and comparison, trend analysis, and a graphing function.

Awards won at the 2007 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2007 - EV041

WHAT'S IN YOUR WATER? PHASE III

Erin Marie Gaugler

Grant County High School Elgin, North Dakota, United States of America

Soil quality and its relationship to water consumption is an important component in livestock performance. My research project resulted from observing the livestock bypassing a water source. Testing was performed on the soil surrounding the particular dugout by using the Gempler's Professional Soil Quality Test Kit.

In the summer of 2004 I conducted a variety of water chemistry tests using the HACH kit. The tests were performed for alkalinity, nitrates, pH, and phosphates. During the summer of 2005 I collaborated with the North Dakota State Health Department. Every two to four weeks the water was tested for alkalinity, nitrates, pH, phosphates, and total dissolved solids. This past summer I observed the soil type and structure surrounding the particular water source, known as the Suko Dugout.

From the analysis of my observations, I have determined that the top of the soil column leads to prisms, an indication of sodium sulfates. The soil has an iron accumulation because, naturally, it is poorly drained. I also noticed that the sodic soils in our area lower the water table. So, had the original land owners examined their surroundings and researched their project more, all these problems may have been eliminated. As stewards of the land, we need to seriously research and observe the land around us, in bad years our previous actions could kill us or save us.

2007 - EV042

EVALUATING THE EFFECTS OF HEAVY METAL SEDIMENTS ON WATER QUALITY AND MACROINVERTEBRATES

Aaron Mark Weaver

Miami High School, Miami, Oklahoma, United States

The 1900's marked the beginning of a new era for the tri-state area containing northeastern Oklahoma, southwestern Missouri, and southeastern Kansas. Contamination in this area has evolved into many different forms like the visible mountains of chat that can be seen from miles away, the heavy metals (Lead, Manganese, Cadmium, and Zinc) have leached their way into the surrounding area. Recent studies have shown that the toxic chemicals Lead, Zinc, and Manganese have all made a significant rise in levels within the liver meaning that these levels are dangerously high in the area. The purpose of this study is to discover the levels of toxicity that sediments in Tar Creek contain, along with how hospitable the environment is due to this contamination to macroinvertebrate species. The overall hypothesis is that there will be a significant difference between the selected models put into solutions and sediment extracts and the controls. This will show that the heavy metals have a significant affect on amphipods and *L. variegatus*. Testing will be done with a Water Quality Index test and a soil texture test. The selected models will be put into two different tests, one that is made up of 100 ppm, 50 ppm, 25 ppm, 12 ppm, 6 ppm, 3 ppm, and a control in spring water. These concentrations will all be made for Lead, Manganese, and Cadmium. Then spring water will set on top of sediment samples collected from along Tar Creek and absorb the heavy metals from the sediment. Then the models will be put into the extracts and the worms will be counted on their regeneration in a week, and the amphipods will be counted on how many days they lived. The data suggests that the hypothesis was correct, the *L. variegatus* regenerated with a pattern that suggested the lower concentration of solution or the further away from the point source of the pollutant, the higher regeneration rate ($p = .0001$). This trend was continued in the amphipod data as they lived longer in lower concentrations.

2007 - EV044

EMISSIONS OF ETHANOL, GASOLINE, AND THEIR BLENDS

Zhong Zhuang

John Jay Senior High School, Hopewell Junction NY, USA

Recent fear of a fossil fuel shortage has led to a rush to embrace alternative fuels, such as ethanol. Much has been done to study the cost and energy efficiency of ethanol and gasoline but relatively less is known about the environmental implications. This study tested four blends of gasoline and ethanol currently in use and found that CO₂ and CO emissions can be significantly reduced by 80% and 60% respectively when pure ethanol is used as fuel instead of pure gasoline.

Using a relatively simple, but original procedure, the experiment measured the emissions of each fuel while taking into account the amount of energy released. Based on the blends that are currently in use, two different ethanol and gasoline blends were prepared. These blends plus pure ethanol and gasoline were burned and their emissions were collected with a glass funnel, which was sealed on the top by Parafilm. The gas emissions were extracted by injecting a syringe through the Parafilm and measured with a gas chromatograph, specially designed to measure combustion products. The energy released was then calculated based on the loss of fuel volume during combustion.

Overall, it was found that the blends with highest concentrations of ethanol yielded the lowest amounts of CO₂ and CO pollution per megajoule of energy. It was also found that a 36% reduction in pollution can be achieved by substituting just 10% of the pure gasoline with ethanol.

2007 - EV045

POTENTIAL USE OF VEGETABLE OILS AS CLEANERS FOR OILED SHORELINES

Steven Andrew Morris

Mansfield High School, Mansfield Missouri, United States

Oil spills continue to be a problem throughout the world and there has to be a way to clean them up. Now biosolvents are used, which are not as safe for the environment. With vegetable oils, the cleaning up of oil spills could be solved in a more environmentally safe way.

To test this theory an ocean shoreline was simulated and motor oil acted as crude oil and was added to various types of rock. The amount of drained oil was then weighed and various vegetable oils were added in hope of draining the largest amount of motor oil from the rock. The overall weight of the oil drained was then found. The amount of vegetable oil added was subtracted from the amount of total oil drained to calculate the final amount of motor oil removed from the rock.

Various vegetable oils removed different amounts of motor oil. Canola oil was the best oil used for draining motor oil and is less harmful to the environment than the currently used biosolvents.

2007 - EV046

A SURVEY OF CADMIUM ADSORPTION ONTO SOIL SURFACES

Melissa Ann Baranay
Marian High School, Mishawaka, IN, USA

Iron metal has a high affinity of binding towards soil surface locations. The ability to discover such adsorption trends will aid in the remediation of a contaminated site as it will render it possible the ability to predict metal movement in natural environments. This study investigated eight soils samples and their individual capacity to adsorb aqueous Cd²⁺ as a function of pH. It was hypothesized that Cd²⁺ will have a different affinity for soils depending on their percent composition of organic matter, inorganic matter, and water. The soil sample was first sieved to remove any large organic material and then suspended in a solution containing aqueous Cd²⁺ metal. Samples were collected and the pH values adjusted using dilute NaOH or HCl. The results yielded the following rate of adsorption: Winter Wheat > Grotto > SC 1 > Illinois Aquifer > SC 3 > SC 2 (second) > SC 2 > St. Joseph River. The results partly support the hypothesis as all samples did have different percent composition and different levels of adsorption. However, it is impossible to accurately relate one component to the rate of adsorption at this time. Desorption experiments were conducted to determine the permittivity of the adsorption and the experiments were found to be completely reversible. All soils had 100% adsorption at high pH levels which indicates that soil is an effective way to control the spread of Cd²⁺ and lead to decontamination of near-surface locations.

Awards won at the 2007 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation
Award of three \$1,000 U.S. Savings Bonds, a certificate of achievement and a gold medallion. - United States Army

2007 - EV047

NITRATE REMOVAL BY CYPERUS PAPYRUS L. IN A CONSTRUCTED WETLAND

Adria Katrin Schwarber
Notre Dame Academy, Park Hills, KY, USA

Nitrate, which can have adverse effects on animals and humans, is a naturally occurring contaminant in soil and water. The nitrate levels in some areas, especially where nitrate-containing fertilizers are in use, can exceed the 10 mg/L Maximum Contaminant Level (MCL) set by the EPA. Constructed wetlands have recently been explored as a cost-effective and environmentally friendly alternative to waste removal. Four simulated wetlands were constructed for this experiment. Levels exceeding the MCL of nitrate were used by mixing varying amounts of NaNO₃ (0.35 g, 0.70 g, and 1.4 g) into 10 L water. A gravel substrate topped with a layer of soil was placed in the bottom of tall, plastic containers. The nitrate-containing water was added. *Cyperus papyrus* L. was planted to determine if it would be able to remove nitrate. Every two days for about two weeks, water samples were taken from each wetland and labeled. Using a Veriner conductivity probe and a Vernier nitrate ion-selective electrode, data were acquired. The experiment demonstrated that over the course of two weeks *Cyperus papyrus* L. was effective at reducing the nitrate levels in water in constructed wetlands by up to 31.3 %.

2007 - EV048

GLOBAL WARMING

Nathalie Albaladejo - Quiles
Segunda Unidad Almirante Norte, Vega Baja, Puerto Rico

The purpose of this research was to establish the relationship between the conditions in a greenhouse and a plastic box with the conditions that generate global warming. The hypothesis established that the air in the greenhouse and the plastic of the box will resemble the greenhouse gases of the atmosphere of the Earth that trap the heat as evidenced by temperature measurements. The experimentation was done for six consecutive days at the same hour in a greenhouse, in a plastic box and in the open air. The building material of the greenhouse and the plastic box simulate the concentration of greenhouse effect gases that produce global warming. Temperature measurements were done inside and outside of the greenhouse and the plastic box. After measuring the initial temperatures, six temperature measurements were done at intervals of five minutes each inside and outside of both the greenhouse and the plastic box. The average temperature was determined for each site using the seven registered temperatures in each one. The hypothesis turned out to be correct. It was possible to reproduce in the greenhouse and in the plastic box the conditions that generate global warming. The air and the plastic prevented the infrared radiation from getting out and thus the temperature increased.

2007 - EV049

STUDY OF DISSOLVED OXYGEN LEVELS, PH, CONDUCTIVITY, TEMPERATURE AND NITROGEN CONCENTRATION IN WELLS FROM DIFFERENT TOWNS OF PUERTO RICO

Iris Noemí Lopez - Perez

Colegio Congregacion Mita, San Juan , Puerto Rico

Our planet is going through a crisis due to the pollution of the natural resources. Water, as an essential life element, is suffering the consequences of the inadequate use of the environment. In Puerto Rico there are two ways to obtain potable water: from the Water Authority and from wells. The purpose of this study was to investigate the quality of consumed water, that comes from wells in different regions of Puerto Rico. The hypothesis was that the wells from the central region will show better water quality because the dissolved oxygen levels, pH, water conductivity and nitrogen levels will be good enough according to the established standards. Different wells from the northern southern, western and central regions of the island were studied. The water samples were tested for temperature, pH, conductivity, dissolved oxygen and nitrogen levels using a calculator based laboratory (CBL) and the appropriate sensors. Tests were performed three times for each well. Data demonstrated that the quality levels for the wells from the western and eastern regions were within the acceptable parameters while the wells from the northern and southern regions showed poor quality levels as tested. In the future, water quality from the wells will be compared with the processed water from the Puerto Rico Water Agency.

2007 - EV050

HUMAN IMPACT AND DIFFERENCE IN SEDIMENTATION ON THE ABUNDANCE OF MACROINVERTEBRATES IN 10 BEACHES IN PUERTO RICO

Keilla Ortiz-Ortiz

Aurea E. Quiles Claudio High School, Guanica, Puerto Rico

The problems presented are: How does sedimentation and human impact influence macroinvertebrates abundance? Can macroinvertebrates serve as bioindicators for the beaches? The hypothesis was: Variation in the sedimentation process affect sand grain size in the beaches and macroinvertebrate abundance. The goal was to analyze the sediments that are found in the sand, and determine how these affect the habitat in the seashore zone.

 This study was done in eleven beaches from the southwestern zone of the island using one as control. These were identified and classified by their topographic cross section traits and were subdivided into three zones in the inclination angle. Sand was taken at depths of 2 inches, then was separated using a turbulence net to identify everything that was found above and underneath the surface. Hydrological and sedimentological tests were performed and the organisms were collected and identified.

 The results demonstrated that the most affected beaches due to solid pollutants are Jungla and Pieza Beach. Reduced numbers of organisms were found where there were marine solid pollutants. The populations of macroinvertebrates were reduced compared to the control beach. The results indicated that the inclination of the beach is a determining factor for the sand grain size distribution and macroinvertebrate abundance in the beaches. Changes in macroinvertebrate abundance due to pollution and shifts in grain size distribution suggest that macroinvertebrates might be useful biomdicators for the beaches. This investigation could serve as a base line study to evaluate future changes in sedimentation and pollution caused by humans.

2007 - EV051

WELL!!! IT'S BETTER THAN SPRING WATER

Katessa Ann Karch

Canadian High School, Canadian, OK, United States

In my experiment I wanted to find out the best water to drink. I collected samples from Quinton, Canadian, McAlester, Longtown, Eufaula, Haskell County, two wells, and I also got three popular brands of bottled water to test. In my opinion I figured the water from bigger cities would be more sanitary to drink than water from smaller cities. In the tests that I performed most were right with my hypothesis. However, the second part of my hypothesis is that the three bottles of water would be more sanitary than the rest of the water samples, on that part I was wrong. The first popular brand spring water I tested was the only sample that showed bacteria in it. To make sure my findings were right I tested two other samples of the same popular spring water and they also tested positive for Coliform bacteria. I extended my research and I tested a second spring water and a third spring water and they also tested positive for Coliform bacteria. I performed 5 tests on my water samples, they are: Ammonium, Chloride, Ph, Coliform, and Colorimeter test. All the samples were equal to the control on the Ammonium test.

2007 - EV052

REMOVAL OF TARGETED ORGANIC COMPOUNDS FROM MUNICIPAL WASTE WATER

Evan Matthew Duggan

Cherry Creek High School, Greenwood Village Colorado, U.S.A

Triclosan, estrogen, and caffeine carry potential environmental and human health risks yet are not treated in our municipal wastewater treatment plants. This project explores the feasibility of removing these compounds using low cost treatment alternatives that may be applicable to municipal wastewater treatment. Simple household granulated activated carbon (GAC) filters demonstrated some success in the removal of these compounds.

 Solutions of triclosan, estrogen, and caffeine were run through standard household GAC filters and analyzed by high-performance liquid chromatography with UV/vis photodiode array detection. Additional experiments were performed with activated carbon outside the drip filter cartridge. Both techniques were effective in the reduction of the targeted pollutants. Pending a cost benefit analysis of a scaled up GAC filter in an industrial setting, this technique may prove effective in the removal of the compounds for environmental and health friendly wastewater.

2007 - EV053

IS DAPHNIA MAGNA AFFECTED BY AMMONIUM NITRATE IN FERTILIZER

Justin David Sammons

Westview, High School, Martin, Tennessee, United States

The purpose of this project is to determine the survival of Daphnia magna when exposed to ammonium nitrate (NH4NO3), the main ingredient in fertilizers. To test the hypothesis, five different amounts of NH4NO3 were added to containers of the Daphnia. The effects of the different concentrations of NH4NO3 were observed and compared to the control sample.

The procedure of testing is as follows: Place four Daphnia magna in the testing container. Then add the solution to the container. The solutions of NH4NO3 are 0.5%, 1%, 2%, 5% and 10%. The diluted solutions are 0.05%, 0.1%, 0.2%, 0.5% and 1.0%. Observe and record every five minutes for thirty minutes. Remove the Daphnia and clean the containers with warm water. Repeat the experiment two more times.

Daphnia magna is highly affected by Ammonium Nitrate. Many farmers over fertilize their fields. Therefore the run off of Ammonium Nitrate goes in to ponds and lakes and kills Daphnia magna in minute quantities. Daphnia magna is a major food source for fish and other animals. The fish population will decline if Daphnia magna dies off.

2007 - EV054

DIFFERENCES IN BENTHIC MACROINVERTEBRATE DENSITY IN AND AROUND A POLLUTED URBAN LAKE

Amanjot Kaur Grewal
Liverpool High School, Liverpool, NY, USA

Over the years, the New York State Department of Environmental Conservation has initiated programs to measure the water quality of Onondaga Lake's tributaries. One of these programs is referred to as the Onondaga Lake Tributaries Macroinvertebrate Monitoring which examines the benthic macroinvertebrate density in Onondaga Lake and its tributaries. However, a crucial component is missing in these programs. Only the major tributaries are monitored- which account for 82% of total inflow to Onondaga Lake.

In this study, we looked at Bloody Brook and Saw Mill Creek, two of the smallest tributaries to Onondaga Lake. We sampled at the delta, 100m, and 500m away from the delta. The benthic macroinvertebrates that were collected are excellent indicators of water quality. The NYSDEC uses aquatic macroinvertebrates to monitor the water quality of the New York State's rivers and streams. Macroinvertebrates can be used to assess water quality because of their sensitivity to environmental impacts.

Based on the data we obtained, we can make preliminary conclusions that both Bloody Brook and Saw Mill Creek have poor water quality. This can be concluded because the particular benthic macroinvertebrates collected and identified at the tributaries, are all indicators of poor water quality. The only classes in Insecta that were collected were Amphipoda, Oligochaeta, and Isopoda, all of which live are indicative of poor water quality. With future sampling in the spring, we hope to create a sound basis on which we can accurately determine both Bloody Brook's and Saw Mill Creek's water quality.

2007 - EV055

FIRE ON THE MOUNTAIN PHASE II

Lindsey Eva Rugh
Hotchkiss High School, Hotchkiss, CO, United States

ear's phase of this experiment determined that the burn site of the 1994 Wakefield Fire in Paonia, CO had severe soil organism deficiencies as a result of the fire that have caused the area to remain barren of new life. This year's objective was to find a method to treat the soil organism deficiency. The researcher collected twenty samples from the burn site and tested the soil's protozoa and bacteria counts. After this data was collected the researcher applied cane sugar, Nature Safe, chicken manure, and alfalfa meal as soil amendments. After the amendments were applied the soil re-tested the soil's bacteria and protozoa counts at

different time intervals during the experiment to determine which amendment increased the protozoa and bacteria the most. After all tests were completed the researcher determined that samples that had cane sugar applied showed the largest increase in protozoa and bacteria counts . The researcher believes the cane sugar worked the best because it is carbon based, whereas the other three amendments are very high in nitrogen and phosphorus which are more complex substances that are harder for protozoa and bacteria to consume. The researcher also believes that the pure glucose found in sugar also encouraged more growth of bacteria and protozoa. The results of this experiment could be used to treat the soil organism deficiency of the burn site so it could support plant life in the future.

2007 - EV056

WHO IS IN YOUR WATER: A STUDY OF ANTIBIOTIC RESISTANCE IN ENTEROCOCCUS AND ESCHERICHIA COLI IN RURAL VIRGINIA.

Sara Dean Schutte
Clarke County High School, Berryville VA, USA

The purpose of this experiment is to determine what bacterial species contribute to the high fecal coliform count in certain water samples, and to determine if there is antibiotic resistance by the bacteria. The water was found, through previous study, to be contaminated by high fecal coliform counts, which (I hypothesized) should decrease after the water treatment plants and increase in rural agricultural areas. I believe that the bacteria from the rural agricultural areas will exhibit antibiotic resistance, and that the water will be less contaminated after the water treatment plant. The study was designed to specifically analyze the prevalent strains of bacteria in the contaminated water, and to determine their colony counts and antibiotic resistance.

I found that escherichia coli (e-coli) was present in Abrams Creek, Opequon Creek, and Spout Run. The e-coli from Neil Road (on the Opequon Creek) exhibited antibiotic resistance to Cefiximine, Fosfomycin, and Ampicillin. The e-coli was found intermediately resistant to Cefazolin. Cefiximine and Fosfomycin are uncommonly used for human ailments. However, Ampicillin is commonly prescribed for multiple human ailments. If resistance develops to these antibiotics, the implications to wildlife, humans, and plants could be disastrous. It is worrisome that by providing preventative antibiotics to livestock, humans could develop "super strains" of bacteria that we are susceptible to and could not treat.

2007 - EV057

THE EFFECTS OF OXYBUTYNIN CHLORIDE ON THE MOTILITY OF DAPHNIA MAGNA

Bryce J Wiatrak

Nicolet High School, Glendale, Wisconsin, USA

This experiment is designed to help prove the dangers that prescription drugs impose in nature. For this project, I had the help a physician. This experiment will test the effects of oxybutynin chloride on the ability of *Daphnia magna* to swim away from light. *D. magna* try to avoid light, in order to stray for predators. Oxybutynin chloride is a prescription medication that is used to prevent people from uncontrolled urination. It works by relaxing smooth muscle, the muscle *Daphnia* use to swim. For this experiment, a cylindrical vase is divided into three equal sections: top, middle and bottom. The vase is filled with two liter of either pure water, or water with a 10-3%, 10-4%, or 10-5% concentration of oxybutynin chloride. 15-20 large *D. magna* are poured into the vases in the dark. The vases are laid on top of a light. After 15 minutes in the vase, the light is turned on. The amount of *D. magna* in the top, middle, and bottom third of the vase is recorded 0, 2, 4, 6, 8, 10, 20, 30, and 60 minutes. Three trials for each concentration were performed. In the control group, 83% of the *D. magna* swam to the top of the cylinder after 60 minutes. For all three concentrations of oxybutynin chloride, the majority of the *D. magna* remained at the bottom after 60 minutes. This shows that the drug impairs the *D. magna* 's ability to swim away from light.

2007 - EV058

THE PHYSIOLOGICAL & ETHOLOGICAL EFFECTS OF ENVIRONMENTAL FLUOXETINE (PROZAC) FROM HUMAN WASTE WATER SOURCES ON *PROCAMBRARUS CLARKII* PHASE V

Alexander Lynn Thurmon
Chillicothe High School, Chillicothe MO, USA

In the early phases of this research project, phases I through IV were determining the effectiveness of using serum hemolymph glucose to monitor various types of stress that crayfish encountered in their environment. In this phase using the hemolymph glucose monitoring methods of the early phases, the crayfish were used to examine their physiological and behavioral responses to Fluoxetine in concentrations as found in surface waste water. The crayfish were placed into groups of sixteen crayfish for experimental purposes. The test groups were as follows: 0 mg/L, 20,40,60 & 80 mg/L. The crayfish were sequestered in individual PVC pipes with mesh for good water flow during their exposure to Fluoxetine for each of the trials. The trials consisted of different groups of sixteen crayfish for each concentration. The hemolymph glucose levels were determined immediately after the crayfish were removed from the trial tank. Next the sixteen crayfish were divided into two groups male and female, they were size matched and watched for aggressive behaviors. The behaviors that were monitored were standard observed behaviors in crayfish. The results of the hemolymph glucose levels showed the there was significant difference in all groups when compared to the control. For the behavioral test there was a significant difference between the control and all groups, most notably was a reversal in normal aggression. The males became less aggressive and the females became more aggressive. For both sexes this would change the dynamics of the entire population.

Awards won at the 2007 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2007 - EV059

CAN SUGAR FIX MY TOOLS? "USING ORGANIC SUGARS TO PREVENT CORROSION OF GALVANIZED STEEL"

Rosa Armendariz
Dove Science Academy, Oklahoma City, OK, US

Corrosion is the major factor resulting in the replacement of steel equipment with new ones. Even treated steel such as galvanized steel corrodes, and becomes unusable through time. Therefore, I hypothesized that using everyday organic chemicals such as starch, sucrose, glucose, and fructose would leave a positive effect on corrosion inhibition, particularly when corrosive chemicals such as chloride and water are present. In order to support this hypothesis, I conducted an experiment in which nails were put into a container with different organic sugars. Weight losses of these nails due to corrosion are measured and compared to those of controls by means of a mathematical formula that concentration of the chloride solution, and the concentration of the inhibitor, while the dependant variables were weight loss values, and inhibition efficiencies. On the other hand, the constants were the volume of the solution, temperature, and pressure. The results of the experiments have proven my hypothesis true, which could result in sugars to be used to their common way of consumption. Some of these application areas could be closed circulated water systems used either for cooling or heating purposes in transportation vehicles, buildings, and pipelines.

2007 - EV060

THE ADVERSE EFFECTS OF GROUNDWATER AND SURFACE AREA RUNOFF ON STREAM ECOLOGY

Jesse Martin Hutton
Whiteland High School New Whiteland IN United States

Pollution is a readily increasing problem among small communities and the world as a whole. Taking an objective viewpoint, my opinion of the situation is that if one can change a small community, then the world can in turn change as a whole.

 Designing an experiment to solve a readily increasing problem was nothing short of challenging. One problem arising in small communities is the increasing amount of polluted surface area runoff and groundwater sources that empty into small streams. The experiment sets up a total of four different sites along a small stream; with two being groundwater sites and two representing surface area runoff.

Various water quality tests were done over the course of 31 days on all four sites. Along with doing the tests, I analyzed the results and kept a detailed journal of my observations and factors that could possibly affect my results.

Results from tests and analytical data proved that the sites that represented surface area runoff contained more "pollution" than those sites that represented groundwater. After concluding the project, a letter was sent to the state DNR office explaining the findings of my project and suggestions for the betterment of the stream's ecology.

Once again, I feel that if the research of one student can help change a small stream, the bodies of water around the world can become more pure as well.

2007 - EV061

PYRETHROIDS AND NEURODEGENERATION: THE ABSORPTION OF PYRETHROIDS INTO S. DOMESTICUS (PIG) LUNGS AND THE EFFECT OF THE RECOVERED PYRETHROID LEVELS ON PC12 NEURITE RETRACTION

Graham William Wakefield Van Schaik

Spring Valley High School, Columbia, South Carolina, USA

Pyrethroids are the most commonly used insecticides in the world. Research has suggested that the pyrethroid bifenthrin promotes neurite retraction, a sign of neurodegeneration typical of diseases such as Alzheimer's. Phase 1 of this research determined if the pyrethroids permethrin and cypermethrin can be absorbed into lung tissue. Phase 2 determined if the absorbed amounts could induce neurodegeneration, specifically neurite retraction, in R. norvegicus PC12 cells. In Phase 1, lung models were assembled using S. domesticus (pig) lung tissue. Model rooms were treated with two home-use pesticides (Raid Fumigator® 12.6% permethrin and Hot Shot Pest Control® 26% cypermethrin), and air from these rooms was pumped across the lung tissue for either 4 or 8 hours using an Ambu® resuscitation bag to simulate human breathing. Residual pesticide was extracted from the tissue and analyzed by gas chromatography. In Phase 2, permethrin, cypermethrin, and bifenthrin were applied to PC12 cells in concentrations derived from the amounts recovered in Phase 1 (0.1, 1.0, and 10 M). The cells were examined for neurite retraction 24 hours after pyrethroid application. Nine T-tests supported the hypothesis that all compounds at all concentrations would cause a significant reduction in neurite length compared to untreated cells (p-value for all tests <.001). Average reductions ranged from 27% to 54%. Three ANOVAs were performed, one for each concentration, to determine the effect of pesticide type upon retraction. It was found that the percentage of retraction was independent of compound type. Linear regression analyses were performed to determine the effect of concentration level (re-expressed logarithmically) upon the average percentage change in neurite length for each pesticide type. Bifenthrin-treated samples exhibited a strong relationship between the log of pesticide concentration and average percentage change in neurite length.

Awards won at the 2007 ISEF

Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by Intel Foundation

2007 - EV062

GEOMICROBIOLOGY OF NEW MEXICAN TRAVERTINE SPRINGS

Kristina Graham Dahm

Rio Rancho High School Rio Rancho, USA

Travertine springs precipitate calcium carbonate (travertine) downstream of their sources. The carbon dioxide (CO2) dissolved in the ground water will degas and cause the pH to increase and travertine to precipitate. Travertine precipitates in various cool water springs in New Mexico, in addition to hot springs at Yellowstone National Park. In 2005, chemistry samples were taken at Tunnel Springs and Las Huertas Creek in Placitas, New Mexico. The major anions and cations were calcium and bicarbonate. Cultures of bacteria were obtained from Tunnel Springs and revealed DNA with closest relatives from cold, fresh water environments. In 2006, samples were taken at another travertine spring in San Ysidro, New Mexico. The travertine springs at San Ysidro are much larger than those in Placitas and geologically different. The major anions and cations at San Ysidro are sodium, bicarbonate, and sulfate. Culture-independent methods were used to test the types of bacteria present in San Ysidro springs. The bacteria from San Ysidro have closest relatives from salt water environments such as coral reefs and The Great Barrier Reef. The range of marine locations the DNA relatives came from is surprising. The energy sources at the San Ysidro travertine springs are similar to those at hydrothermal vents beneath the ocean, which makes this geologic setting intriguing. Identifying the role bacteria play is useful in understanding environmental habitats, such as travertine springs. Studying these bacteria could help with the restoration of limestone monuments. These findings are promising for further research on cool-water travertine ecosystems.

Awards won at the 2007 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation

2007 - EV301

EVALUATION OF AIR POLLUTANTS' IMPACT IN NOVO HAMBURGO THROUGH SULFUR ANALYSIS IN LICHENS

Fabiano Thiele Fracassi, Everton Hansen; Cristina Theves Lourenco

Fundacao Liberato Salzano Viera da Cunha - Novo Hamburgo - RS - Brasil

Nowadays, we are living in a world daily under a great number of atmospheric gaseous pollutants. These pollutants, especially sulfur and nitrogen compounds, carbon monoxide and particulate material, affects somehow the life in Earth. So, it makes necessary its controls.

 Lichens are usually used to determine the air quality because of their easy intoxication by these pollutants. However, they are very resistant to natural issues, as being an association between an algae and a fungi. Despite they can be found in everywhere, they can be considered as bioindicators.

 Sulfur dioxide is one of the pollutants used as an air quality parameter. If lichens are especially sensitive to that compound, its analysis in lichens becomes a way to determine the air quality, once the sulfur absorbed by lichens range through its atmospheric concentration.

 In this study three regions were analyzed in Novo Hamburgo city, looking for measure how much this pollutant has been absorbed by some species of lichens. So that, determine the air quality on these regions. The analysis where conducted using the LECO SC 132 Sulfur Analyzer.

 By using ANOVA (Analysis of Variance) method, is possible to differentiate the school region (0.271% average sulfur in Rimelia sp.) from the industrial region (0.461% of sulfur). Downtown's air quality is between these two regions. Since these results were similar to quantity and variety analysis, it's suggested that the air quality range on the same way between the studies regions, and it is directly correlated with sulfur content on lichens.

2007 - EV302

DECLINE OF THE NORTH AMERICAN LESSER SCAUP: PHASE 3 - COMPOSITION AND TRACE ELEMENT CONCENTRATIONS IN EGGS AND PREY FOODS

Mitch Dale Weegman, Matt Moraco Weegman
Winona Senior High School, Winona, MN, U.S.A.

The lesser scaup (*Aythya affinis*) population has markedly declined from 7.5 million breeding birds in the 1970s, to 3.25 million breeding birds in 2006. Although many researchers have studied the scaup decline, few hypotheses point to a given solution. Contamination of food sources is a factor believed to be affecting the scaup decline. It was hypothesized that contaminant concentrations in invertebrates consumed by scaup would vary by species. It was hypothesized that freshwater shrimp would contain the lowest selenium and chromium concentrations, while chironomid larvae would contain the highest. It was hypothesized freshwater shrimp would contain the most nutrients and chironomid larvae would contain the least. Also, it was hypothesized that concentrations of contaminants in lesser scaup eggs would vary. Seventeen scaup eggs, 581 amphipods, 311 chironomid larvae, and 7 snails were collected. A petite ponar dredge and sweep net were used to collect the invertebrates. A significant correlation exists between mercury (Hg200 and 202) concentrations in amphipods and eggs ($p = 0.05$). Se82 concentrations in amphipods were significantly higher than those found in scaup eggs ($p < 0.0001$). Chromium concentrations in eggs increase as Cr52 chironomid larvae concentrations increase. The geometric mean in eggs for Cr52 was 1.99 mg/g. Mercury geometric mean concentrations in amphipods were above the normal standard (0.15 mg/g wet weight) for healthy aquatic organisms. Selenium concentrations in invertebrates and eggs were lower than the hazard level. We believe contaminants are not affecting scaup in the Cando area of North Dakota.

Awards won at the 2007 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News
Distinguished Team Award of \$1,000 - Society for Technical Communication

2007 - EV303

EFFECTS OF PHOSPHATE ON CRAWFISH PHASE III

Alisha Marie Bailey, Shanee' Tranise Turner
St. James High School, St. James, LA 70086

This project is a third year project to test the effects on phosphate on crawfish. This year's project was to quantify the amount of molting crawfish needed to remove phosphate from an aqueous sample. Further investigation tests the effects of phosphate concentration on the shell growth of molting crawfish. Phosphorus is an essential nutrient of all aquatic plants and algae; however, excess phosphorus can cause pollution and lead to eutrophication. Eutrophication is known for lowering levels of dissolved oxygen in water which causes a decrease in aquatic population. The research plan was developed to test the response of molting crawfish in various concentration of phosphate (sodium phosphate). Live molting crawfish samples were placed into three-gallon aquariums with various concentrations of phosphate and into a control aquarium of plain water. The molting crawfish were observed over time. Initial results showed that higher concentrations of phosphate (0.1 ppm and 0.2 ppm) promoted healthy shell growth. The minimum concentrations of phosphate (0 ppm, 0.025 ppm and 0.05 ppm) resulted in crawfish death. Molting crawfish uptake higher concentrations of phosphate to aid in healthy shell growth.

2007 - EV304

THE INTERRELATIONSHIP OF A EUTROPHIC SYSTEM ON NUTRIENT THRESHOLD LEVELS FOR IMPAIRED AQUATIC BODIES

Lafeyounda J. Brooks, Mauriel Robinson
Noxubee County High School, Macon Mississippi United States of America

This project's objective was to define the nutrient threshold levels of nitrogen and phosphorus that needed to be added before water sources became eutrophic in nature; highly polluted and a real problem. Secondly, this indicator's potential was to increase community awareness and understanding of the importance of water quality and the factors that contribute to water quality. Four sites were selected, upstream and downstream, from the Mississippi 2006 Section 303 (d) List of Impaired Water Bodies. Each site was divided into four groups, three trials each, by weight percentage (concentration) of urea phosphate, $[CO(NH_2)_2.H_3PO_4]$ in total fluid. The percentage by weight concentrations were: control, 0.00%, 0 mL $CO(NH_2)_2.H_3PO_4$, 250 mL H_2O ; and variances in concentration of urea phosphate, independent variable, 0.17%, 175 mL $CO(NH_2)_2.H_3PO_4$, 75 mL H_2O ; 0.12%, 125 mL $CO(NH_2)_2.H_3PO_4$, 125 mL H_2O ; and 0.07%, 75 mL $CO(NH_2)_2.H_3PO_4$, 175 mL H_2O . The nutrient threshold levels were observed with noticeable differences in all dependent variables (algal growth, coliform, dissolved oxygen, and turbidity), upstream and downstream, for 0.07% at all sites. This indicator found that several low concentrations were about the same as the control variable. Changes became more dramatic above 0.07 % for all sites, upstream and downstream. The major constraints to the use of this indicator were: water agitation, more contact with oxygen in the atmosphere, higher dissolved oxygen; organic wastes such as leaves and feces, consume oxygen, lower dissolved oxygen; and temperature, lower temperature, higher dissolved oxygen because organisms increase activities in warm water, greater demand for oxygen.

2007 - EV305

THE EFFECT OF VARYING CONCENTRATIONS OF SOY ISOFLAVONE ON THE FECUNDITY OF ARTEMIA SALINA

Elena Tenore Elizabeth Tenore, Samantha Dodgebe
Hayfield Secondary, Alexandria, Virginia, United States

The introduction of foreign chemicals into aquatic environments poses a great threat fish populations. In recent years an increased number of fish have been found with delayed sexual maturation due to semi-synthetic estrogens. To accurately simulate and test the effects of estrogen upon aquatic life, *Artemia salina* and soy isoflavones are used in conjunction as a small-scale indicator of the potential threats that estrogen-like substances may pose for organisms. Sexually mature *Artemia salina* were divided into six groups. Each group was introduced to a specific concentration of soy isoflavone twice, which were made

by serial dilutions. Random population sampling was done to attain a sample count on the same day that the soy isoflavone was administered. The average increases in population sizes for each group are as follows: Group 1 (control): 10.5, Group 2 (0.0048 M):1, Group 3 (0.0095 M): 6, Group 4 (0.0143 M): -2, Group 5 (0.0191): -2.5, Group 6 (0.0238): -3.5. In general, as the concentration strength increased, a significant decrease in population size followed, which suggests that the soy isoflavone hindered the brine shrimps' ability to reproduce. Results were found significant through a Chi square test. The original hypothesis that if *Artemia salina* is exposed to high concentrations of soy isoflavone, then fecundity will significantly decrease was supported.

 This experiment demonstrates that if a marine ecosystem were to receive a source of runoff that contained a semi-synthetic estrogen such as soy isoflavone, then the reproductive systems of organisms in that environment may degenerate, possibly resulting in an overall decline in population sizes.

Awards won at the 2007 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2007 - EV306

AN ASSESSMENT OF ALTERNATIVE MICROWAVE EXTRACTION METHODOLOGIES FOR THE RECLAMATION OF OIL CONTAMINATION

Christopher Merle Hall, Christopher James Hederman
Greybull High School, Greybull, WY, USA

Will the use of microwave radiation improve the reclamation of oil from contaminated soil when compared to current methods? The purpose of this project is to determine if the application of microwaves on oil contaminated soil will effectively reclaim oil from the top soil. Fifty mL of top soil was measured out into a beaker. Crude oil was added to the soil until saturation point was achieved. This process was repeated for the following percentages: 85% saturation, 75% saturation, 60% saturation, 50% saturation, 35% saturation, 25% saturation, and 10% saturation. A small, saturated piece of cheesecloth was placed in a funnel and the funnel was placed into a flask. The cheesecloth held 18 grams of oil contaminated soil from falling into the flask, but allowed the oil to flow through. The funnel and flask was placed into a microwave and irradiated with microwaves. Each sample was tested at various time and power levels. The temperature of the sample was tested after completion of the test to ensure that flash point (the point at which the oil will ignite) was never attained. The oil reclaimed at the bottom of the flask was measured to find the results of the test. This test was repeated several times for each sample. The data was recorded and graphed. Oil shale was broken into small pieces and a small piece was placed in the funnel to be irradiated with microwaves and the data was recorded. Eighteen grams of the saturated sample was placed into a beaker and set on a heat plate at 59° for 90 seconds which was then compared to the results of the tests on the saturated sample. The use of microwaves on oil contaminated soil was more effective in reclaiming the lost oil than modern methods. The microwaves enabled a maximum of 31.5 percent of the oil in the soil to be reclaimed whereas modern methods aren't able to reclaim any oil that the top soil has absorbed. The evidence shows that microwave radiation recovers a better percentage of the oil than modern methods.

2007 - EV307

HOW THE PRESENCE OF TRIBUTYLTIN IN PACIFIC BLUE MUSSELS (MYTILUS TROSSULUS) IN AUKE BAY, ALASKA HAS CHANGED SINCE THE INTRODUCTION OF ITS REGULATIONS ON MARINE VESSELS

Daniel Reed Stoops, Aaron Douglas Badilla
Juneau-Douglas High School, Juneau, Alaska, United States

To determine the levels of tributyltin (TBT) in the Pacific blue mussels in Auke Bay, in Juneau Alaska, we first collected

mussels from eight different sites around Auke Bay and separated and homogenized the tissue from each site into three 15 gram samples. TBT was then chemically extracted and analyzed in a graphite furnace atomic absorption spectrometer. Our data rejects the null hypothesis that the presence of TBT in Pacific blue mussels in Auke Bay has not changed since the introduction of its regulations (T-test, p-value <.05). We found that all samples had concentrations significantly lower than levels found in 1989, two years after the ban of TBT in marine vessels. TBT concentrations ranged from a low of 0.00217 µg of TBT/g of tissue at Coghlan Island in Juneau (a site with very limited marine traffic) to a high of 0.01224 µg of TBT/g of tissue at the Ferry Terminal.

 TBT has been shown to harm marine organisms, which is why its use was banned in 1987. TBT use has not yet been banned in large marine vessels, such as the ferries of the Alaska Marine Highway System. Perhaps the regulation of TBT use in larger vessels should be re-examined, but for now we can be content with the fact that TBT in marine organisms in Auke Bay has been drastically reduced since its ban in 1987.

2007 - EV308

THE EFFECTS OF CARBON DIOXIDE ON GROWTH AND URUSHIOL PRODUCTION OF TOXICODENDRON RADICANS

Stephanie Robyn Seman, Layne Deaton McBeath, and Tyler Bryant Jenkins
Burkburnett High School, Burkburnett, Texas, U.S.A.

urpose of this project was to determine the effects of increased carbon dioxide rates on the plant species Toxicodendron radicans. Increa ed levels of carbon dioxide (CO2) might also lend to Toxicodendron radicans growing at alarming rates, while at the same time producing more urushiol, the oil that causes urushi of contact-induced dermatitis.

 Carbon dde levels were measured at three separate locations: a creek surrounded by little activity, a residential area, and a nature center located in the city. Samples of Toxicodendron radicans were taken from the creek and nature center to be evaluated for urushiol content. The oil was extracted using diethyl ether and the samples were analyzed using a gas chromatograph.

 Our hypothesis was partially correct. Observations of the proliferation of each plant corresponded accordingly, with the nature center (average CO2 rate- 603.30ppm) having eighteen plants per square meter as opposed to the creek's (average CO2 rate- 527.13ppm) three to four plants. Conversely, the ratio of oil extracted to mass of plant matter showed no defining variation between the samples. CO2 rates seem to have no effect on amount on oil produced. The gas chromatograph scans showed no identification of urushiol. This is believed to be the result of hydroxides in the urushiol sticking to the column and not separating. However, a single phenol was detected. In the first two trials, a greater abundance of this phenol was shown in the CO2 enriched samples. The third trial showed no phenol, but instead butylated hydroxytoluene in abundances differing with the previous trials.

2007 - EV309

THE EFFECTS OF METALS ON RIVER BACTERIA

Lucas C. Gabrielson, Jacob E. Stramer, John D. Earl
Harding High School, Saint Paul, Minnesota, USA

When Science Fair started we decided that doing our experiment on metals and their unique properties would yield great results. Then we heard about copper's antibacterial properties, and decided that this would be the problem to our experiment, what metal kills river bacteria the best? We hypothesized that copper would kill the river bacteria best because of the research we had done, and that other metals close to it would kill bacteria such as nickel and zinc. But, metals such as aluminum and titanium would not kill bacteria because it is far away from copper on the periodic table. Then we started our experiment, we took metals sterilized with hydrochloric acid and immersed them in water taken from the Mississippi River. We keep the metals in the water for twenty minutes, and then we took the metals out, and opened our sterile swab. Then we dipped the swab in the water and swabbed the water onto the nutrient agar. We sealed the Petri dishes with paraffin sealing wax and let it grow for the next week. We also swabbed just straight river water, sterile water, and no water on the Petri dishes. For the next week we observed the growth of the river bacteria. Then after the experiment we counted the river bacteria that grew on the Petri dishes. Our hypothesis was proved wrong, copper did not kill the most river bacteria, and its alloy brass which is alloyed with zinc killed more bacteria than it.

2007 - EV310

THE EFFECT OF TEMPERATURE ON FECAL COLIFORM REPRODUCTION IN FLINT CREEK WATER

Kirstin Denise Kramer, Whitney Marie Plein
Burlington Community High School, Burlington, Iowa USA

The amount of Fecal Coliform bacteria in a body of water is used to help determine pollution levels. Water temperatures can fluctuate greatly in a shallow creek. This project was designed to determine which water temperatures have an effect on bacterial reproduction in creek water. If the fecal coliform is reproducing in the creek, accurate bacterial counts cannot be made.

 Water was collected from Flint Creek in sterilized jars and brought back to the lab. Six jars of creek water and 4000 mL of distilled water were placed in simulated creeks (insulated coolers with heaters and aerators). Water was pulled from the "creeks" and ran through a Millipore filtration unit to determine a baseline bacterial count. Fecal Coliform media was added to the creeks and allowed to incubate for 24 hours. The "creek" temperatures were approximately 45, 30, 20, 13, and 9 degrees Celsius. After the 24 hour incubation period, levels of fecal coliform were retested to determine amount of bacterial reproduction.

 As temperatures increased from 13 to 25C the number of colonies exponentially increased. Using an F-test, no significant increases in bacterial colonies were found at temperatures below 13C or above 25C. Creek water is usually between 0-23C , so an exponential regression with an r value of .90 was calculated using only this data. The model represents a mathematical correlation (with 90% accuracy) between temperature and the amount of bacterial reproduction. This model can be used to compare fecal coliform counts from testing dates with different water temperatures.

Awards won at the 2007 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2007 - EV311

THE EFFECT OF POINT SOURCE POLLUTION ON SPATIAL PATTERNS OF BACTERIAL INTERACTION AND GROWTH IN AQUATIC ECOSYSTEMS

Kyle Abney Huninghake, Fredrick Regginald Bentley
duPont Manual, Louisville, KY, USA

In 1999 to 2000, a U.S. Geological Survey was taken to examine the streams in America. Over 80 % of the streams examined were found to contain some form of drug or pharmaceuticals. Last year's experiment dealt with determining the effects of several common antibiotics on controlled habitats mimicking the average stream ecosystem. It was found that the antibiotics severely disrupted the balance of the ecosystems; specifically, the bacteria showed higher mortality rates, while the larger organisms flourished. To take these results further, it was decided this year to focus more inclusively on the microbiological component. Instead of using controlled environments, samples were taken from the South Fork of Beargrass Creek in Louisville. Five locations were selected along the stream relative to a combined sewer overflow (CSO). Bacterial counts, diversity testing, and antibiotic resistance were measured to examine the spatial patterns of the bacterial behavior. The results of these tests brought to light many interesting trends. The largest concentration of bacteria was found to be 1000 feet downstream from the CSO. This indicates that the presence of the CSO did in fact create spatial patterns and zones of various microbiological populations; furthermore, the CSO altered the antibiotic resistance significantly. In conclusion, the CSO had a tremendous impact on the stream's microbiological element, and because of last year's results, it can be accurately stated that the CSO disrupted the ecosystem as a whole.

2007 - EV312

THE CONTAMINATION OF THE WATER OF THE TANK DE HUACHAC AND THEIR INFLUENCE IN THE POPULATION'S HEALTH DE NINACACA

Raul Vicente, Jhenyfer Espinoza
CPI "Apostol San Pedro", Jr Bolivar N° 498 Ninacaca –Pasco – PERU

The present proyect has for purpose to elevate the water quality

The agriculture , the cattle raising (mostly bovine), the poultry farms, and other animals are the source of many organic and inorganic pollutants of the superficial and underground waters. These pollutants include sediments coming from the cultivation lands and also nitrogen and phosphorus compounds coming from animal residuals, which home pathogen organisms that produce human illnesses some of them mortal.

The water is a main source of life and it is unvaluable, day by day it hasppens to be more polluted, affecting helth population. Among the 37 most commum illness in America Latina 21 of them are produced by the contaminated water. After Peruvian statisticss, 5 children die

daily because of the contamination of the water

It exists at the moment an infinity quantity of purification methods, but no all of them are well known and effective in the treatment of polluted waters.

Our new water treatment includes the use of sedimentation deposits for liquids, the limited biological treatment, a boiling treatment, solar rays. All of them are used in springs, lagoons or reservoirs, aerobics water, they allow us to prevent some important illnesses and the mortality in the population of Ninacaca

2007 - EV313

WHAT'S WRONG WITH O'HAIRE RESERVOIR? A WATER QUALITY STUDY OF THE SWEET GRASS HILLS WATERSHED

Brittany Joan Marie Blair, Valeska Schairer
North Toole County High School, Sunburst, MT, United States

The purpose of this project was to study 4 ponds and 3 springs down the Sweet Grass Hills watershed. We studied them by doing a chemical analysis including the following tests: pH, temperature, turbidity, dissolved oxygen, nitrates, chemical contaminates, aquatic plants, macroinvertebrates, B.O.D, Coliform organisms, terrain around the pond. We also did a macroinvertebrate study and plant study.

We found out that all ponds down the water shed had a fair water quality except for O'Haire which had a poor water quality. All the springs had good water quality. The ponds showed elevated levels of dissolved solids that could be due to chemical and fertilizer runoff. O'Haire seems to be the worst of the four ponds, not only because of elevated dissolved solids, but the absence of aquatic life, and the stagnant smell.

2007 - EV314

MEASURING THE ATMOSPHERIC CONCENTRATION OF NO2 ABOVE A CITY USING DOAS

Shunsuke Nishida, Masaki Shinohara
Kyoto Municipal Horikawa Senior High School , Kyoto , JAPAN

We measured the concentration of (NO2) in the atmosphere above Kyoto city by differential optical absorption spectroscopy (DOAS).

To do this measurement we designed a system capable of measuring the NO2 concentrations above a city; something that is difficult to measure using conventional methods. Using this system, we developed a new model of the vertical distribution of NO2 in the atmosphere that is different from the conventional one.

NO2 is the chief cause of air pollution.

It collects on the surface at night. But heat island effect causes air circulation which rises NO2. To confirm this phenomenon we have to measure the NO2 concentration into the upper atmosphere.

Its atmospheric concentrations are monitored by the Ministry of the Environment at fixed locations throughout Kyoto, but they are unable to measure NO2 concentrations from a distance. We designed a system that uses DOAS to measure the average NO2 concentration along a long straight line enabling us to make long distance measurements. Using a telescope, spectrometer, and high-luminance white LED light source, we investigated the vertical distribution of NO2 in Kyoto city by measuring its concentration along a straight line.

We discovered that NO2 collected in the upper atmosphere on the night we took the measurements. The result of this study shows that our system is capable of measuring NO2 concentrations to a high degree of accuracy, and we verified our hypothesis concerning the nocturnal change in the vertical distribution of NO2.

Awards won at the 2007 ISEF

First Award of \$1,000 - American Meteorological Society

2007 - EV315

BACTERIOLOGICAL ANALYSIS ON THE CONCENTRATION OF ENTEROCOCCI AND THERMOTOLERANT COLIFORMS IN BATHING WATER OF ISLA VERDE, ESCAMBRON AND IN THE BEACHES OF GUAYAMA...

Dilianne Vargas-Rivera, Coral Valencia De Gracia
University Gardens Hight School in San Juan Rio Piedras Puerto Rico

The Enterococci are spherical bacteria that form colonies in groups or chains. These are part of the intestinal flora of many organisms including humans. The Thermotolerant coliforms are bacteria with common biochemical characteristics that serve as indicators of contamination in water and in food. An analysis was carried out to determine the concentration of these bacteria in Isla Verde and the Escambrón and in the beaches of Guayama and Patillas. The hypothesis established that the beaches that are highly frequented by bathers are the most contaminated by these bacteria. Several beaches of the island were visited and samples were taken to be analyzed using the membrane filtration process. The bacteria were grown in Azide Dextrose Broth and Lauryl Tryptose Broth medium. The average values of the counted colonies in the beaches of Guayama and Patillas were 117.4 Enterococci and 33.5 Thermotolerant coliforms. The average values in Isla Verde and Escambrón were 2 Enterococci colonies and 1.5 Thermotolerant coliforms. These results demonstrated that the less frequented beaches had the largest number of colonies of both bacteria contrary to the most frequented beaches which had a low concentration of both bacteria. The conclusion was that there is no correlation between the numbers of bathers that visit a beach and the concentration of bacteria that can be found in the water. It is demonstrated that there are diverse forms in which a body of water can be contaminated and for this reason everyone should be very careful in the care of the beaches.

2007 - EV316

PURIFICATION OF WATER WITH ACTIVE CARBON DERIVED FROM NUTSHELLS VS. REGULAR ACTIVE CARBON

Jakob Refer Thygesen, Kaare Thode Joergensen
Odense Technical High School, Odense, Denmark

water is a basic human right - but today, some 1.1 billion people suffer from lack of clean water and this causes 3.4 million deaths annually.

 Water

be effectively purified by passing it through an activated-carbon filter. We chose to study two different types of activated-carbon, one made of wood (which for example Ghana imports 785 tons of annually), and one made of coconut shells (of which there is a local surplus in West Africa), in order to determine whether or not a local production of the activated-carbon would be viable.

To test the efficiency of the two types of activated-carbon we used KMnO₄ (potassium permanganate). We used this substance to simplify the measuring of adsorbed KMnO₄. We constructed small accurate glass filters all containing 1.50g of activated-carbon. We then used different concentrations of KMnO₄ (0.01M, 0.1M and 1M) and ran these through the filters.

The results were astonishing: activated-carbon made from coconut-shells were able to purify 358.8mL of 1M KMnO₄ whereas the regular type was able to purify 91.8mL of 1M KMnO₄. The same trend was seen with the other experiments. It can be concluded that the coconut-shell derived activated-carbon is three to four times more efficient than the regular type.

Our studies indicate that if coconut shell activated-carbon were produced (based on simple production methods) and used in e.g. Ghana, it would be possible to decrease the cost of water-purification, decrease the local unemployment and increase the availability of pure water.

Awards won at the 2007 ISEF

Second Award of \$1,500 - Team Projects - Presented by Science News
Scholarship Award of \$1,000 - National Collegiate Inventors and Innovators Alliance/The Lemelson Foundation

2007 - EV317

SOFTENING DE-CARBONATED WATER

Chaima Amor Bouhlel, Marya Al-Jeshi, Jumana Baghabrah
Dhahran Ahliyya Schools, Dhahran, Saudi Arabia

Water contains dissolved CO₂ in the form of carbonates. Ca²⁺/Mg²⁺ ions in hard water react with carbonates forming CaCO₃/MgCO₃ which is poorly soluble in water. The scale has no economical importance and is a waste of minerals. Using H₂ and O₂ to form a bipolar hydrogen fuel cell will separate CO₂ from HCO₃⁻ ions in water. The process depends on reversing the reaction that produces carbonates by disturbing the balance of the alkaline electrolyte (CaCO₃ (aq)). Adding H₂ will lower the high pH level leading to the formation of HCO₃⁻ then its breakage into CO₂ and OH⁻ to neutralize the electrolyte again. When experimented using Hoffman's Water Electrolysis Cell, a change in pH level, from high to low then back to high, proves the possibility of reversing the reaction and separating CO₂. Ca²⁺/Mg²⁺ ions react with OH⁻ giving a hydroxide (base). With no carbonates, the salt type is controllable. An acid is chosen to add to the water to form preferable salt. After acid is added, water is boiled and ingathered in the same chamber CO₂ was. Water will react with CO₂ forming carbonates again without causing problems for the absence of Ca²⁺/Mg²⁺ ions. Water is condensed by cooling the steam down. The salt is gathered and used where needed.

2007 - EV318

AFTER I'M GONE, WHEN WILL THE DIRT RETURN TO NORMAL?!! WHICH OF TWO PESTICIDES PERSISTS IN THE ENVIRONMENT?

Guy Parker Miller, Riles Martinez
Kaua'i High School, Lihue Hawaii, United States

Our project compares the 2 pesticides which are most commonly used in Hawaii to kill coqui frogs. We tested hydrated lime and citric acid for its tenacity in the soil. We tested them to see which pesticide in the soil runoff returned to neutrality (pH 7) the fastest. Extremely acidic (low pH) or alkaline (high pH) pH soil levels can damage or even kill plants. To test this we sprayed the suggested amounts of the two different pesticides on dirt samples and then flushed them with water. We believed that they would return to neutrality in two tests, but it ended up taking six tests for some to return to normal. The real experiment took three times longer than expected for the soil runoff to return to normal. In the end it was hydrated lime that returned to neutrality the fastest.

2007 - EV319

A SEARCH FOR OIL BIODEGRADATION WITH MARINE, AQUATIC, AND TERRESTRIAL SYMBIOSIS.

Monique Ashley Pena, Marques Pena, Shay Anderson
Texico High School, Texico, NM, U.S.A.

One of the largest parts of our economy in Southeastern New Mexico is the oil industry. Although it is a viable and important industry to our economy and to our country, it does have some major environmental hazards. The oil contamination of soil and water is a critical issue that effects us all. The basis of this research is to search for and isolate an microorganism that can biodegrade oil and still exist in a symbiotic relationship with aquatic, marine and terrestrial environments.

The search for oil eating microorganisms originated for us from the idea that organisms have to adapt to survive. We cultured oil crankcases of old tractors that had been abandoned for at least 30 years. We then isolated the microorganisms using streak plate techniques and then placed two loopfulls of the pure culture in oil sample jars containing 50 milliliters of oil. We were amazed to find the staphylobacillus bacteria ate an average of 63% of the oil in the sample jars. The other three types of bacteria; diplococcus, diplobacillus, and spirillum had very little effect on eating the oil.

Once the staphylobacillus had been identified and isolated, we tested it with regular (our controls) and oil contaminated test simulations of aquatic, marine, and terrestrial environments. We were amazed again that the staphylobacillus was symbiotic with all three environments.

Awards won at the 2007 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2007 - EV319

A SEARCH FOR OIL BIODEGRADATION WITH AQUATIC, MARINE, AND TERRESTRIAL SYMBIOSIS

Shay Elyse Anderson, Marques Pena, Monique Pena
Texcio High School; New Mexico; United States

One of the largest parts of our economy in Southeastern New Mexico is the oil industry. Although it is a viable and important industry to our economy and to our country, it does have some major environmental hazards. The oil contamination of soil and water is a critical issue that affects us all. The basis of this research is to search for and isolate a microorganism that can biodegrade oil and still exist in a symbiotic relationship with aquatic, marine, and terrestrial environments.

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Awards won at the 2007 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2007 - EV320

WATERSHED WATCH

Selina Maria Mae Garcia, Brittney Martinez
McCurdy High School, Espanola, New Mexico, USA

The purpose of this experiment is to compare the water quality of our local Santa Cruz, New Mexico watershed from 2005-2006 to 2006-2007. We hypothesize that the Rio Santa Cruz, New Mexico watershed quality will be affected negatively due to growing population and pollution.

 In 2006-2007 there was an increase in stream flow, total phosphorus, temperature, conductivity, compared to 2005-2006. From 2006-2007 there was a decrease in, pH, nitrate, turbidity, copper and aluminum compared to 2005-2006.

 The following were monitored: copper, nitrate, aluminum, phosphorus, calculating and measuring stream flow, measuring temperature, measuring pH, measuring turbidity, and measuring conductivity. In addition benthic macro-invertebrate were used to measure the water quality for 2006-2007. For collecting the macro-invertebrate we used the Frame dip-net sampling (Collection level two). Identification, sorting and counting to the taxonomic family level one of order according to The New Mexico Game and Fish Work Order.

 In conclusion our hypothesis was proven incorrect. This could be due to the watershed area being affected by the weather. In our case heavy rain and heavy snow showers have cleared out the pollutants.

2007 - EV321

THE EFFECT OF THE IN-SITU BURNING OF CRUDE OIL CONTAMINATED WATER AND ITS EFFECTS ON THE VITALITY OF CALIFORNIA BLACK WORMS

Dan Adam Miller, Ben Roark
North Toole County High School, Sunburst MT, United States of America

The purpose of this experiment was to determine if the residual effects of the in-situ burning of crude oil contaminated water had any effects of the overall vitality of California Blackworms. Also, we want to determine which, if any of the various cleanup methods of oil spills is preferable for various aspects of vitality.

 We believe that the residual effects of the in situ burning of crude oil contaminated water will have a harmful effect on the vascular contraction rates, activity rates, and mortality rates of California Black Worms. We believe that the residue produced from the in situ burning, and the remaining hydrocarbons in the water will adversely affect the various aspects of vitality in the worms compared to the other methods of remediation in the water.

 To test this, we gathered a pure sample of crude oil from an oil well. This oil was then added to spring water and removed by the various reclamation methods, and later introduced to California Blackworms. For five days we tested the vascular contraction rates, mortality rates, and general activity of these California Blackworms.

 We found that of the samples, the skim method was the preferable cleanup method. Although the skim method showed preferable over the burnoff method, both methods compared to the Oil/Water group were significantly superior. Mortality rates for both reclamation methods were the same as the control with no deaths, and Activity proved to be much higher in the Oil/Water group and somewhat lower towards the end of the experiment for the Burn off test group.

2008 - EV001

ENVIRONMENTALLY FRIENDLY OUTDOOR ANTHRAX DECONTAMINATION STRATEGIES

Brittney Ann English
A Crawford Mosley High, Lynn Haven, FL

Bacillus anthracis is one of the most common biological warfare weapons. It is extraordinarily environmentally stable and difficult to decontaminate from the environment. Toxic chemicals or aggressive oxidizing agents are currently required for anthrax decontamination. Thus, the project explores environmentally friendly methods of anthrax decontamination. Due to the extreme dangers of Bacillus anthracis, this experiment will substitute Bacillus atrophaeus spores, a common and frequently used anthrax stimulant.

 The decontamination method researched in this project germinates the Bacillus spores. This removes their environmentally stable cortex. Once vulnerable, the Bacillus is exposed to harsh environmental conditions. Experiments were performed to prove that concept in soils, liquids and on solid substrates. For the soil and solid substrate experiments, Bacillus atrophaeus spores were added to the materials. A germinant mixture was added to half of the tested materials. Then, they were all incubated in a dry incubator at room temperature. The lack of moisture was the environmental stress that the Bacillus were exposed to. For the liquid experiments, Bacillus atrophaeus spores were added to the liquids and they were allowed

to sit at room temperature. Each of these materials was plated every two to four days.

 The amount of colony forming cells was counted from the plates. This data found that the hypothesized method of decontamination was successful and could be extremely efficient when hybridized with other environmentally friendly decontamination methods or harsher environmental conditions.

Awards won at the 2008 ISEF

First Award of \$3,000 - United States Air Force

2008 - EV002

DETERMINING THE VERACITY OF THE MERV NUMBER OF PLEATED AIR FILTERS THROUGH METHODS OF OBSCURATION

Savan Mayan Dave
Stanton College Preparatory High School, Jacksonville, FL

The purpose of this project was to determine how well pleated air filters with different MERV numbers would remove contaminants from the air, based on the MERV number. The researcher choose three MERV numbers, MERV 7, MERV 8 and MERV 10. Four of each filter was brought and each was placed into 12 AC units, all that operated at the same time, as they were controlled from 1 location. Before the filters were placed the reasearcher took an initial reading of the filters. Then he placed each into the AC units for about a week and then returned and took another reading. The filter hypothesised to do the best, MERV 10, already was showing debris on hte sides by week two, a sign that it was removing most of the contaminants in the air. OT take readings the researcher had constructed two ciruits, one to emit light at a constant rate and another to read how much light was coming out. The Light Emmiting Circuit emitted a constant 100 ohms of light. The reading is in Ohms rather than candelas because the readings were taken using a cadium sulfide photoresistor. At the end of the five week period the final results showed that MERV 10 had infact removed the most from the air since its MERV readings compared to the other filters final readings was considerably lower.

2008 - EV003

THE EFFECT OF BIFENTHRIN ON PALAEMONETES PUGIO (GRASS SHRIMP) USING A FLOW-THROUGH SYSTEM TO TEST ECOTOXICITY

Jonathan Patrick Barnett
La Plata High School, La Plata, MD

Bifethrin is a pyrethrin class insecticide that is widely used in agriculture and is commercially available for home use. Very little research has been published regarding bifenthrin toxicity to marine crustaceans such as Palaemonetes pugio, which widely inhabit marine estuaries. Further, many of the studies that have been published employed a simple, constant-dose testing method that best simulates a static environment such as a small pond or lake. These static testing methods do not adequately simulate a flowing-water estuary such as a stream flowing into the Chesapeake Bay, or where a dose of toxic chemical is continuously diluted over time.

In this research, a novel, flow-through system with a constant flow rate and continuous toxin dilution was employed to determine bifenthrin toxicity to Palaemonetes pugio (Grass Shrimp) in order to more realistically simulate a natural, flowing-water environment. This research also determined the dose which is lethal to 50% of the test population (LD50) and lethal to 100% of the test population (LD100) in a specific timeframe using this flow-through system.

In this research, a known concentration of bifenthrin was injected into the 5-gallon flow-through test apparatus, with a constant water flow rate of 10 gallons/hour. This flow reduced the starting concentration by an estimated 50% (1:2 dilution) every 30 minutes. Using this method, an LC50 starting dose was determined to be 0.08 ug/liter (80 parts per trillion--PPT) within eight (8) hours. This dose was also determined to be 100% lethal (LD100) in thirteen (13) hours. Higher starting concentrations resulted in 100% lethality, within shorter time frames.

These results indicate that very small bifenthrin concentrations are highly toxic to Palaemonetes pugio. Even when testing in a flow-through system with constant dilution, an 80 PPT LD50 is lower than previously published LD ranges. It is clear from this data that very low doses of bifenthrin in water can have a dramatic affect on these crustaceans, which serve as an important component of the coastal marine ecosystem. This data also suggests the need for environmental monitoring for this insecticide, particularly in areas of agricultural use near marine estuaries.

Awards won at the 2008 ISEF

Scholarship Award of \$12,500 per year, renewable annually - Florida Institute of Technology

2008 - EV004

PHYTOREMEDIATION IN CONTAMINATED ENVIRONMENTS UTILIZING ASSISTED HYPER-ACCUMULATION PHYTOEXTRACTION

Steven Richard McCommon
Merritt Island High School, Merritt Island, FL

The scope of this year's experiment was to determine if phytoremediation was a viable solution for metallic contamination. With the use of assisted hyper-accumulation phytoextraction will be made plausible.

Two grow containers were created, fitted with light source, potting soil and equally spaced mustard and radish seeds. These were grown for one week until complete germination. After this initial growth period the plants were transferred to two pre-made hydroponic systems, one labeled humic and the other control. A 100 mL copper algaeicide solution was added to both systems which contained pumps circulating water past the root systems of the plants. The experimental hydroponic container labeled humic was fitted with a mixed solution of humic acid hopefully to assist in the hyper accumulation process. Over the course of the experiment stability measurements were taken such as nitrate, phosphate, ammonia and ph. The amount of copper was tested also throughout and after the experiment was complete a microwave digestion dry analysis was performed to validate the results.

Overall it seemed that the hyper-accumulators performed adequate phytoextraction and significantly reduced the amount of copper in the hydroponic systems. It also seemed that the humic acid system grew healthier plants with greater biomass thus explaining the increased copper absorption in this system.

This experiment proves that in order to alleviate ecosystems plagued with heavy metal pollution phytoremediation can be used along with a photosynthetic stimulant (humic acid) to serve this exact purpose and help make our environment more suitable for habitation.

Awards won at the 2008 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV005

ASSESSING THE IMPACT OF HUMAN METABOLITES OF ARSENIC ON SELENIUM METABOLISM USING E. COLI AS A MODEL SYSTEM

Daniel Kenneth Cook

Lake Highland Preparatory School, Orlando, FL

Arsenic is a toxic metalloid that contaminates drinking water and poses a significant environmental risk to humans. When consumed, it is metabolized to the methylated form, specifically monomethylarsonous acid (MMA(III)) and dimethylarsinous acid (DMA(III)). While studies demonstrate arsenic's carcinogenic nature, the specific compounds and molecular events that lead to carcinogenesis are not well defined.

 Recent studies suggest that selenoproteins created during selenium metabolism protect against oxidative stress and are thus vital to human health. It is believed that reduced amounts of selenoproteins can lead to increased levels of free radicals and reactive oxygen species. This research examines the impact of MMA(III) and DMA(III) on selenium metabolism using an Escherichia coli (E. coli) model system in order to better understand factors contributing to arsenic induced carcinogenesis and how selenium may be used to detoxify arsenic.

 Selenium metabolism pathways of E. coli are analogous to those in humans and can provide insight into the correlation between arsenic and selenium. Growth analyses were performed to compare relative growth of E. coli treated with varying combinations of arsenic and selenium compounds. A study of hydrogen gas production by the formate hydrogenlyase (FHL) complex was conducted as a measure of selenium metabolism activity. Radiolabeling experiments using isotope selenium-75 served as a quantitative measure of selenoprotein levels, specifically formate dehydrogenase (FDH-H).

 Results indicate that MMA(III) and DMA(III) block selenium metabolism and the biosynthesis of selenoproteins. Data collected using this model system suggests that selenium has the ability to reduce the toxicity of MMA(III) and DMA(III) in humans by binding with the arsenicals and converting them into a less toxic form. This innovative approach to studying metabolic pathways is critical to the development of a selenium drug treatment targeting the detoxification of long term environmental exposure to arsenic, thereby reducing the risk of developing arsenic induced cancer.

Awards won at the 2008 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV006

EFFECTS OF PESTICIDES ON OYSTER HEMOCYTE ACTIVITY

Gene Bonnette Rodrick

Oak Hall School, Gainesville, FL

Oyster production is an important global economic resource threatened by oyster mortality. The causes of oyster deaths are unknown but are hypothesized to relate to impaired immunity to bacteria and pollutants such as pesticides contaminating oyster estuaries. The oyster's immunity is dependent on hemocytes. Since the oyster has an open circulatory system, the oyster hemocytes may be influenced by the presence of pollutants such as pesticides in the seawater. The objective of this research was to investigate the effects of selected pesticides (imidacloprid, permethrin and fipronil) on oyster hemocyte activity by flow cytometry. Flow cytometry was used for monitoring the in vivo oyster hemocyte mortality and phagocytosis of Escherichia coli and Vibrio vulnificus in oysters acclimated at either 40C, 250C or 370C in 10/oo, 150/oo or 320/oo salinity at days 0, 3, 5, and 7 and challenged in vivo for 7 days with a mixture of pesticides, imidacloprid, permethrin and fipronil. Differences (p< 0.01) were demonstrated in oyster hemocyte mortality and phagocytosis activity towards E. coli and V. vulnificus in oysters acclimated with and without pesticides at 40C, 250C or 370C in 10/oo, 150/oo or 320/oo salinity at days 0, 3, 5, and 7. Pesticides were shown to significantly decrease (p< 0.01) oyster hemocyte mortality and the phagocytosis of E. coli. In vitro oyster hemocyte phagocytosis was dependent on the presence of oyster serum (hemolymph) and was decreased significantly (p< 0.01) when 150/oo artificial seawater or pesticide-treated hemolymph was substituted for normal hemolymph. In comparison to the in vivo pesticide exposure, in vitro pesticide exposure of oyster hemocytes significantly (p< 0.01) increased hemocyte mortality. Differences between in vivo and in vitro hemocyte mortality may be due to the oyster's ability to detoxify the pesticides. These results indicate that pollutants such as pesticides can influence the oysters' hemocyte activity and the preferential phagocytosis of E. coli by oyster hemocytes. Preferential phagocytosis of E. coli by oyster hemocytes may explain the high levels of V. vulnificus in oysters, which can be a threat to human health.

2008 - EV007

STUDY ON THE INFLUENCE OF MANGROVE RHIZOSPHERE ECOSYSTEM ON HEAVY METALS TRANSPORTATIONS IN ESTUARY SEDIMENTS

Qinhua Yan

Xiamen No.1 Middle School, Xiamen, Fujian, CHINA

Many tropical and subtropical estuaries are being contaminated by heavy metals while their naturally distributed mangrove forests take an important role in sediment reactions that greatly influence heavy metals mobility, nevertheless, possibility of phytoremediation by mangroves has not been taken into serious consideration.

 In this study, mangrove Kandelia candel's influence on heavy metals transportations and control in estuary mangrove sediments were studied. Low molecular weight organic acids (LMWOAs) in mangroves' root exudates were detected by high performance liquid chromatography (HPLC), and thin layer chromatography was used to analyze the effect of LMWOAs on heavy metals transportation.

 The results show that formic, succinic, malic and citric acids were dominant in exudate LMWOAs. The coefficients of transportation indicate that LMWOAs increase the heavy metals transport in sediment. The transport rate of heavy metals shows the following trend: Zn>Cd>>Pb, while their concentrations in different sediments show the following order: forest sediment>forest edge sediment > bare beach sediment. Heavy metals' concentrations were influenced by sediment's texture, organic matters, irons and manganese content and sedimentation dynamics. The quantity of clay obviously influences heavy metals concentrations in bare sediment. To inner forest sediment, organic matters influence the heavy metals concentration much more. Mangroves's rhizosphere effect on the physical and chemical characteristics of

heavy metals and obviously influence on heavy metal transport from terrestrial areas to oceans.

 This study will help provide theory evidence for phytoremediation and pollution control, and improve the conservation of mangrove wetlands through sustainable development of coastal ecosystem.

Awards won at the 2008 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation

2008 - EV008

THE RESEARCH ON THE REASONS OF SOIL, WATER, AND AIR POLLUTION IN GEORGIA AND THEIR CONTROL

Shalva Khokhashvili

Georgian-American High School, Tbilisi, GEORGIA REPUBLIC

I decided to write a research on soil, Water and Air Pollution because this topic is very rarely talked about and the quality of environmental pollution is one of the vaguest questions for Georgia. At first, I tried to collect some information about environmental problems, but I could not find any books related to this question in bookshop or in libraries. There was a lack of information even in Intel. I was beginning to think that no data existed on the pollution of environment in Georgia, when the Ministry of Environment and Natural Resources protection, Regional Ecological Center and Georgian Green Party agreed the help me in getting some books and gave reports made by them. Then the questions was hoe precise these data were because the information related to the same questions varied in different sources and few of these data, as I finally concluded included unacceptable errors. I consulted the staff working in the information, included in my research is unavailable to the public.

2008 - EV009

IMPACTS FROM BURNING AGRICULTURAL CROP STUBBLE

Alex Brendan Heeb

Heeb Home School, Chaffee, MO

year after harvest in Southeast Missouri a large percentage of the wheat and corn crop stubble is burned. This study examined possible health effects from the Particulate Matter < 2.5 µm (PM2.5) resulting from the burning of wheat stubble.

 A Data air monitor recorded PM2.5 levels from the burning of wheat stubble in Scott and Stoddard counties. Emergency room diagnoses at three hospitals in Southeast Missouri were obtained for each day of the burning season.

 Statistical ing showed that the three hospitals combined had statistically significant (p<.01) differences in number of emergency room visits resulting in respiratory diagnoses on days with PM2.5 levels > 25 µg/c bic meter of air as compared to days with PM2.5 < 25. The EPA 24ur PM5 standard is 3 µg/cu ic meter.

 Regression tests showstrong positive correlation between number of fields burned and PM2.5 levels (r =.80) A small positive correlation between PM2.5 levels and number of respiratory diagnoses was shown (r = .29). This low correlation could be due to people developing symptoms before PM2.5 values peaked.

 Apparently this is the first study to examine PM2.5 levels in a rural area from agricultural fires and the PM2.5 effects on visits to hospital emergency rooms.

 This study demonstrated an association between PM2.5 levels from wheat stubble burning and hospital emergency room visits for respiratory conditions. This study indicated that PM2.5 monitors are needed in Southeast Missouri, that Missouri should consider either regulating or banning agricultural burning, and that alternatives to burning need to be explored.

Awards won at the 2008 ISEF

Second Award of \$1000 - American Meteorological Society

2008 - EV010

THE INFLUENCE OF FISH COMMUNITIES ON DIURNAL HORIZONTAL MIGRATION OF DAPHNIA SPECIES IN DEEP PRAIRIE WETLANDS

Megan Marie Miller

Lincoln High School, Thief River Falls, MN

The purpose of this project was to examine the influence of fish communities on diurnal horizontal migration of Daphnia in deep prairie wetlands. Fifteen wetlands were sampled to get an overall picture of Daphnia population, using a vertical column sampler. Four specimens were collected in the near-shore habitats (NS) and three in offshore

 habitats (O).

The experimental hypothesis states if Daphnia species exhibit diurnal horizontal migration then Daphnia will be found near-shore in wetlands containing Planktivores (PL) and Benthivores (B) and off-shore in wetlands containing Planktivores, Benthivores and Piscivores during the day, Daphnia will be more prevalent in off-shore sites in both types of fish communities during the night. The hypothesis was accepted. Daphnia preferred near-shore habitats during the day in wetlands 216, 372, 374, 384 and 1001, which contain Planktivores and Benthivores. Daphnia could be found in off-shore sites during the day in wetlands 4, 16, 20, 22, 103 and 327, which contained Planktivores, Benthivores and predatory Piscivores. In both types of wetlands, Daphnia moved into the middle during the night hours. In wetland 302, Daphnia overwhelming inhabit the off-shore sites both day and night due to large Pl:PL ratio. Wetland 393, shows Daphnia mostly in near-shore habitats during the day. This wetland has a high abundance of Planktivores. Wetland 316, the fishless community, shows Daphnia throughout the wetland.

This experiment indicated that fish communities do affect migration patterns of Daphnia.

Looking at the affects of Daphnia migration could ultimately help water quality issues plaguing the world.

Awards won at the 2008 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation

Award of three \$1,000 U.S. Savings Bonds, a certificate of achievement and a gold medallion. - United States Army

2008 - EV011

CAN ELODEA BE USED AS A BIO-FILTER TO REDUCE CARBON DIOXIDE EMISSIONS?

Ariel Simone Winter
Nicolet High School, Glendale, WI

This experiment simulated the strategic placement of aqueous plants in areas with high concentrations of carbon dioxide, to ascertain whether Elodea may serve as a bio-filter to decrease carbon dioxide emissions. This experiment utilized infrared probes to measure plant response and photosynthesis levels in supersaturated closed environments. Four containers, each holding 26 elodea plants, were built with a series of disconnects in the lid, creating a closed system by using ¾- inch PVC piping and ball valves to prevent outside air flow. Four containers held the following: Control-water and carbon dioxide, container 1-water and elodea, container 2-water plus elodea plus carbon dioxide, and container 3-water and elodea and carbon dioxide and fertilizer. Supersaturation existed in 12-hour periods followed by a 12-hour rest period. Probes documented photosynthetic activity by using relative data for comparison of containers. This was done for a total of 11 days until plants died. Infrared probes were placed in biochambers and measured away from liquid to prevent distortion of data from sensitivity to liquid. Equilibration of aqueous and gaseous phases allowed for correlation of findings. Anoxia and increases in carbonic acid overwhelmed the plants, resulting in premature plant death. The oxygen data showed increased levels, correlating to increased photosynthesis. The data supported reasoning for elodea to be used as a bio-filter to decrease carbon dioxide. Closed system aquatic plants present many variables, which require additional instrumentation to monitor chemical change. Further research may prove invaluable in utilizing plants to offset harmful greenhouse gasses.

2008 - EV012

THE VIABILITY OF GREEN CLEANING: A QUANTITATIVE ASSESSMENT OF THE PHYTOREMEDIATION OF COPPER EFFLUENT USING LEMNA MINOR

Emily Felicia Schapira
Nicolet High School, Glendale, WI

Metal pollutants in industrial processed water and ground water are most commonly removed by precipitation or flocculation, followed by sedimentation and disposal of the resulting sludge. A promising alternative to conventional clean-up methods of contaminated groundwater is rhizofiltration, a phytoremediative technique in which aquatic flora hyperaccumulate heavy metals and remove pollution from aquatic ecosystems. This project was designed to quantitatively assess the viability of phytoremediation of copper effluent using the aquatic flora Lemna minor. Multiple trials were conducted exposing randomly assigned samples of Lemna minor to copper effluent at varying concentrations. Rhizofiltration was demonstrated by a decrease in the absorbance of light as measured by a colorimeter. Decreased light absorption was observed in treated samples of copper effluent at concentrations of 33 ppm (0.040 vs. 0.017, p<0.010), 67 ppm (0.080 vs.0.045, p=0.045), 100 ppm (0.120 vs. 0.053, p=0.024), and 133 ppm (0.165 vs. 0.130, p=0.045). The biological impact of rhizofiltration on the ecosystem was then evaluated by monitoring the heart rate of Daphnia magna exposed to the copper effluent samples. The heart rate of Daphnia magna increased when placed in copper effluent solutions. Exposure of Daphnia magna to copper effluent at 133 ppm for 20 minutes resulted in a heart rate increase of 125% in pre-treatment samples compared to 110% in post-treatment samples, indicating a decrease in environmental stress on the Daphnia magna after treatment. In conclusion, Lemna minor shows promising potential for the rhizofiltration of copper effluent from groundwater and the improvement of overall water quality.

Awards won at the 2008 ISEF

Scholarship Award of \$12,500 per year, renewable annually - Florida Institute of Technology
Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV013

TOXICITY OF AGRICULTURAL DITCH SEDIMENT TO HYALELLA AZTECA

August James Steigmeyer
Canterbury School, Fort Wayne, IN

The herbicide atrazine was widely used in agriculture prior to 1993. Its persistence in rural environments is of ecological concern due to its association with hormonal imbalances and disruptions of reproductive and developmental processes in laboratory animals. The purpose of this study was to determine possible adverse effects of atrazine on the amphipod, Hyalella azteca. Outcomes measured included reproductive output, growth rate, survivorship and sex ratios. Sediment samples were collected from 3 sites in the Cedar Creek watershed in Northeastern Indiana (AXL, BLG and CLG) and assayed for toxin concentrations. A control sediment sample was collected from a non-agricultural site outside this watershed. Sediment samples were placed in bioassay chambers which were then filled with processed water and stock populations of Hyalella azteca. Following 31 days of sediment exposure, the amphipods were removed, counted and placed in new containers devoid of sediment. After 7, 14, and 21 days, juvenile amphipods were counted for determination of reproductive rates. Following completion of the study, sex ratios and organism growth measurements were performed. Both survival and reproduction rates were lowest in BLG which strongly suggests the influence of one or more toxins. Although sediment atrazine assays demonstrated levels below the detectable limits of 0.02 ppm, water testing from the site revealed a concentration of 1.3 ppb compared with AXL (0.5 ppb) and CLG (0.00 ppb). This is strongly suggestive of multiple adverse effects of pollutants on Hyalella azteca.

Awards won at the 2008 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV014

CAVEMEN AND FIRE: A PROBABILITY SIMULATION ON THE IMPACT OF HUMAN-INDUCED FACTORS ON GLOBAL WARMING

Cesar A. Torres
Americas High School, El Paso, TX

Global warming is attributed to both internal and external factors; however, the rise of global temperatures has been most recently evaluated as an effect of human activity. This third-year project focuses on quantifying the overall contribution human activity has had on the overall retention rate of radiation specifically that contributed by CO2 production. The CO2 retention rate was determined utilizing a controlled system that had one fluctuating variable – the concentration of carbon dioxide. Heat was applied to the system and the rate of diffusion of the heat energy was calculated by dividing the overall change in temperature by time. Ninety trials were collected of which sixty-one were used for statistical tests that supported a relationship between the concentration of the carbon dioxide and the overall diffusion rate of the system with a negative slope. A level of significance of 0.01 was employed. Furthermore, a probability simulation involving the construction of multiple systems with abiotic and biotic features, a self-sustained environment, and a similar procedure involving fixated systems and variable CO2 concentrations were used. A matched pairs test was conducted with the conclusion that the retention rates differed. A table of values was obtained with an average net contribution of CO2 to the retention rate of eighty-five percent. Sources of error include the use of the simulated net retention rate that did not take into account the negative feedback mechanisms present that help control CO2 concentration. The overall probability of measurements explained by the data compiled was 0.0986 which could be greatly improved by larger sample sizes.

Awards won at the 2008 ISEF
Tuition Scholarship of \$120,000 - Drexel University

2008 - EV015
WHAT IS THE BEST WAY TO SOLVE ANOXIA IN WATER?

Dong Kyu Seol
Escola Americana de Campinas, Campinas, SP, BRASIL

My Science Fair Project for 2007/2008 was designed to find the best way to solve anoxia in water. Anoxia is a phenomenon that occurs in aquatic environments as reduction of Dissolved Oxygen in concentration to a detrimental point to aquatic organisms living in the system. Since lacking of dissolved oxygen in an environment is very harmful to organisms, such as fish, it is important to recover the reduced amount of dissolved oxygen. In order to find out the best way to solve anoxia by providing oxygen, I prepared 3 different models; providing oxygen, providing plant, and providing both oxygen and plant, as solutions. Oxygen was provided through electrolysis, and Elodea was a plant source of production of oxygen. In order to simulate the real condition most effectively, Betta was used to consume oxygen in water samples. Measurement of Dissolved Oxygen was recorded before and after the experiment to see the difference of amount of DO. According to result, providing plant is the best way to solve anoxia in water.

2008 - EV016
WHAT'S THE DIRT ON GROUNDWATER? A STUDY OF THE EFFECTS OF POLLUTED RUNOFF ON THE BACTERIAL CONTENT OF SOIL AND GROUNDWATER

Shivani Mangirish Gaitonde
James Madison High School, San Antonio, TX

This project modeled microbial transfer from various types of contaminated subsurface runoff into different agricultural soils and groundwater. The hypothesis stated that if contaminated runoff percolated through soils into groundwater, then field soil would retain the most bacteria and groundwater collected from sand would harbor the least amount of bacteria. Sand, potting soil, garden soil, field soil, old compost, and fresh compost were collected from above the Edwards Aquifer recharge zone. A baseline was set by measuring 10 g of each sample with 90 g of phosphate buffer. Samples were homogenized, set in SMA agar and LST broth to 104 dilution, and incubated. The plates were read with a Colony Counter, and the tubes were confirmed with BGB broth. Results suggested that LST was not needed for future tests. The groundwater recharge model was designed with PVC pipes, filter paper, and mesh netting. Runoff samples were created by inoculating tap water with contaminants. 200 mL of each water type were passed through the various soils and collected, along with the soils. These new samples were plated using the modified baseline procedure. All tests were repeated. The results partially supported the hypothesis: old compost, fresh compost, and garden soil retained more bacteria than field soil; however, groundwater from sand and potting soil did harbor the least amount of bacteria. The behavior of soils showed that textured soils held more bacteria, while finer soils produced groundwater with fewer bacteria. Future applications include preventing groundwater pollution, crop contamination, and hazardous agricultural practices.

2008 - EV017
NITRATE LEACHING: ASSESSMENT AND PREVENTION

Dharti Bhulabhai Bhakta
Elko High School, Elko, NV

The intent of experimentation was to prevent nitrate leaching by increasing denitrification rates for conversions to gaseous nitrogen. In order to accelerate denitrification, the activity of chemoheterotrophic denitrifying bacteria was stimulated with methanol and potential anaerobic treatments. Soils were also expected to achieve a balanced system of bacterial activity. During two three-week intervals, concentrations of nitrate runoff were determined by a Nitrate Ion-Selective Electrode. Denitrification were analyzed using measurements from NO3- and NO2- soil concentrations and NO and N2O draeger tube quantifications. Soil respirations tests suggested overall microbial health. Results revealed that stimulating the activity of denitrifying bacteria through methanol treatment reduced concentrations of leached nitrate while maintaining optimal microbial activity. Methanol-treated soils averaged a leached nitrate concentration of 176 mg/L and 126 mg/L compared to the control soils' average of 201 mg/L and 180 mg/L over the three-week trials. The aerator and porous soils averaged 191 mg/L and 197 mg/L respectively over the combined two trials. NO and N2O gas emissions of 0.5 ppm and 0.7 ppm were greatest in the

methanol-treated soils as a consequence of accelerated denitrification. The control, aerator, and porous soil groups averaged the same NO and N2O emissions. Soil respiration rates were nearly constant with every soil group.

An additional experiment was conducted to clarify results from this study. Nitrate leaching in soils of various concentrations of methanol was assessed. When compared with the control group, methanol groups reduced nitrate leaching and accelerated denitrification as molality became stronger.

Awards won at the 2008 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV018

THE HISTORY OF A RIVER AND ITS INFLUENCE IN OUR LIVES

Mateus Rockenbach

Fundacao Liberato Salzano Vieira da Cunha, Novo Hamburgo, Rio Grande do Sul, BRASIL

The river that bathes a city is a source of water for human consumption and industrial as well as being a choice of leisure, bringing benefits to the local population. Meanwhile, it has served as tailings deposit of industrial or household whose margins are inadequately cleared and occupied by man. Considering the significance of these issues and, given that the city of Feliz-RS-Brazil is bathed by the Rio Caí, raised up, the first chance that we can show the environmental changes that occurred in recent years and reflects the same on the behavior of population, but also the desires of the community regarding the future of the river and its use. The second hypothesis is that the preparation of a manual, which recovers the history of the Rio Caí and distribution of this material in the public schools and private, will allow the access to information that warn about the anthropogenic interference and its consequences. There has been research-descriptive literature and field, with a population of Feliz. After analysis of the data the chances were substantiated. It was found that the population off to the river, not using more for recreation and fishing, due to changes in its margins suffered and water quality. The people want and suggests changes, which will be realized with the efforts of the community. The public power, willing to cooperate, and the manual distributed to younger, as a way of warning, are the first steps for the rescue of Rio Cai the community of Feliz.

2008 - EV019

THE IMPACT OF SELECTIVE WEATHER PARAMETERS AND RAINFALL IN THE PROLIFERATION OF AMBIENT FUNGAL SPORES

Gabriel Jose Echegaray

Colegio San Ignacio de Loyola, San Juan, PUERTO RICO

The main purpose of this investigation was to find statistical relationships between selective weather parameters and mold growth. Airborne mold samples were taken on the roof of a suburban building using the Andersen Sampler equipment at intervals of four hours (12 am, 4am, 8am, 12pm, 4pm and 8pm) for a 7-day period. Mold spores were inoculated in Malt Extract Agars (MEA) to grow for five days. To record the weather parameters data, a Vantage Pro 2 weather station was used, which recorded rainfall, humidity, temperature, and wind speed at 30 minute intervals for a week.

 Statistical Pearson Correlation was made between mold growth and the different weather parameters individually. There was no definite relationship between rainfall and mold growth due to a low positive correlation, and a moderate and strong positive correlation between mold growth and humidity, temperature and humidity was found. These two correlations, humidity/temperature and humidity/wind speed may indicate that as one weather parameter raises the other decreases; alluding to the fact that as temperature increases humidity decreases, and that as humidity increases wind speed decreases. Nevertheless, the correlation of wind speed/temperature resulted in a strong positive correlation of 0.8, suggesting that when temperature rises, wind speed rises as well.

 The results clearly suggest that outdoor mold concentrations decreased during the higher temperature intervals of each day (4pm and 12pm), except in day 6 when a thunderstorm was recorded. In contrast, the lower temperature intervals of the day (12am, 4am, 8am and 8pm) showed higher mold colony counts.

2008 - EV020

LICHENS AS BIO-INDICATORS OF AIR QUALITY AND FORESTATION PATTERNS

Patricio Gabriel Martinez

Academia del Perpetuo Socorro, San Juan, PUERTO RICO

In this research, lichen's ability to serve as indicators of air quality levels and changes in forestation patterns within urban-industrial and semi-rural costal sectors was examined in order to establish significant differences between lichen coverage percentages due to air and soil conditions. Lichen colonies were identified and measured on each sector within up-wind and down-wind areas from thermoelectric plants through a grid-plot method to obtain coverage percentages for each sampled concentration. Aerial pictures of the studied sectors were obtained to identify areas with representative urban and vegetative areas within the range sampled. Results proved lichen's tendency to develop in areas where they are not directly impacted by atmospheric pollutants. The t-tests performed demonstrated an extremely significant statistical difference of 0.001 and 0.002 between the coverage percentages of the up and down wind areas within semi-rural and urban-industrial sectors, respectively. After relating lichen coverage percentages with EPA's air quality index pollutant values, it was determined that higher lichen coverage percentages exist in the urban-industrial sector studied which, according to EPA, has higher levels of pollutants on its atmosphere, yet below contamination standards, and lower levels of forestation. Lower lichen coverage percentages were observed in the semi-rural sector studied due to soil abuse over the past years. The higher concentration values observed evidence lichen participation in the natural reforestation cycle occurring within the urban-industrial sector sampled, establishing lichens as an ecologically and cost efficient sentinel for identifying atmospheric and soil conditions.

2008 - EV021

THE EFFECTS OF CAR TRAFFIC ON THE AMOUNT OF LEAD BEING DEPOSITED ON TIANJIN INTERNATIONAL SCHOOL, TIANJIN, CHINA

Ethan Alonzo Williams
Tianjin International School, Tianjin, CHINA

The purpose of this project was to test the amount of lead that was being deposited on the surface area of one square centimeter of a surface by using a spectrometer. I chose this project because of the living conditions of metropolitan cities is often polluted containing contaminants of many harmful molecules. I decided to test for lead that was distributed by passing vehicles and how much lead was being deposited on a daily basis. In order to test the variation of lead that was produced by the ongoing traffic I had to find an appropriate location with enough flora growth on which to test. When the appropriate location was found independent and dependant variables were set in place. In order to test the amount of lead produced each day certain areas of the bush were washed and similarly scrubbed until no lead was left on the leaf. The samples were collected over a period over a week. I took these samples and tested them for lead using a spectrometer at 520 nm. The results of the project proved my hypothesis correct, that lead was being deposited on the surface area surrounding the road by the passing vehicles. There was an exponential increase in the amount of lead that was being accumulating in a twenty-four hour time period. The data concluded that there was an average of a .37 variance in the absorption rate. The mathematics of this project also proves the increase of lead ppm.

2008 - EV022
THE EFFECTS OF ACID RAIN AQUATIC LIFE

Ji Yun Kim
Tianjin International School, Tianjin, CHINA

In the modern world, development of societies and industries has caused increased air pollution. The air pollution leads to acid rain, which is a major problem that pollutes bodies of water and contaminates aquatic life as well. This problem is especially serious in industrially developed regions. Tianjin is a very industrial city, with many factories and vehicles. Due to these factors, there is extreme air pollution and also acid rain. Living in Tianjin, such a problem as acid rain is something that is closely related to my own life. For that reason, I wanted to find out what effect acid rain has on aquatic organisms. For the observation, I made acid solutions in several different pH levels and monitored the microorganisms inside to see how the acid will affected them and their enviroment.

2008 - EV023
ASSESSMENT OF LAND USES EFFECTS ON THE WATER QUALITY OF RURAL AREAS IN SOUTHEAST BRAZIL

Victor Paolillo Neto
Colegio Sao Carlos, Sao Carlos, BRASIL

Considering the great importance of water to the various ecosystems in the planet as well as the degradation process to which the hydro resources have been exposed to, there is a need to find new ways to preserve the aquatic ecosystem and assure the maintenance of life. In this project an environmental diagnosis of three weirs situated in EMBRAPA Pecuária Sudeste (Brazilian Research Enterprise of Livestock and Agriculture of Southeast) and in ten springs located in Bom Repouso - MG farming area, both located on Southeast Brazil. In order to carry out this environmental diagnosis, physic, chemical and biological parameters of the water of this three weirs and ten springs were analyzed: temperature, pH, conductivity, dissolved oxygen, water transparency, nutrients, coliforms, metals and organ chloride pesticides as well as ecotoxicological tests, using Daphnia similis and Ceriodaphnia silvestrii, correlating the results to each different environmental impact. A protocol was applied to make a brief assessment of the habitat diversity in order to check the current conservation level of the weirs' and springs' ecological conditions establishing a relationship between the results and the different water surrounding land uses. According to the results, significant differences on the water quality were registered from each kind of land effect. In the evaluated systems, the variations among conductivity, pH, and dissolved oxygen were small although greater contents of nutrients was found in agricultural areas, especially with potato culture where fertilizers are largely applied on the soil and higher levels of coliforms was found in the livestock areas where animals are near to the water.

Awards won at the 2008 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV024
FOUNDRY SAND: WASTE OR BENEFICIAL?

Kayleigh Sue Warner
DeKalb High School, Waterloo, IN

The project is a result of experimentation using foundry sand and Blount soil mixture to determine optimal growth. The general belief of my community was sand exposed to chromium, manganese, nickel, and iron in the castings presented a danger to the community.

 To determine the levels of these elements I tested both. Using Atom Absorption Peckin-Elmer 2380 I was able to determine the sand had a lower amount of iron with 356 grams of iron per Kg of sand with a ±6.7 margin of error compared to soil with 1696 grams of iron per Kg of soil with a ±7.9 margin of error, a lower amount of chromium with .18 grams of chromium per Kg of sand with a ±0.006 margin of error compared to 1.6 grams of chromium per Kg of soil, a lower amount of nickel with 1.08 grams of nickel per Kg of sand with a ±0.02 margin of error compared to 2086 grams of nickel per Kg of soil with a ±0.031 margin of error, and a lower amount of manganese with 5.4 grams of manganese per Kg of sand with a ±0.03 margin of error compared to 38 grams of manganese per Kg of soil with a ±0.2 margin of error.

 The contributions are twofold. First by disproving the community belief the sand can now be used as fill. Secondly, by determining the correct Blount soil mixture crop production will increase.

2008 - EV025
USING THLASPI CAERULESCENS IN AN ALTERED PH ENVIRONMENT TO PHYTOEXTRACT CADMIUM FROM SEWAGE SLUDGE AUGMENTED SOIL

Jessica Lee Jackson
Eastern High School, Pekin, IN

Hyperaccumulator plant species are key to soil safety in useful phytoextraction technologies. Through this process of hyperaccumulation, plants can take up toxic metals through their roots and transport them to the leaves and stems. Then the plants can be harvested and the metals can be extracted (Barak, 1995). This project was designed to determine how pH levels in soil would affect *Thlaspi caerulescens*' phytoextraction of Cd and Zn, and to determine if phytoextraction and altered pH levels could be used as a solution to cleanse contaminated soil naturally. Soil was collected in Frankfort, Indiana based on the sites previously used in an Environmental Protection Agency (EPA) study completed in 1977. *Thlaspi caerulescens* and Swiss chard were grown on the sewage sludge augmented soil. The samples were tested using atomic spectroscopy to determine the amount of cadmium and zinc present in each sample based on wavelength and absorbency. The data ranged from 1038.0 to 1225.0 ppm of cadmium. The Swiss chard and the *Thlaspi caerulescens* plants all accumulated hazardous amounts of cadmium according to the Codex Alimentary Commission standards, which states that 4 ppm of cadmium in dry plant matter is hazardous for consumption. The pH of the soil did not seem to have an effect on the phytoextraction of cadmium. Student's t-Tests were conducted and all data was found to be significant except two zinc groups. Based on the data collected the hypothesis was partially supported.

2008 - EV026

NUMERICAL AND EXPERIMENTAL ANALYSIS OF A DIRECT SOLAR-TO-THERMAL ENERGY CONVERSION SYSTEM FOR THE TREATMENT OF WATER RESOURCES

Denilson Luz Freitas
Centro Federal de Educacao Tecnologica da Bahia, Vitoria da Conquista, Bahia, BRASIL

Most of the water available in northeast Brazil is improper for human consumption, and often becomes the only alternative for drinking water. One of the solutions adopted has been the drilling of artesian wells, however many of these present water with a high salinity index. This problem is faced with the installation of desalinizators by reverse osmosis, which implies in high production cost, high production of liquid reject and use of electric energy. Due to the increase in demand for desalinizators, in particular those that use solar energy, there's a need to use standard procedures to establish their technical features. Industry needs to know the working characteristics of the equipments produced in order to improve the planning of thermo-solar desalinizators. This research presents the results of a numerical and experimental analysis of a direct solar-to-thermal energy conversion system for the treatment of water resources. The experimental assays were carried out with artificial source for the sizing of the components and with natural source to determine the equipment efficiency. The solar desalinization equipment consists of two linked systems: Primary Heating System (PHS) and the Secondary Heating System (SHS). In PHS, saline water is preheated, contributing with up to 10% of the total energy required by full process and increasing desalinization flow of the equipment. In this system, desalinization occurs through the evaporation in the thermal reservoir. In the SHS the water is heated until its boiling point in the absorber pipe, where it is distilled by evaporation and boiling. The equipment produces no liquid reject. The outdoor assays were carried out in the town of Umbuzeiro dos Santos (13oS), and the methodology adopted was in conformity with ABNT NBR-10184; ASHRAE 93-77 and NBSIR 75-635 standards. From the results it was possible to determine these technical characteristics: global thermal efficiency of 47% and productivity of 4.5 l/m²h. The equipment has a final cost of \$80.00 and the price per liter of treated water is \$0.0005, calculated for 10 years of use. The treated water was analyzed and it was considered potable in conformity with the WHO standards.

Awards won at the 2008 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation
Third Award \$150 - Patent and Trademark Office Society

2008 - EV027

STUDY OF THE PLANKTONIC DIVERSITY AT PARANA'S COAST: A TOOL FOR BIOTIC INTEGRITY ANALYSIS

Lucas Marder de Oliveira Reis
Colegio Interativa, Londrina, Parana, BRASIL

This work aroused from the great interest in the marine environment and its fundamental importance for the maintenance of ecosystems all over the world. The marine environment has always been a reason of entertainment for many people and especially to the scientific community that is more and more concerned with the ecological misbalances in these regions, mostly originated through anthropic activity. The planktonic organisms are the basis of a trofic chain in the marine environment, besides being the main responsible for the oxygen renewal on Earth and excellent bio-indicators. This work has the goal of establishing, through collected data and identified organisms, an index of the Biotic Integrity for Parana's coast; making a taxonomic profile of planktonic organisms and establishing the richness and abundance indexes of the planktonic communities on the coast. Planktonic organisms were collected between August 4th and 5th, 2007 at the main Parana beaches, making a total of 15 collect points. For the collects a net for planktons with 45cm of entrance diameter and 200µm mesh was used. The collects were doubled and in each point there were two manual pushes of 2 minutes. The samples were fixed in 3% formaldehyde and analyzed on a stereoscopic microscope, to the class level. For the bio-diversity analysis, indexes as Shannon, Simpson, Margalef, equitability and Fisher Alpha were used. The results obtained showed a great difference in richness and abundance of the analyzed points, coinciding with the data of resort possibility showed for the 2008 Brazilian summer, also showing that most environments are not recovering from the impacts suffered during summer time.

2008 - EV028

PHOTOCATALYTIC REDUCTION OF HEAVY METALS: METHODOLOGY AND EFFICACY OF AN APPARATUS

Megan Moulding
Fremont High School, Plain City, UT

Heavy metal contamination from mining or industrial waste threatens aquatic systems. The process of using titanium dioxide as a photocatalyst has been previously established, however a process using a low-cost, feasible apparatus that did not introduce chemicals to the aquatic system was still needed. This project focused on the design, assembly, and use of an apparatus that used affixed titanium dioxide on a substrate with exposure to ultraviolet light (UV) to reduce water contaminated with copper II ions.

The apparatus involves a laminar flow of water over a titanium dioxide coated substrate, with recirculation to maximize exposure to the catalyst and UV light. Several substrates and adhesives were used to find the most effective combination. In addition, variables of the apparatus such as flow rate and flow volume were adjusted to maximize ion reduction. The most effective substrate and flow characteristics yielded results sufficient to reduce the threat to aquatic organisms. In trials lasting 4 hours, copper II ions were reduced from 5.99 ppm to 1.80 ppm. The control trials, involving UV exposure without titanium dioxide, reduced ions from concentrations of 6.23 ppm to 5.86 ppm as measured by an atomic absorption spectrophotometer.

The apparatus and methodology established in this project have potential as a solution to water contamination from light industry. The apparatus is small, inexpensive, and does not introduce additional chemicals to the system due to the affixed titanium dioxide.

Awards won at the 2008 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV029

THE SEQUESTRATION OF CARBON DIOXIDE FROM COAL-FIRED EXHAUST

Rachel Ann Bigos
Holy Name High School, Reading, PA

This project was born from my concern for the phenomenon known as global warming. Global warming is one result of increasing amounts of greenhouse gases, such as CO2, in Earth's atmosphere. Coal-fired power plants are major sources of CO2 released into the atmosphere.

 The purpose of this experiment was to study the effect of an atomized solution of calcium hydroxide and water on CO2 emissions. A device was modified to atomize an aqueous solution of calcium hydroxide directly into the coal-fired exhaust gas. The effect of the calcium hydroxide on the CO2 concentration was measured. The effluent was collected and examined for the presence of calcium carbonate (CaCO3).

 The experiment demonstrated that CO2 can be sequestered from actual coal-fired exhaust. A 0.1 molar solution of calcium hydroxide lowered the CO2 content of the exhaust gas by 31% and a 1.0 molar solution removed 66% of the CO2. A precipitate was found in the liquid collected from the drainage bucket indicating the presence of calcium carbonate.

 Developing methods to actively decrease the amount of CO2 in the atmosphere may be necessary to save the planet from the effects of global warming. The results of this study confirm that calcium hydroxide could be used to sequester carbon dioxide emissions from coal fired power plants.

Awards won at the 2008 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV030

EXHALING CO2: YEAR THREE

Joanne Kathleen Heslop
Northern Nevada Homeschool, Incline Village, NV

This study sought (1) to establish whether or not wildland fires affect carbon dioxide release rates from soils and (2) to determine what the rate of recovery is for carbon dioxide emissions from soil following a wildland fire. Ten wildland fires, occurring over a time spectrum of 13 years and located in regions surrounding Northern Reno and Verdi, were examined in the study.

 Testing was conducted by collecting burnt and un-burnt soil samples from each burn site. Collecting both burnt and un-burnt soil samples allowed for differentiation between the effects of wildfire on carbon dioxide release rates and natural, unaffected carbon dioxide release rates from soil. Each of the soil samples were tested within closed terrarium environments. The terrariums were incubated at a constant temperature of 279 K, during which time air samples were collected every 24 hours. All air samples were examined for CO2 content using an infrared carbon dioxide analyzer.

 The carbon dioxide release rates from each fire were formatted to take differences in the soil's organic matter into account, thus formulating an even platform by which to compare the different burns to each other. With the wildland fires which had been lower intensity burns, the soil which had not been burnt released more carbon dioxide than the soil that had been burnt. With the wildland fires which were higher intensity burns, the burnt soil released more carbon dioxide than the un-burnt soil. In both cases, the differences between the burnt and un-burnt soils' carbon dioxide release rates decreased with time.

Awards won at the 2008 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation

2008 - EV031

THE EFFECT OF PHARMACEUTICALS ON STREAM ECOSYSTEMS

Amatul Aziz Salma
Niles North High School, Skokie, IL

The purpose of this experiment is to measure the effect of caffeine on algal biomass (chlorophyll a and organic matter) and on the mortality and instantaneous growth rate of Gammarus fasciatus. Caffeine is a pharmaceutical product and has been measured in rivers. To measure its effects, twenty four artificial streams with different concentrations were prepared. It was predicted that invertebrate mortality would increase and growth would decrease, which may lead to an increase in algal biomass; this was the same for the streams without invertebrates. First, algae was scraped from stream tiles and filtered to obtain organic matter (ashing process) and chlorophyll a. For invertebrates, small-flow through containers were prepared. The containers included invertebrates (whose initial

lengths were obtained) and a food source. After seventeen days, the containers were removed. Then, mortality and final lengths were recorded. Overall, caffeine showed an increase in algal biomass, though there was no clear treatment effect at all which may have been due to stream activity. Also, it had a negative treatment effect on invertebrate growth rates and mortality.

2008 - EV032

THE RISE IN OCEAN ACIDITY: NO BASIC SOLUTION

Kara R. H. Dastrup
Kapa'a High School, Kapa'a, HI

Since the start of the industrial revolution, carbon dioxide emissions have skyrocketed to never before seen levels. Research shows that the more CO2 in the Earth's atmosphere, the higher the atmospheric temperature. Research also tells us the more CO2 absorbed by the ocean, the more acidic the ocean water. This acid that forms when CO2 bonds with water, known as carbonic acid, eats away at calcium carbonate. Many oceanic creatures' shells and homes as well as coral reefs are made out of calcium carbonate.

 This raised the following question: Does increasing water temperature, without increasing CO2 concentration, result in changes in the ocean's acidity?

 Salt water samples were created with a pH varying between 8.2 and 8.0 (average ocean pH) and dry ice (CO2 in solid form) was dissolved in these samples, thus creating carbonic acid. The solutions were heated, and the pH was measured at 5°C increments. The results proved the hypothesis. When water temperature is increased, the salt water becomes more acidic.

2008 - EV033

MEASURING POLLUTANTS WITH BIOLUMINESCENCE

Leah Victoria Schecter
Spruce Creek High School, Port Orange, FL

This project investigated the effect of IMAGE pesticide on the duration of the bioluminescence of the dinoflagellates *Pyrocystis fusiformis*. The bioluminescence of this organism is an indicator of its overall health, so if the light is bright, the organism is healthy. If the light is weak, then the organism is unhealthy. This project was testing if the duration of the bioluminescence, as well as its intensity, can also be an indicator of water toxicity. To conduct the experiment, 30 vials (3mL each) of dinoflagellate-filled, pure saltwater were ordered from Sunnyside Sea Farms. They were kept under a strict circadian rhythm, and then .005 mL of IMAGE pesticide was added to each of 15 vials after a week. This group was the pesticide group, and the remaining 15 were the control. The main active ingredient of this pesticide is Atrazine, the most commonly used pesticide in the US, and a chemical that causes harm to humans and animals alike. The vials were then tested over a period of 4 days by vortexing each vial for 3 seconds to stimulate the bioluminescence while operating a timer. Once all lingering light faded, the timer was stopped. The results showed that there was a significant decrease in the duration of bioluminescence over the 4 days in the pesticide group, despite some variability in the data. In conclusion, the duration of bioluminescence can indicate toxicity, and IMAGE pesticide, containing Atrazine, in even miniscule amounts is very detrimental to dinoflagellates, and could therefore affect whole ecosystems.

2008 - EV034

EVALUATION OF ECONOMICALLY FEASIBLE METHODS OF ARSENIC REMOVAL IN AREAS OF UNDERDEVELOPED INFRASTRUCTURE

Matthew Samuel Chorost
Moore High School, Moore, OK

This project looks at arsenic removal methods that are both effective in their application and economically feasible. Removal items included sand, wood charcoal, activated carbon, iron nails, granular ferric oxide, and calcium oxide. First, the treatments were tested individually. Then, substances were combined together based on performance in trial one to see if there could be an increase in effectiveness. I mixed removal methods with sand and/or coal to see if they were able to be improved. Results showed that mixing removal substances with fine sand and the wood charcoal increased effectiveness without increasing price. Also, it showed that concentration of arsenic was not a significant factor. When the cost was calculated, it was found that using CaO for removing arsenic was effective in that it removed almost all of the arsenic with only two grams at about 3 cents per gram. The nails, GFO, and carbon were all very effective but due to large quantities required they are not good candidates. Still, when all of them were mixed with the sand and coal, at no additional cost, and significant amounts of arsenic were removed with less of the substance. In conclusion, this project was able to prove that mixing arsenic removal methods can be an effective way to increase the effectiveness without increasing the cost, and in some cases reducing the cost.

2008 - EV035

EFFECTIVE FORMALDEHYDE TESTING OF PARTICLEBOARD IN COMPARISON TO THE STANDARD EPA LEVEL

Brianna Maria Arendt
Hamilton High School, Chandler, AZ

The experiment was designed to study the levels of formaldehyde emitted from particleboard, mimicking the conditions of the Bay St. Louis region in Missouri, in comparison to the standard EPA levels. The hypothesis is, under hot and humid conditions created, levels of formaldehyde will be emitted using freshly pressed particle board. Levels of formaldehyde emitted will surpass the standard EPA levels, proving that particleboard used in homes and other industrial projects is dangerous due to formaldehyde emitted in humid regions. The levels of formaldehyde in particleboard were determined using an environmental chamber and formaldehyde monitor. Water in levels of 80 and 130 mL were placed in the environmental chamber with a piece of particleboard. A fluorescent light built into the lid, to generate the humid environment. The formaldehyde monitors were researched by Advanced Chemical Sensors, Inc. in Boca Raton, Florida. The second phase of the experiment, tested a polyurethane coating and Kilz sealer/primer on the particleboard to determine if there is a reduction in the level of formaldehyde emitted. The summary of the data showed that without the coatings the level of formaldehyde greatly exceeded the standard EPA

level by 286% for 80 mL and 382% for 130 mL. However, with the polyurethane and Kilz primer/ sealer coatings the level of formaldehyde was greatly reduced to 20%, 32%, and 57% above the standard EPA level. The hypothesis was supported. Future research includes adding more layers of the primer/ sealer to determine if it would reduce the formaldehyde level even more.

2008 - EV036

WASTE ANTIBIOTICS: WASTE WHAT?

Kalli Nicole Davis

Blevins Junior High, Fort Collins, CO

Researchers have found alarming levels of antibiotics in agriculture waste water run-off and municipal waste water. Two of the most common wasted antibiotics are Keflex and Azithromycin. A previous study estimated the concentration of antibiotics in municipal waste water to be 9,200(ng/L). With all of these antibiotics contaminating our water, we need to see the effect it has on plants.

 My study tested the effect of Azithromycin and Keflex on Pelargonium x crispum minor or fingerbowl lemon scented geranium. I gave plants A1, A2, and A3 5cc of the Azithromycin suspension each night. The suspension was at a concentration of 2,500mg/L (2,500ppm).I would then give C1, C2, and C3 5cc of the Keflex suspension. The Keflex suspension was at concentration of 2,500mg/L (2,500ppm). I would then give plants CO1, CO2, and CO3 5cc of filtered water per night.

 The conclusion to my project was Azithromycin and Keflex do affect the growth rate of Pelargonium x crispum minor. The Keflex and Azithromycin made the growth rate of the Pelargonium x crispum minor increase. However, the plants on the Azithromycin and Keflex began to die towards the end of the study. Hopefully we can find a solution to this problem in the near future!

2008 - EV037

WATER SOURCES AND POLLUTION: A RELATIONSHIP?

Zachary Christopher Wanersten

Seckman Senior High School, Imperial, MO

This experiment was done to broaden my knowledge on the study of water pollution. My question was: Does the type of water source dertermine the amount of pollution that water can hold befor it becomes unsafe. A hypothesis was made that Kincaid Lake would be able to hold the most pollution before becoming usafe. The other two water sources were the Meramec River and a nearby pond. The methods used in the experiment were to first, collect water from the three water sources that were being tested. Second, test the litmus paper on distilled water as a control. Then, do ten trials on each of the water sources. In order for these trials to be done, the water samples have to be filtered by coffee filters. The, two hundred milliliters of one of the water samples was put into a glass cup. After that, one milliliter of HCl is added to the sampl every thirty seconds until the pH level readed four. Test th ewater each time that a milliliter of HCL is added to the sample. Tepeat this process ten times for each water source, average the trials together, and record the data. The results of my experiment show that the hypothesis was not supported. The Lake held and average of 3.0 milliliters of HCl. The River held and average of 6.4 milliliters of HCl. And finally, the pond held an average of 3.3 milliliters of HCl.

2008 - EV038

MODELING THE TOXIC EFFECTS OF SILVER NANOPARTICLES UNDER VARYING ENVIRONMENTAL CONDITIONS

Joyce Sophia Chai

Palos Verdes Peninsula High School, Rolling Hills Estates, CA

Over 25 percent of the nanotechnology consumer market contains silver nanoparticles. However, the obscurity of the associated environmental risks necessitates the development of a reproducible assay to quantify the toxicity of nanosilver. Phase I of this investigation included preliminary experiments to determine the optimum conditions for the bacterial toxicity assay. In Phase II, the development of a high throughput method quantified the toxicity based on ratios of the fluorescence intensity of live to dead cells (green : red fluorescence intensity). Toxicity was redefined as the percentage of cells that died in excess to that of its natural death. The percentage of dead cells was determined from the live to dead ratio. This novel technique established a positive logarithmic association between the various concentrations of nanosilver and its resultant toxicity on model environmental bacteria, Pseudomonas putida and Bacillus subtilis; as concentration increases, toxicity increases at a logarithmic rate. In Phase III, a practical application of a silver nanoparticle water filtration system revealed the passage of nanosilver through a 1-micron filter into the filtered waters. This may, in turn, come into indirect or direct contact of the environment and continue to induce toxic effects in the environmental surroundings. This investigation not only showed that a nanosilver concentration as low as 1- micromolar can induce approximately 50% death of surrogate environmental bacteria, but it also revealed the potential risks of using consumer products that contain silver nanoparticles. Furthermore, this investigation took fundamental steps toward understanding and quantifying the potential environmental consequences of nanotechnology.

Awards won at the 2008 ISEF

First Award of \$3,000 - Environmental Sciences - Presented by Intel Foundation

Tuition Scholarship Award in the amount of \$8,000 - Office of Naval Research on behalf of the United States Navy and Marine Corps

2008 - EV039

DEVELOPMENT OF BIOSENSORS FOR DETECTING HAZARDOUS CHEMICALS

Natalie Saranga Omattage

The Mississippi School for Mathematics and Science, Columbus, MS

Food additives contaminated with cyanuric acid and melamine were responsible for recent deaths of many pets. Food imports are currently being screened using chromatographic and mass spectrometric methods (e.g. HPLC & GC-MS/MS). Although these methods are very sensitive, the instruments as well as the reagents are expensive and require highly trained personnel to operate. A recombinant M13 bacteriophage library was screened to identify peptide sequences with high affinity to cyanuric acid and melamine. Amino acid sequences STNFFYQTFAFH and RNSNHTAYGEEP were identified as the consensus sequences specific to cyanuric acid and melamine, respectively. Quartz crystal microbalance (QCM) based biosensors were developed using these peptides. Although cyanuric acid binding peptide demonstrated better mass accumulation rates than the melamine binding peptide, both peptides were capable of detecting their respective ligands at concentrations as low as 1.25 parts per billion (ppb) during the first five minutes of the experiment. Cyanuric acid and Melamine binding peptides coupled to a gold binding peptide sequence are currently being developed to increase the peptide density and sensitivity of the assay. Biosensors with synthetic peptides could decrease the detection limit to picomolar concentrations of the ligands. QCM instruments are portable, cost much less than GC-MS setups, and do not require highly trained personnel to operate. Therefore, QCM based biosensors may be used at ports and warehouses to more thoroughly screen food additives imported into the United States. In addition to food contaminants, the QCM based biosensors may also be employed to detect other harmful chemicals.

Awards won at the 2008 ISEF

Scholarship Award of \$5,000 and 10-week summer research experience. Total value is \$10,000 - Department of Homeland Security, University Programs Office
A Scholarship of \$50,000. - Intel Foundation Young Scientist Award
Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by Intel Foundation
Second Award of \$1,500 - United States Air Force

2008 - EV040

EFFECTS OF IMIDACLOPRID ON OLIGOCHAETES

Austin T. Butler
American Fork High School, American Fork, UT

My project was a study of the effects of the insecticide Imidacloprid on Oligochaetes. Imidacloprid is used in the eradication of the Japanese Beetle and I hypothesized that using the Imidacloprid would prove to be extremely lethal to Oligochaetes. To conduct this experiment I set up a decomposition test and a soil test. For the decomposition test I had the worms attempt to compost grass which had been exposed to Imidacloprid and I also had a control group which composted grass free of the insecticide. For the soil test I administered the Imidacloprid directly to the soil at levels ranging from ½ Parts Per Million levels to 4 Parts Per Million.

After collecting data, I compared that from the decomposition test to the control group, and that from the soil test, among the other levels of insecticide which had been administered. I ran multiple trials of each test, and the data was similar. My experiment proved my hypothesis right, that Imidacloprid is extremely lethal to earthworms even at extremely small levels.

2008 - EV041

ARE MARNE BIODEGRADABLE THERMOPLASTIC POLYURETHANES SAFE? AS MEASURED BY ARTEMIA SALINA TOXICITY & LYTECHINUS VARIEGATUS EMBRYO DEVELOPMENT

Carter Henry Londagin
Grove High School, Grove, OK

The purpose of this experiment is to test for toxic effects of Thermoplastic Polyurethane (TPU's) on aquatic life.

It was hypothesized that: TPU's would not be toxic to brine shrimp nor would it effect the development of sea urchin embro development.

Controls of sea salt were used in both tests. For the TPU solutions, TPU was placed in sea salt (.75g/100ml) for 20 days. The plastic in solution was agitated daily. At the end of 20 days, the solution from the TPU was used in these concentrations: 100%, 50%, 25% and 10% to test toxicity of brine shrimp and sea urchin embryo development.

The hypothesis was rejected. Toxic effects were shown with brine shrimp, showing typical trends with more toxicity in the 100% and the least toxic at 10%. All test solutions had higher toxic effects as compared to the control.

A student t-Test was done to test the probability of the hypothesis being supported. The statistics supports the results. The toxic effects of especially the higher TPU concentrations were supported statistically.

2008 - EV042

USE OF INDUSTRIAL ORANGE WASTES TO IMPROVE ELECTROKINETIC REMEDIATION OF LEAD CONTAMINATED SOIL

Emily Alyse Dellwig
Blue Valley North High School, Overland Park, KS

In today's society, environmental pollution is constantly increasing. Utilizing an organic waste product to improve collection and removal of soil pollutants would provide an environmentally friendly soil remediation method that does not rely on the use of synthetic chemicals. It is expected that waste byproducts from the orange industry can be used to enhance electrokinetic remediation of lead contaminated soil. Specifically, it is predicted that the citric acid in orange waste will enhance electroosmosis of the metal ions in the soil as well as make the lead compounds more soluble. It is also anticipated that a Saponified Orange Waste gel (SOW gel) "sleeve" around the collecting electrode can be designed such that lead ions migrating to the electrode can be adsorbed and removed. Citric acid in the form of orange juice was added to lead contaminated soil to increase the migration and the solubility of the lead compounds during the electrokinetic remediation process. The addition of orange juice to the contaminated soil resulted in greater removal of lead. The anode surrounded by SOW gel absorbed the migrated lead ions and significantly improved the electrokinetic remediation of the contaminated soil.

2008 - EV043

EFFICACY OF A RADON PUMP AT MITIGATING BACKGROUND RADIATION LEVEL

Andre Sebastian Gerner
George C. Marshall High School, Falls Church, VA

Radon gas is a naturally occurring radioisotope purported to account for more than half of all human radiation exposure. Due to the controversy surrounding residential applications of Radon mitigation, this experiment was conducted to scientifically determine if the Radon pump in my house caused a statistically discernable reduction in the level of background radiation in my basement. To measure the background radiation, I interfaced a Geiger counter with a microcontroller to engineer a data logger. I programmed the data logger to record the number of counts of ionizing radiation during 10 min data intervals, collecting data for several days at a time. I used Student's t-test within the framework of hypothesis testing to determine if there was a statistically measurable difference in background radiation between the steady-state pump on baseline and the pump-off average. With greater than 99% confidence, test results supported the alternate hypothesis that with the Radon pump turned off; there was a discernable increase in background radiation level of up to 12% beyond the nominal pump-on level.

Awards won at the 2008 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by Intel Foundation

2008 - EV044

POEA IN THE ENVIRONMENT, YEAR TWO: TOXIC EFFECTS OF POEA ON EISENIA FOETIDA IN A PLAYA LAKE ECOSYSTEM

Jayton Lewis Rainey
Slaton High School, Slaton, TX

Polyethoxylated tallowamine (POEA) is a surfactant and an inactive ingredient used in a common herbicide formulation to control weeds in crop production. In the Texas High Plains, where cotton is produced, there are small water bodies called playa lakes. Farming special herbicide-tolerant cotton and repeatedly spraying the herbicide in this area is affecting the playa lake ecosystems. Eisenia foetida, the earthworm, is an important species in this ecosystem.

In this study, Eisenia foetida was used to examine the lethal and sub-lethal toxicity of five polyethoxylated tallowamine (POEA) concentrations consisting of 10, 100, 1000, 10000, and 100000 mg/kg soil. A soil avoidance test showed 100000 mg/kg was the most acutely toxic with 85% soil avoidance and 100% lethality. Using the Organization for Economic Co-operation and Development (OECD) guidelines for testing earthworm acute toxicity, changes in weight, length, and lethal concentrations (LC50) at 7 and 14 days were determined. Worms gained weight (mg), however, the stronger the concentration the less weight they gained by 15%. Worms decreased in length (cm), and the stronger the concentration the shorter they were by 22%. At day 7 the LC50 value was 23281.61 mg/kg, and at day 14 the LC50 value was 19453.29. Therefore, it is conclusive that there are lethal and sub-lethal toxicity effects of POEA on Eisenia foetida.

2008 - EV045

FURTHER INVESTIGATION OF DIATOMS AS BIOLOGICAL INDICATORS OF PHARMACEUTICAL RUNOFF

Ronit Batya Roth Abramson
Canyon Crest Academy, San Diego, CA

Pharmaceuticals have been detected in bodies of water worldwide and pose significant threats to the environment and human health. Antibiotic runoff is an especially hazardous aquatic contaminant due to the sensitive use of these drugs as antibacterial agents and the threat of developing resistance. Current uses of abiotic indicators to detect pharmaceuticals are costly and tend to be less sensitive to cumulative changes in environmental conditions. Diatoms are very sensitive to changes in water quality. They also provide an important link between the various levels of the aquatic food web. Therefore, diatoms are ideal as bioindicators, providing vital information regarding the biological veracity of the ecosystem and factors likely to be causing changes. In order to investigate the potential of diatoms as bioindicators of antibiotics in aqueous environments, a study utilizing five diatom species isolated from the wild (Mayamea atomus, nitzschia palea, two nitzschia species, and a navicula species) was conducted. Each of the five species was grown in separate cultures with one of three common antibiotics (ampicillin, tetracycline, and kanamycin) at concentrations of 7, 22, 67, 200 micrograms/mL. After seven days of exposure, samples were viewed using scanning electron microscopy for observation of morphological changes. Nitzschia palea exhibited changes in raphe and punctae structure, likely due to an interrupted silica deposition process on the frustule surface. These findings suggest a new technology for widespread detection of pharmaceuticals in waterways worldwide and increase the awareness of water conservation, pharmaceutical management, and public health concerns with regard to pharmaceutical runoff.

Awards won at the 2008 ISEF
Tuition Scholarship of \$120,000 - Drexel University
Second Award of \$1,500 - Environmental Sciences - Presented by Intel Foundation
Third Award of \$250 - North American Benthological Society

2008 - EV046

MOTOR BOAT WAKES AND RIVERBANK EROSION

Marcel Williams
Savannah Arts Academy, Savannah, GA

Many studies of riverbank erosion acknowledge the impact of motorboats, yet they do not provide a method for measuring waves created exclusively by motorboats. The purpose of this project is to demonstrate that erosion of riverbank soil caused exclusively by motorboat wakes occurs and can be measured in

a relatively quick time frame. My hypothesis was that if riverbank soil is contained above the waterline within a floating apparatus and exposed to waves caused by motor boat wakes, then it will experience greater erosion than soil in an identical apparatus placed in a location not subjected to rapid motor boat traffic.

Two test units were deployed at each control group and test group site. Two methods of measurement were employed: the decrease in the height of the soil inside each unit and the decrease in the weight of soil. The test group experienced an average decrease in height of 18.75mm (10.42%) and an average decrease in weight of 142.5g (7.13%), compared to respective decreases of 3.25mm (1.80%) and 33.5g (1.67%) for the control group. These results suggest that my hypothesis was correct. Conducted over three 7-day periods, this experiment further demonstrates that short-term studies of erosion are feasible.

Awards won at the 2008 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV047

THE EFFECT OF CACTUS MUCILAGE ON THE IRON CONCENTRATION LEVEL IN WATER

Sydney Ellen Yarbrough

Mayo High School for Math, Science, & Technology, Darlington, SC

The cactus most common to the United States is the platyopuntia branch of the Opuntia phaeacantha, also known as the “Prickly Pear” cactus. The mucilage (the center of the cactus where the water and nutrients are located) of this particular cactus was recently shown to effectively lower the arsenic levels in drinking water in Mexico. Although extremely hazardous, arsenic is not a very common element found in water in the United States, however, iron contamination is a very common occurrence worldwide. Seeing that cactus mucilage effectively lowered arsenic levels, there was reason to assume that it could possibly lower other metal contaminant levels as well. An experiment was performed by obtaining a leaf of Prickly Pear cactus, boiling it to liquid solution form, and mixing it with an Iron III Nitrate water solution. After all treated sample iron levels were tested and compared against the control, and the data was collected, a student T-test was performed using the results of the iron level readings. With a p-value result of less than .0001, the null hypothesis was rejected, indicating a change, and therefore indicating that cactus mucilage was effective at lowering iron levels, in addition to lowering arsenic levels in the earlier published study.

2008 - EV048

THE PHYTOREMEDIATION OF AQUAPONIC WASTEWATER WITH HYDROPONICALLY CULTIVATED VEGETATION

Manpreet Kaur Brar

Liverpool High School, Liverpool, NY

Aquaponics is a bio-integrated system that links recirculating aquaculture with hydroponic plant production in a sustainable way. Each system supports the other because the fish waste which is the result of aquaculture becomes the nutritious, organic nutrient water for the plants in the hydroponics component. The nutrients that are generated from fish manure, algae, and decomposing fish feed, are contaminants that would otherwise build up to toxic levels in the fish tanks, but instead serve as liquid fertilizer to hydroponically grown plants. In turn, the hydroponic beds function as a biofilter stripping off ammonia, nitrates, nitrites, and phosphorus, so the freshly cleansed water can then be recirculated back into the fish tanks. This project compared the performance of an aquaponics system to a hydroponics only system. The tested hypothesis was that the aquaponics system would perform better than the hydroponics system in that it would produce better quality and quantity vegetables (biomass). After experimentation, the results varied from the hypothesis. The aquaponics plants grew a little taller than the hydroponics plants but the leaf count for all the plants were very similar. Aquaponics plants showed at statistical difference in height, there was no difference in leaf count. In conclusion, this experiment showed that both systems are very similar. The advantage to the aquaponics system is that in addition to vegetation fish can be raised simultaneously. The waste generated from the rearing of fish can be used in a sustainable system which could reduce waste entering the environment.

2008 - EV049

DETERMINATION OF 17BETA-ESTRADIOL AND ETHINYLESTRADIOL CONTAMINATION IN THE AMBIENT WATER SUPPLY OF SARASOTA, FLORIDA

Hannah Bergan Kates

Sarasota High School, Sarasota, FL

In recent years, endocrine disrupting compounds in the nation's water supply have become a major concern. When consumed in excess, these compounds impact the functions of natural hormones in animals, affecting reproduction, development, and behavior in humans and other organisms. Environmental exposure to estrogens, especially ethinylestradiol and 17BETA-estradiol, is of great interest. Ethinylestradiol is a synthetic strain of estrogen used in oral contraceptive pills. These specific estrogens are the most common forms found in drinking water, and they are being discovered in increasing concentrations.

The researcher collected different kinds of water samples from multiple locations around Sarasota County in Florida: city-provided drinking water, well water, surface water, non-potable treated wastewater. The researcher used a SPE and HPLC-UV method to determine the presence and concentration of these estrogens by comparing retention times and percentage of overall area under peaks to that of the standards. Estrogen was found in all collected water samples.

2008 - EV050

WILL AMERICANS BECOME CORNHUSKERS?

Nyzel Jhamahl Williams

Pine Bluff High School, Pine Bluff, AR

This study samples and analyzes soils in each field plot for Nitrogen(N), Phosphorus(P), and Potassium (K) nutrients to check for best yield results between and the four varieties of sweet corn as well as nutrient uniformity between plots. The experiment was established in a randomized complete block design with four varieties of sweet corn:(1) A&C844BC, (2)Devotion, (3)Obsession,&(4) Passion replicated four times. Each plot consisted of four rows, 30 inches between rows and 25 feet long. The application and herbicide were applied to each plot. The plots were thinned to two plants per row per foot. Top dress nitrogen was applied twice to each row at intervals of two weeks. Furrow irrigation was applied four times. Dates of mid tassel and mid silk were recorded for each plot. Soil samples were collected from each plot. Ears were harvested for yield determination. The average marketable ear yields for A&C, Devotion, Obsession, and Passion were 50.8, 32.0, 50.8, and 48.0 per 1000 square feet, respectively. The ear lengths were not significantly different between the various varieties and the equality ranged from very good to good. Soil Analysis results from samples taken from each individual plot show that average Nitrate Nitrogen ranged from 30.5 to 38.0 pounds per acre. Phosphorus across replications ranged from 72.0 to 89 pounds per acre. Potassium replication averages ranged from 210.0 to 223.0 pounds per acre. In conclusion, Obsession proved to yield the most productive and the field nutrients proven to be fairly uniform.

2008 - EV051

STUDYING EFFECTS OF NATURAL ENEMIES ON SURVIVAL OF MONARCH BUTTERFLY LARVAE (DANAUS PLEXIPPUS) TO AID IN MONARCH CONSERVATION

Emily Anne Nimmer
Breck School, Minneapolis, MN

Monarch butterflies (Danaus plexippus) are part of a delicate ecosystem. Given that monarchs face habitat destruction and climate change, understanding natural factors, such as predation and parasitism, is becoming increasingly important. I monitored predation of monarchs in Falcon Heights Park, MN, over a period of 12 weeks and surveyed parasitism of monarchs in three study sites in Minnesota and Wisconsin. Predation results showed that aphids and herbivory are significant factors that influence mortality rates of monarch eggs and first-instar larvae. Past studies showed that predation could be indirectly monitored by monitoring aphids and herbivory. Therefore, my results suggest that predation is a significant factor that influences mortality rates of eggs and first-instar larvae. Predation results also showed that out of approximately 350 eggs that an adult butterfly lays in her lifetime, only 3% survived to the third-instar stage. Parasitism results showed 4% of larvae collected were parasitized in 2007 versus 7% in 2006; however, sample sizes were not large enough to statistically analyze.

My study contributed new information on survival rates of monarch eggs and first-instar larvae due to predation. More importantly, my study showed that only 3% of monarch larvae survive to the third-instar stage. This low survival rate suggests that unnatural causes of monarch mortality may severely threaten monarch butterfly populations.

Awards won at the 2008 ISEF
First Award of \$1,000 and a plaque - American Veterinary Medical Association

2008 - EV052

MACROINVERTEBRATES AS WATER QUALITY INDICATORS IN THE CHICAGO RIVER, YEAR II

Eva Ruth Feldman
Lincoln Park High School, Chicago, IL

This project studied how populations of aquatic macroinvertebrates varied at five test sites along the North Branch of the Chicago River, a natural river, and the North Shore Channel, an artificial channel dug to carry Lake Michigan water and treated sewage. Two sites were on the North Branch; two were on the North Shore Channel (one upstream of a sewage treatment plant, the other downstream); and one was downstream of the junction of the two branches. It was hypothesized that there would be lower species diversity and fewer pollution-sensitive species downstream from the junction of the two branches as compared to upstream, but that the Channel would be even less diverse and contain fewer pollution sensitive species than the North Branch.

 One collecting apparatus supporting three multi-plate macroinvertebrate samplers was used at each site. Each apparatus was submerged in the river for two weeks, then removed, the macroinvertebrates living on it collected, counted, and identified, and their pollution tolerance calculated.

 The results support the hypothesis that upstream sites on the North Branch were more diverse and contained more pollution sensitive species than downstream sites. It was also found that Channel sites were significantly less diverse and less pollution sensitive than North Branch upstream sites.

2008 - EV053

ION SCIENCE, EYE ON POLLUTANTS, A LONG-TERM STUDY OF RED RIVER WATER QUALITY, YEAR THREE: EFFECTS OF CITY LAND USE

Benjamin Chang Sun
Red River High School, Grand Forks, ND

PURPOSE

Assess the effects of different city land usage on water quality.

HYPOTHESIS

Different city land uses will contribute specific pollutants to the streets, storm drains, and outfalls.

PROCEDURE

Water samples were collected from storm drains in different city zoning areas during rain events and analyzed for heavy metals and nutrients. A city zoning map, outfall map, and traffic counts map were used to determine correlations between pollutants found and their sources.

RESULTS/DISCUSSION

Overall the pollutant levels in the storm drain samples were higher than the levels in the river water. Locations where high levels of pollutants were found were plotted on city zoning maps to assess the links between city land usages and pollutants.

•Factors that could affect the outcome of the storm drain water assessment such as the effect of sampling time and the influence of solids were studied and indicated that samples collected at different times during rain events would affect the final results.

•High levels of nitrate found in sump pump discharge but not in storm drain samples indicated that pollutants might travel through pathways to the river other than the storm drain water due to their chemical characteristics.

•City outfalls were found to contribute on average from 12-15 tons of nitrate annually to the river based on calculations using the dry season outfall discharge data. Higher levels of heavy metals were found in the city outfalls and correlations to specific drainage areas were studied.

•A river water quality comparison during flood periods (multi-year flood and spring and summer

flood comparison) was also conducted.

2008 - EV054

ACID RAIN TWO: AFFECT ON AQUATIC LIFE

Bea Ann Fischer

Ashley Public School, Ashley, ND

At what pH level will Daphnia die after being in the solution for 3 days?

I hypothesis that the Daphnia in the 4.0 to 4.5 pH solution will die within the 3 days.

Gather your supplies. Once you've figured out the lake water and acid pH levels by using the probe, label each test tube. Start with 10mL of water in a beaker, gradually add more acid until you get to the desired pH level. Mix each solution until it has the same pH as marked on each of the test tube, put 10 mL of the solution in a test tube. Put 2 Daphnia in each of the test tubes. Using a stop watch record the time the Daphnia were put into the solution. After 24 hours take one piece of fish food and place it in each test tube. Continue to observe the Daphnia for the next 3 days.

The results of my experiment were that the Daphnia in 4.0 pH solution died after 34 minutes-7 seconds, pH solution 4.1 died after 37 minutes-21 seconds, solution 4.2 died after 1 hour 14 minutes-51 seconds. it took 10 hours-5 minutes for the Daphnia to die in solution 4.3. The Daphnia in pH solution 4.4 died after 16 hours- 18 minutes.

My conclusion was that my hypothesis was incorrect. The Daphnia from pH levels 4.0 to 4.4 did die within the 3 day time frame but pH level 4.5 never died.

2008 - EV055

AN ANALYSIS OF BACTERIA FOUND IN SOILS

Preston James Gilderhus

Maddock Public School, Maddock, ND

The project purpose was to determine the susceptibility of certain antibiotics with bacteria found in soil samples.

After collecting the soil, I made a serial dilution of 10-6. Next, I made duplicate plates of MacConkey (MAC), Nutrient (NA), and Skim Milk (Skim) agars. I then counted CFUs and conducted the Kirby-Bauer test. Finally, I made statistical information.

CFU Theory: In Sample 1 (Clay), the MAC made the bacteria salt-loving. The NA showed it wouldn't be beneficial for growing. The Skim became either gram-positive or anaerobic gram-negative.

In Sample 2 (Sand), the MAC made it salt-loving, the NA showed it's very allowable to developing, and the Skim resulted in a gram-negative bacterium.

Interpreted Kirby-Bauer test results include: 1-1 10-2 Skim, the bacterium was resistant to K-30, NB-30, TE-30, and N-30, and intermediate to E-15, C-30, and S-10. In 1-2 10-2 Skim, it was resistant to NB-30, E-15, TE-30, and C-30, and intermediate to K-30, S-10, and N-30. In 1-2 10-3 NA, it was intermediate to K-30, E-15, and N-30, and susceptible to C-30 and S-10.

In 2-1 10-6 NA, it was resistant to K-30, NB-30, E-15, TE-30, S-10, and N-30. In 2-1 10-6 MAC, it was resistant to K-30, NB-30, and E-15, and intermediate to TE-30. In 2-2 10-6 MAC, it was resistant to K-30, NB-30, E-15, TE-30, C-30, and N-30, and intermediate to S-10.

The analysis of Sample 1 (Clay) and Sample 2 (Sand) varied in their bacteria results from resistant to susceptible. Overall, sand was more resistant to antibiotics.

2008 - EV056

MATHEMATICAL ATMOSPHERE

Isabella Vallory

Escuela de Comercio No2 Martin Miguel de Guemes, Concordia

This project is the result of an analysis of the characteristics of the plume of an industrial chimney located in the urban area of the town of Concordia, Province of Entre Rios, Argentina

This research seeks to establish the methodology and procedures necessary to carry out control and monitoring of emissions from stationary sources, and to determine the relationship between the various disciplinary fields determined through mathematical equations sobre elevación the plume, for the purposes of analyzing concentrations in a pen, identifying changes that are needed to implement to improve the air quality consistently with the quality of life of people and the environment.

An analysis literature, interpretation of the interviews, and the application of the formulas concluded that it is necessary to optimize the height of the chimney And that the air quality in the area is in direct function of the amount of emissions and the transport phenomena of scattering that takes place in the atmosphere, taking into account the geographical and meteorological conditions of the site In accordance with the provisions at the national level by the Standard IRAM 29.227/99 (Planning Monitoring Air Quality) and IRAM 29.230/02 (for stationary sources).

This paper seeks to implement concrete actions to strengthen environmental awareness from school to the community and putting young people at the centre of the stage, through the design of programs and projects, as it is in the field of education which consists of contributions from different disciplines; allowing describe the problems associated with the environment; identify impacts and outline answers pointing to protect and repair, in the context of the needs of the city.

2008 - EV057

GLOBAL WARMING: VARIATION IN THE ENVIRONMENTAL TEMPERATURE CONDITIONS THROUGH TIME IN A CENTRAL REGION OF PUERTO RICO

Julius Cesar Reyes-Lopez

Patria Latorre Ramirez High School, San Sebastian, PUERTO RICO

Global Warming is a serious problem that is affecting us all. It is expected that this research make people aware of this situation. Is there an increase in the average environmental solar noon temperature in the town of San Sebastián (in the Central Region of Puerto Rico) during 2006 and 2007? The hypothesis stated that the average environmental solar noon temperature in the town of San Sebastián will evidence a significant increase during the years 2006 and 2007.

The local maximum, minimum and solar noon temperatures were recorded using the instruments in the GLOBE Project meteorological station located at Patria Latorre High School in San Sebastián. The Digital Thermometer (Multi-Day Max/Min) measured the maximum, minimum and solar noon

temperatures of the air and the soil on a daily basis at the time of reset. These measurements were made between the months of May to December 2006 and May to December 2007, according to the temperature protocol field guide provided by the GLOBE Project. Measurements of humidity and precipitation were also made. The data analysis demonstrated that the average solar noon temperature increased 1.94 °C and that the average minimum temperature decreased 2°C in the town of San Sebastián. These significant temperature changes are a threat to the island’s delicate environmental balance. These results demonstrated that, as the hypothesis stated, there was a significant increase in the average environmental solar noon temperature in San Sebastián during 2006 and 2007.

2008 - EV058

TO CONFIRM ENVIRONMENTAL EVALUATION CRITERIA OF PARKS IN THE METROPOLITAN CITY BY USING ANALYSIS BUTTERFLIES

Keitaro Obara
Waseda University Senior Highschool, Tokyo, JAPAN

The aim of this research is to establish a simple method of assessing the environment of a park in a major city center using butterflies. The field study was conducted from 27 July to 28 August, 2007, for 5 hours from morning till afternoon daily, in 16 parks in Tokyo by means of counting at a fixed point.

In this research, I could take an approach and attain results not found in similar previous studies. It was found that the total number and the composition of species in each park or area of the park, total number of species, presence or non-presence of a specific kind of butterfly, Neope goschkevitschii, could be used to assess the environment of parks in the city center.

These study data will be able to provide indicators of how a green park with a rich environment and abundant biota can be created in a city center with more ease and efficiency than the conventional assessment using flora.

In the future, I would like to establish some indicators to measure the maturity of the environment in the city area by identifying the year of establishment of the park, the number of butterfly species and the number of butterflies.

2008 - EV059

COMBINED EFFECTS OF A LATE FREEZE AND PROLONGED DROUGHT: CONSEQUENCES FOR AN EAST TENNESSEE HARDWOOD FOREST

Katharine Michelle Sloop
Oak Ridge High School, Oak Ridge, TN

This study was undertaken to achieve a better understanding of the repercussions of a late freeze and prolonged summer drought on an East Tennessee hardwood forest. In April 2007, a freeze occurred following an abnormally warm March. New growth on many plants was killed, and there was a delay in the canopy development of the forest as shown through the normalized-difference vegetation index (NDVI). An analysis of Leaf Area Index (LAI) was also used to document further effects of canopy development. Compared to normal years, there was a delay of approximately twenty days in the forest becoming a net carbon sink, and the overall productivity of the forest (in terms of carbon fixation) was greatly reduced from previous years. The combination of the freeze and the prolonged summer drought, as well as increased summer temperatures, severely inhibited the forest’s productivity.

2008 - EV060

MORE OR LESS? HOW THE DROUGHT EFFECTS RIVER POLLUTION

Elliott James Lynn
Glenwood School, Phenix City, AL

The purpose of my project is to determine if a serious drought has any effect on the levels of pollution in the Chattahoochee River. I think that drought conditions will not have an effect on river pollution because the lack of run-off will counter-balance the increased concentration of the pollutants.

I took water samples at 8 points along the Chattahoochee River between Sandy Springs and Omaha and tested them in the lab for levels of fecal coliform. I analyzed these results and compared them to the data I had collected from the same 8 points once a year since 2006 to see if any trends developed that would show a relationship between the current drought and water pollution.

My results, when analyzed with previous data, did not show a trend towards any drought effects. My experiment verified my original hypothesis. In this project, drought conditions did not noticeably increase or decrease the levels of pollution in the river. The numbers of fecal coliform colonies in samples taken during the current drought were relatively equal to the previous 2 years of data. The best theory for the reason I got this result is that although the drought caused the pollution to be in a higher concentration, the lack of run-off during the drought decreased the amount of non-point source pollution in the river.

2008 - EV061

EFFECTS OF THE ANTIBIOTIC OXYTETRACYCLINE ON ESTUARINE PHYTOPLANKTON AND BENTHIC COPEPODS

Yupeng Liu
Academic Magnet High School, North Charleston, SC

Aquatic species may be exposed to pharmaceuticals via hospital and sewage treatment plant effluents. Due to the therapeutic effects of drugs like antibiotics, they may have detrimental effects on the environment. Phytoplankton and zooplankton play significant roles in energy transfer within the aquatic ecosystem. In this study, the effects of the antibiotic oxytetracycline on the growth of cyanobacterium Microcystis aeruginosa and green alga Dunaliella tertiolecta were explored using standard chronic algal toxicity tests. The microcystin toxin production of M. aeruginosa was determined by enzyme-linked immunosorbent assay (ELISA). The effect of oxytetracycline on survival and development of the copepod Amphiascus tenuiremis was examined using a microplate assay. M. aeruginosa was shown to be much more sensitive to the antibiotic than D. tertiolecta, with an oxytetracycline concentration that effectively reduced algal cell growth by 50% (EC50) of 3.45 mg/L for D. tertiolecta, and 0.31 mg/L for M. aeruginosa. The algal species were then exposed repeatedly to oxytetracycline, to determine whether antibiotic resistance could be induced. It was found that while most concentrations of oxytetracycline treatments had an indirect relationship

between the growth of the two species, there was no significance in exposure history. Increased oxytetracycline concentrations may increase the mortality of *A. tenuiremis* and alter the time for metamorphosis from nauplii to copepodite. Antibiotic impacts on phytoplankton growth could harm aquatic systems by changing the phytoplankton composition and the food source for zooplankton, in addition to releasing algal toxins.

2008 - EV062

WATER PURIFICATION BY CYPERUS PAPYRUS L. IN A SIMULATED SUB-SURFACE WETLAND

Adria Katrin Schwarber
Notre Dame Academy, Park Hills, KY

Two contaminants that are of serious concern in wastewater are nitrates and textile dyes. Nitrate, which can have adverse effects on animals and humans, is a naturally occurring contaminant in soil and water. The nitrate levels in some areas, especially where nitrate-containing fertilizers are in use, can exceed the 10 mg/L Maximum Conaminant Level (MCL) set by the EPA. Reactive dyes from textile industries are the most commonly found pollutant in natural water. Constructed wetlands have recently been explored as cost-effective and environmentally friendly alternatives to waste removal. Previous research by this experimenter examined nitrate removal by *Cyperus papyrus* L. in stationary wastewater containing nitrates. This research uses sub-surface flow. Four simulated sub-surface flow wetlands were constructed. A pea gravel and larger gravel substrate layer topped with a soil layer was placed in the bottom of plastic containers. *Cyperus papyrus* L. was planted in the soil to determine if it would be able to remove the input nitrate and Procion Strong Orange Dye conaminants. Samples were taken after about 10 L of contaminated water slowly flowed through each simulated wetland. A control had the same soil substrate as the wetlands, but no *papyrus* plant. A spectrometer and a Vernier nitrate ion-selective electrode were used to measure input and output concentrations of dye and nitrate responses. The soil alone removed significant contaminants. The experiment demonstrated that over the course of flow time, *Cyperus papyrus* L. was effective at reducing the nitrate levels in water in constructed wetlands by up to 57.1% and up to 27.6% of the dye.

Awards won at the 2008 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel Foundation

2008 - EV063

ANALYSIS OF CHEMICAL RUNOFF ON CROP DEVELOPMENT

Caylin Faith Drews
McArthur High School, Hollywood, FL

The purpose of this research is to analyze the effects of chemical runoff on crop development. The independent variables in this experiment are water as the control, aluminum sulfate, cupric chloride, barley, radishes, alfalfa, and red clover. The dependent variables in this experiment are the amount of germination of seeds, the root length, the shoot length and the root to shoot ratio of the seeds. Factory runoff is a major problem in both industrial and developing countries of the world, these chemicals could be leaking into and contaminating the soil. This research can be used to prove whether chemical runoff is affecting crop development. The researcher used two different statistical tests to analyze the data. For the germination of the seeds in the plastic bags, the Chi-square statistics=207.72>the Chi-square alpha 05=25; the researcher rejects the null with a probability> 0.0001. Next, for the germination of the seeds in the plastic potting containers, the Chi-square statistics=194>the Chi-square alpha 05=25; the researcher rejects the null with a probability> 0.0001. Finally, for the root: shoot ratio aspect of the experiment, the researcher performed an ANOVA statistical test for the alfalfa in the bags. By doing so, the F statistic at 28.18> the F alpha 05 at 3; the researcher rejects the null with a probability> 0.0001. This research can benefit farmers of today, be used to help determine whether chemicals are present in the soil based on a crop's development, and can aid those concerned and working with chemical runoff and groundwater/soil contamination.

2008 - EV064

WATER CONTAMINATION

Cristina Flores
Weslaco East High School, Weslaco, TX

Water Contamination consists of the bacteria found in the Weslaco Water from the water found in the canal the Weslaco Water Treatment uses and the water that runs through the faucet. This project shows the bacteria found in the water before it is treated and after it is treated and the side effects this bacteria has on humans. Water samples were obtained from the canal and faucet and then they are put into PDA in order for the bacteria to grow. After all bacteria are grown, then sub-culturing will occur. After bacteria has grown, total colonies will be counted, colony morphology will be described, and the gram stain test will be done all so that the bacteria can be classified. After this, then one can find out the history of this bacteria and the effect it has on Weslaco water. The total number of colonies was ranged from 92-171. On the catalase reaction, oxidase reaction, and gram stain there was either positive or negative. The water faucet only had one bacteria surviving at 25°C meanwhile the water canal had six bacteria growing, two at 25°C and four at 37°C. There were four main bacteria found in the Weslaco water: *Serratia*, *Staphylococcus*, *Micrococcus*, and *Klebsiella*. The water faucet had only the bacterium of *Micrococcus* meanwhile the water canal included the bacteria of *Serratia*, *Staphylococcus*, and *Klebsiella*. All these bacteria aren't deadly yet if taken daily they do affect greatly. Some of the effects include urinary infections, food poisoning, and pneumonia.

2008 - EV065

CAN LEAD-BASED SOIL POLLUTION LEAD TO HUMAN EXPOSURE?

Norwood Robson Dennis
Academy of Richmond County, Augusta, GA

Lead poisoning is an important environmental health concern. The objective of this project is to determine if soil based lead pollution can lead to human exposure. Produce grown in home gardens typically provides the cultivator with a sense of satisfaction and sustainability. However, while the sense of satisfaction and sustainability is attractive without best practices the produce can have detrimental effects on the consumer as it (the produce) becomes a mechanism for lead poisoning. Lead based paint is common on pre-WWII structures (e.g. barns, rural and urban housing) and although illegal today many structures remain covered in lead based paint. Many home gardens are planted next to such structures in order to capture rainwater from the roof. Lead may enter the plant from lead based paint which may leach lead into the soil and consequently be absorbed by the plant through watering. By testing the stalk of plants it was determined that lead based soil pollution can contaminate produce and lead to human exposure.

2008 - EV066
THE EFFECT OF LUMBRICUS TERRESTRIS ON THE LEVEL OF NITRATES AND PHOSPHATES FOUND IN FERTILIZED SOIL

Zalak Vasu Patel
Westview High School, Martin, TN

urpose of this project is to determine whether adding earthworms to the soil will decrease the level of nitrates and phosphates found in the soil. The hypothesis is that the level of nitrates and phosphates will be decreased by the exposure of varying numbers of earthworms to the soil. There five experimental groups and one control group. In all there were thirty Lumbricus terrestris. The level of nutrients in the soil was measured before any variable was added. They were divided in such a way that one experimental group contained a different number of earthworms than the other group, thus yielding comparative data. The earthworms were placed in large containers filled with one hundred grams of soil. The level of nutrients present in the soil in all groups was tested at the end of each week for a one-month period. The data showed that overall the levels of nitrates and phosphates increased in each experimental group. The more earthworms there were in the soil, the greater increase there was in both the nitrate and the phosphate levels. There were no changes in the data of the control group due to the absence of the variable. The final results of this study could be an important benefit in the agricultural world. Certain amounts of nitrates and phosphates are needed to help lawns grow and look healthy. Earthworms may be effective contributing nutrients in the soil. This discovery could play a helpful role in plant life.

2008 - EV067
THE EFFECTS OF ANTHROPOGENIC CARBON DIOXIDE ON THE SHELL DEVELOPMENT OF OSTRACODS

Sally Leanne Barrett
Keebra Park State High School, Southport, Queensland, AUSTRALIA

The aim was to replicate the predicted changes to the atmospheric concentration of CO₂ in 25 and 50 years time and then determine the effect of these increased concentrations of CO₂ on the shell development of ostracods. The shells were compared to shells of ostracods living with the current level of CO₂. The hypothesis is that the increased CO₂ will lead to a decrease in the shell strength of the ostracods. To measure the shell strength it was necessary to use, a force meter to crush samples of ostracods living in environments of differing CO₂ concentrations. To achieve an experiment that would yield reliable and quantitative data an experimental design was established and followed to maintain integrity. The practical stage involved pre-testing to establish an appropriate method of measuring outcomes. After the results were collected they were represented in graphs for appropriate evaluation. They compared the mean force required to crush ostracods from three tanks of differing CO₂ concentrations. The results clearly indicated that the force required to crush ostracods decreases as the concentration of CO₂ increases. This supports the original hypothesis. Microscope photographs were taken for analysis of images, which allowed for comparisons of physical changes within ostracod shells to be made. Analysing the morphology of the shells also supported the hypothesis. There was a clear visible reduction in the thickness of the ostracod shell caused by the increased levels of CO₂. The results suggest that other marine creatures with shells may be adversely affected by increasing CO₂ concentrations.

2008 - EV301
ONE OF THE WAYS OF IMPROVING POLLUTION OF TBILISI WATERING-PLACE ZONE

Giorgi Benashvili, Eradze Lia, Bezhitashvili Ana
Georgian-American High School, Tbilisi, GEORGIA REPUBLIC

Our project is about one of the most important vital problem, which is the purification of drinking water. For the research we offered the river Aragvi, particularly the basin of Jinvali reservoir, because its resources is used by 80% of the population of Tbilisi, the capital of Georgia. We took tests from 6 important places of the river. The analyses have shown that in the tests, taken after the village Jinvali, the following parameters were deviated from the standard (MCL): ammonium and bacteriological indices. We observed the polluted zone, found out the reasons of pollution, particularly: ammonium is increased because of the fertilization – ammonium saltpeter, that falls in the river from the crops by sediments and bacteriological indices is increased because of the agricultural – fecal waters. We discussed several developed methods of filtration the water. Then we found out the most optimal for this territory. We added new details to the purifying mounting for making better result, particularly vertical borders, made of cement, for making the cleaning process more active and fast.

2008 - EV302
THE EFFECTS OF ACID RAIN ON BEAN PLANTS

Meagan Jae Mettler, Casey Aberle,
Timber Lake High School, Timber Lake, SD

The purpose of this experiment was to determine how the pH level of acid rain affects bean plants' growth. The rate of growth and appearance of lesions were a measure of the effect of acid rain. Fifty bean seeds were planted. The plants were watered and allowed to grow seven days before they were tested.

The plants were split up into groups of ten forming four groups: control, 3.5, 3.0, and 2.5. The control was given regular tap water throughout the experiment. The other three groups received a solution of distilled water and sulfuric acid to produce a pH of their designated group number. Everyday each group of plants received a 100mL dosage of corresponding solution. The solution was sprayed on the plants with a spray bottle. A spray bottle was used to simulate actual rain. The plants were tested on observed for seven days.

 The results of the experiment showed that the group that received the lowest pH of acid rain grew the least (2.1cm average) and showed the most lesions (20 total), followed by the 3.0 and 3.5 pH groups respectively. The control group showed the most growth (4.0cm average) and no lesions.

2008 - EV303

TAKE A CLOSER LOOK: A FRESHWATER STUDY OF INVISIBLE CONTAMINANTS IN INDUSTRIAL AND ENVIRONMENTAL WATERS ALONG THE MISSOURI RIVER

*Jerod Brady Wyatt, Drew Jordan Freeman,
Mid-Buchanan R-V High School, Faucett, MO*

With the increase of chemical and pharmaceutical usage, industrial advances and population upsurges, the use and recycling processes of water have been come quite crucial in environmental studies. Fresh water is a limited resource. The experimental project was designed to test the water return quality of various industries and to compare to the original environment water. Water samples were obtained from companies North and South of Saint Joseph, Missouri along the Missouri River. The SP-2100 series microprocessor UV/Visible Cynmar Spectrophotometer was utilized. A peak scan was performed for the following metal ion solutions: cadmium, cobalt, chromium, lead, barium, iron, manganese, nickel, zinc, aluminum, calcium, mercury and strontium. Concentrations of 100 ppb, 200 ppb, 300 ppb, and 400 ppb for each metal were prepared and used to determine the peak wavelength. The average molar absorptivity was calculated according to the absorbance readings of the standards at peak wavelength. Beer's law was employed with the unknown samples collected from a power plant, a metal industry and a waste water treatment plant located in Northwest Missouri. The absorbance readings for the water samples suggested possible concerns for our fresh water systems. The study is important to the accumulation of such metals in fresh water systems. Many of these metals have been linked to various health issues, such as cancer.

2008 - EV304

DIDYMOSPHENIA GEMINATA: THE CORE QUESTION

*Danielle Page Pite, Kelly Ann Lane, Anna Kari Hermann
Boulder High School, Boulder, CO*

Didymosphenia geminata was first described in 1819 on the Faroe Islands in the North Atlantic Ocean. While D. geminata populations were believed to be limited to the northern latitudes, nuisance blooms south of this range have been documented since the 1980's. This broadening effect fits the characteristics of an invasive species, which necessitates studies investigating the paleoecological history of the species and tracking recent environmental changes of D. geminata. The government of New Zealand, for example, has recently imposed strict measures to prevent D. geminata from spreading to new bodies of water since it first appeared in 2004. The discovery of large masses of cells reported from the 1930's in the Kanchou region of China bring about the possibility that these massive blooms have occurred before but no data exist which quantify the growth. We examined the historical record of this species in sediments of Naknek Lake, in Katmai National Park, Alaska, to test the hypothesis that the D. geminata blooms have been increasing globally and to evaluate the morphological changes in the species. Chronological control was established by two ash layers, the Katmai ash and brown ash. We found no statistically significant change in the numerical presence of Didymosphenia geminata in Naknek Lake between the years 1218 and 2003. This suggests no sudden increase in abundance. Our data suggests there to be an unusual variation within the D. geminata of Naknek Lake. This may be the first record of D. geminata var. stricta in North America.

2008 - EV305

THE REMOVAL OF FERRIC IONS UTILIZING MOLLUSK SHELLS

*Olivia Lauren Pecukonis, Laura Garcia,
Brush High School, Brush, CO*

The following experiment demonstrates the effectiveness of oyster shells in the absorption of ferric chloride from a beaker of water. The oyster shells were put in varying concentrations of ferric chloride and standards were prepared. The experiment was repeated with crushed shells to test the effectiveness of an increase in surface area.

 The Visible Light Spectrometry results indicated an increased concentration initially and a drastic decrease of concentration over an extended period of time, depending on the initial concentration. Between the whole shells and the crushed shells, the whole shells were more successful in regard to speed of absorption. The experiment proves the possibility of oyster shells as an alternative water purification method.

2008 - EV306

THE PRESENCE OF 17 BETA-ESTRADIOL IN FLOYD'S FORK CREEK

*Corey Wallace Hall, Mazie Walthall,
Christian Academy of Louisville, Louisville, KY*

Floyds Fork Creek runs throughout the community of Louisville, Kentucky and five adjoining counties. Hormones such as 17β Estradiol, not filtered properly from waste water treatment plants is finding its way into surface water streams around the United State. 17β- Estradiol hormone is a potentially harmful substance with the ability to cause a variety of health problems such as fibrocystic breast and ovarian tumors in women.

 An ELISA Kit was used to test the samples of filtered creek water at five recommended sites located in Louisville. The antigens are designed to find and bind with hormones

within the samples by adding magnetic particles specific to 17β Estradiol. Samples were mixed and placed onto a magnetic separator. The separator holds the bound hormones and magnetic particles to the bottom of the test tube, the remaining sample discarded. Samples are then read by the photometer.

17β- Estradiol was found with a R2 correlation coefficient of 0.9998 and 0.9983 respectfully. Significant amounts were detected in the Chenoweth Run branch of the creek, located in Jeffersontown, Kentucky. Since these samples demonstrated up to a 9.0 ppt presence of 17β Estradiol, the site was tested again to verify the presence of the hormone. Samples were taken at the initial location, then every three meters, up to 30 meters. The results of the second test showed that 17β- Estradiol was again present in the water and traveling downstream, supporting the hypothesis that Floyds Fork Creek contains 17β- Estradiol.

2008 - EV307

AN ANALYSIS OF EFFLUENTS FROM LA PARGUERA SEWAGE TREATMENT PLANT AND THEIR RELATION TO COPPER, NUTRIENTS AND CHLOROPHYLL CONCENTRATIONS IN SEAWATER ALONG LA PARGUERA BAY

Juliana M. Monzon, Isis Marie Garcia,
Academia del Perpetuo Socorro, Miramar, PUERTO RICO

A connection was established between the effluents of La Parguera Sewage Treatment Plant (LPSTP) and the concentrations of copper, nutrients and chlorophyll in the seawater along La Parguera Bay, Lajas, Puerto Rico. La Parguera Bay has been the site of sewage effluent input from the secondary sewage treatment facility for the town of La Parguera for over 30 years. Over 100,000 gallons of sewage effluents per day seep through two percolating ponds located in the landward margin of the coastal mangrove fringes. A significant quantity of nutrients enters the underground water of LPSTP, given that the phreatic level under the percolating ponds of LPSTP is only 2.5' of the surface.

Nutrient measurements of nitrogen and phosphorous in the effluents from LPSTP showed elevated nitrite, nitrate and phosphate levels. Near the discharge area, nutrient levels remained high but their concentrations diluted downstream perhaps due to mixing with seawater or the mangroves removing excess nutrients. Also, there were lower salinity values which may indicate a freshwater intrusion from the LPSTP groundwater. Statistically, chlorophyll-a concentrations were higher in the water near the discharge area of the LPSTP when compared to the waters farther downstream from the ponds.

Nitrogen/chlorophyll concentrations indicate that the effluents of LPSTP have an impact on the biological and chemical composition of La Parguera Bay, especially near the discharge area. Although copper concentrations in La Parguera Bay seawater were higher than the Water Quality Standards of the EPA –PR, there is no contribution of copper from LPSTP.

2008 - EV308

HOW SAFE IS OUR 21ST CENTURY WATER SUPPLY?

Nadia Banks Miller, Nevada Banks Miller,
Sherman High School, Seth, WV

urpose of our project is to investigate the quality of our water supply in Boone County, West Virginia, and surrounding counties in our state of West Virginia. In order to accomplish this task, we obtained water samples from rivers, creeks, springs, wells, and taps throughout Boone County, West Virginia, and surrounding counties of our state of West Virginia. We then performed the following investigatory experimental tests on each water sample in order to form some conclusions about our water resources: 1)Coliform Bacteria; 2)Dissolved Oxygen; 3)Temperature; 4)% Saturation; 5)Nitrates; 6)pH; and 7)Phosphates. Upon completion of our project, we became more informed about environmental issues that affect our community and the water quality of our important water resources. As a result of our analysis of our vital water resources we have gained an interest in the global importance of water quality and quantity, life-long habits of active citizenship and environmental stewardship.

2008 - EV309

AN ENVIRONMENTAL STUDY OF AN ALKALI-PETRO SLOUGH

Raynee Dayne Pace, Jesse Wallewein,
North Toole County High School, Sunburst, MT

This experiment was conducted to determine if the alkali-petro slough located east of Swayze Road outside of Sunburst, Montana, is an overall healthier environment, based on water quality, macroinvertebrate studies, soil analysis, and visual observations, compared to the natural alkali pond located on the Wallewein Ranch. Also, to determine if the alkali-petro slough is a viable way to reclaim saline seep areas by converting them to wetlands. We hypothesized that the Alkali-Petro Slough would be an overall healthier environment and viable way to reclaim wetlands, based on visual observations and tests performed. We analyzed water quality by using tests such as: nitrates, phosphates, macroinvertebrate studies, Coliform bacteria, temperature, pH, turbidity, dissolved oxygen, BOD (biochemical oxygen demand), and dissolved solids. Also, we gathered plant samples and made visual observations and population observations. Water tests were conducted in the field, while soil tests were conducted in the laboratory. Our water test results showed the dissolved solids (water), pH, tests to have significantly different results when compared with a t-Test. Temperature, nitrates, BOD, and dissolved solids (ice) test results were not significantly different. Turbidity test results could not be compared with a t-Test but differences were recorded. Coliform bacteria was present in the slough, but not in the pond. Soil was analyzed using nitrate, phosphate, sulfate, pH, ammonium, magnesium, calcium, iron, carbonates, and potassium tests. Results for soil, pH, and magnesium were not significantly different. Ammonium, iron, phosphates, and potassium tests returned no measurable results. In the nitrates test, 0/12 samples in the pond and 0/3 of the mouth samples tested positive, while 5/12 tested positive in the slough. When tested for sulfates, 12/12 and 3/3 samples in the pond and mouth respectively tested positive while 6/12 samples tested positive in the slough. 5/12 pond samples and 0/3 slough mouth samples and 3/12 slough samples tested positive for carbonates. After analyzing our results, we came to the conclusion that the Alkali-Petro Slough is an overall healthier environment than the Wallewein Pond. Also, this method is also a viable way to reclaim saline seep areas by converting them to wetlands.

2008 - EV310

THE ENVIRONMENTAL IMPACT OF N, N DIETHYL-META-TOLUAMIDE, PICARIDIN, AND CYMBOPOGAN WINTERIANUS ON LUMBRICUS RUBELLUS AND LOLIUM MULTIFLORUM

Samantha Brice Larsen, Kelly Lester,
Long Beach High School, Lido Beach, NY

This project in its present form analyzes the environmental impact of mosquito repellents containing various concentrations of N,N diethyl-meta-toluamide (DEET), Picaridin, and Cymbopogan winterianus (citronella) on the cells of Lumbricus rubellus (red earthworms) and Lolium multiflorum (Italian Ryegrass). With a rising concern for the protection of our earth, it becomes important to take into consideration the chemicals that we are emitting into our environment and their potential impact. Lolium multiflorum and Lumbricus rubellus were placed into two plastic containers that each received the conditions custom to the environment (i.e. 12hr light and dark cycle and water). After both the Lolium multiflorum and the Lumbricus rubellus matured, cell samples were taken from each via the use of a sterilized dissecting needle and probe. The removed cells were then immediately transferred to Petri dishes containing a solution consisting of 90% Grace's Insect Medium and 10% Fetal Bovine Serum. This medium composed 90% of the cell culture; the remaining 10% came from the alamarBlue. AlamarBlue is an assay that will measure cell viability and proliferation via assessing cell respiration and metabolism via a Redox reaction. It was at this point that the cells within the culture were exposed to their designated mosquito repellents. After the cells' exposure they were placed into a spectrophotometer and the cell viability based on the percent reduction of the alamarBlue was observed and recorded. The cell samples were also placed into a spectrophotometer and the absorbency of the mosquito repellents was analyzed. Results were then collected and analyzed after the completion of the spectrophotometer.

2008 - EV311
CATALYTIC DEGRADATION OF CARCINOGEN TRICHLOROMETHANE IN DRINKING WATER

Kuan-Hua Chen, I-Jou Teng,
National Tainan First Senior High School, Tainan, CHINESE TAIPEI

Chlorine is frequently used as a disinfectant in most water supply systems. The disinfection by products such as trichloromethane (TCM) being found carcinogenic in rodents are a major concern in Southern Taiwan. In the present work, an effective catalyst has been developed to degrade TCM in drinking water. An iron-incorporated zeolite-5A type porous material has, therefore, been synthesized with sodium aluminate, sodium silicate and ferric nitrate at a molar ratio of 1:2:2 at 373 K for 24 hours under autogenous pressures (~2 atm). Experimentally, the novel catalyst (Fe-Al-SiO₂) has very high reactivity especially in catalytic decomposition of H₂O₂ and/or indigo dye at 283-295 K. Interestingly, we also found that TCM could be degraded catalytically on the Fe-Al-SiO₂ in the presence of H₂O₂ (1M). The activity of the catalyst was as high as 28.5 ppb TCM/g Cat/sec. The catalyst can be incorporated and fixed on surfaces of argillaceous materials, which provided a very simple process in catalytic degradation of TCM with few separation problems. To achieve better applications, we have designed and installed a catalysis-filtration device at the faucet head for removal of TCM in household tap water. In this fashion, many TCM-related cancers possibly caused by drinking water may be reduced.

2008 - EV312
IMPROVING LIFE QUALITY THROUGH SCIENCES: USE OF SOLAR ENERGY AND PET BOTTLES AS ALTERNATIVE FOR DRINKING WATER DISINFECTION

Julia Soares Parreiras, Veronica Pinheiro Santos,
Centro Federal de Educacao Tecnologica de Minas Gerais, Belo Horizonte

The Solar Water Disinfection (SODIS) is a technique that inactivates pathogenic microorganisms in the water combining the effect of ultraviolet radiation and the heat generated inside plastic bottles. This method is recommended for regions with intense solar radiation to allow the water to reach temperatures higher than 50oC for at least four hours. The objective was to test the efficiency of a SODIS using Polyethylene Terephthalate (PET) bottles and a cardboard solar concentrator with foil lined, adjustable reflectors. The results were compared to a SODIS with fixed reflectors, presented by the Water Technology Mexican Institute (IMTA). The SODIS proposed in this study is based on a low-cost concept using easily available and recyclable materials. The bottles were selected based on the UV transmittance, measured with a spectrophotometer. The selected bottles were clear, with the half bottom painted in black. The water inside the bottles was inoculated with Escherichia coli and placed on the solar concentrator. The parameter evaluated were air and water temperature and solar radiation, measured with mercury thermometers and a quantometer. Results indicate that the higher UV transmittance was obtained with the PET bottle sample "F". The solar concentrator allowed the water to reach temperatures between 50oC and 70oC. Results show that the use of the solar concentrator with adjustable reflectors allowed a reduction in the sun exposure time from 4 hours to 2 hours, with total inactivation of E. coli. at 50oC, resulting in a SODIS system as efficient and the unit presented by the IMTA.

2008 - EV313
THE EFFECTS OF EXTREMELY LOW FREQUENCY MAGNETIC RADIATION ON DROSOPHILA LIFESPAN AND FERTILITY

Zack Saslow Goldstein, Brian John,
William A Shine Great Neck South High School, Great Neck, NY

The focus of this expirement was the effect of Extremely Low Frequency Magnetic Radiation (ELF-MR) on drosophila. EMR consists of electric and magnetic fields that travel perpendicular to each other. All electrical appliances produce ELF-MR, which is found in a region of the spectrum below three hundred hertz. Numerous studies have been done, in some of which, negative effects on health have been observed. While other studies found no effect. The hypothesis for this experiment was that if drosophila were exposed to ELF-MR they would have a shorter lifespan and a lower fertility rate; in addition, reduction of the level of exposure would prevent some of these harmful effects. Seven experiments were run. In every experiment one set of flies were exposed to radiation from a computer monitor while control flies were kept away from all radiation. Temperature was measured to make sure that it was the same for both groups.

The fertility of the flies that were exposed to ELF-MR was approximately 3-4 times less than those in the control. ELF-MR seemed to have variable but significant effect on drosophila lifespan. Two types of experiments were done to examine the effects of radiation dose on fertility and lifespan. In one type, two computers emitting different amounts of radiation were used. In the other, mumetal, a nickel alloy, which is able to block radiation, was used. In the first type of experiment it seemed that the flies exposed to the higher amount of radiation had a higher death rate and fewer offspring as compared to the computer emitting less radiation and the control. The mumetal experiment showed that mumetal does seem to block some amount of radiation and have a positive effect on drosophila lifespan and fertility.

2008 - EV314

DOWN N' DIRTY

Clara Louise Rampy, Annalie Miller,
Fernley High School, Fernley, NV

Our community is growing rapidly which means there is a lot more exposed soil than previously due to development. We live in an arid climate with alkali soil that sometimes produces a white powdery crust on the surface. This creates a problem because we receive a lot of wind resulting in significant dust storms. In 2004 the highway in front of our school was closed due to blowing dust. Because we also have unacceptable levels of arsenic in our drinking water, we were concerned that these alkali salts might contain arsenic, which could become airborne with the dust and cause problems for all of us who have to breathe that air. We determined that the initial direction of our research should be to identify where in the community the alkali crusts form, what depth of soil disturbance might result in the crusts forming, whether any particular method of watering enhances or discourages crust formation and finally whether using bottled water vs tap water changed the crust formation. Preliminary results led us to additional questions about crust formation and soil types, amounts of water causing crust formation, and whether or not the crust forms in the presence of vegetation. We have answered all of these questions and feel that our results justify additional research into the composition of the crust. We didn't begin with this research due to the relative expense of performing detailed chemical analyses of multiple samples, but can now seek financial support in continuing our work.

2008 - EV315

A COMPARISON OF CARBON SEQUESTRATION BETWEEN ALAFALFA GRASS AND CORN AT VARYING DEPTHS

Tejaswini Reddy Nallanagulagari, Yelee Lee,
Upper Arlington High School, Upper Arlington, OH

Global warming is an important issue that is caused by human activity. Green house gases, including carbon dioxide, are released from cars, planes and various industrial and agricultural activities which burn fossil fuels. One method to reduce the amount of carbon dioxide in the air is carbon sequestration. Terrestrial carbon sequestration is the capture of carbon dioxide by plants, crops, and trees that occurs during photosynthesis. After capture, the carbon is transferred to the root system and stored in the biomass which consists of soil, stalk, and roots.

In this experiment, corn (Zea mays) and alfalfa grass (Medicago sativa) were tested to determine which sequestrated the highest percent of carbon pool by mass at the depths of 10 cm and 20 cm. The experiment was divided into four parts: collecting soil samples in triplicate, grinding the soil into a fine mixture, sifting the soil, and analyzing the soil samples. The analysis included using a Carbon-Nitrogen analyzer to determine the carbon-to-nitrogen percentage for each sample. The results of the experiment showed alfalfa grass at the depth of 20 cm as having the highest carbon content. This is most likely because the alfalfa grass plots were not tilled or harvested. Additionally, alfalfa grass has a fibrous root system which extends deeper into the soil than corn's taproot system. Tilling the soil releases much of the stored carbon back into the atmosphere. When harvested, the entire biomass of corn is removed, releasing carbon back into the atmosphere.

2008 - EV316

BEHAVIORAL PATTERNS OF DAPHNIA MAGNA

Annicka Kae Carter, Ellie Antonia Vawdrey,
Hillcrest High School, Midvale, UT

Daphnia Magna are small transparent crustaceans that reproduce asexually. These aquatic organisms react significantly to changes in their environment. A Daphnia Toximeter is a globally circulated instrument that photographically monitors the movement of each individual daphnia and plots the values of recorded velocities, heights, and distances apart from one another. A status index, established by the degree of which the daphnia's behavior drifts from the expected patterns, grades the level of contamination risk in the water. The potential of this mechanism to greatly influence the efficiency of finding water contamination in water plants is extraordinarily high; however it cannot identify the hazardous chemicals present.

 Our research question was split into two stages. The first stage was a series of three tests designed to determine if there were distinct behavioral patterns of Daphnia when introduced to various chemicals. The three categories of chemicals represented in stage one were heavy metals (copper sulfate), fertilizers (20-20-20), and pharmaceuticals (ibuprofen). Through experimentation we proved that there are clear differences between patterns, which lead us to believe that further research would be beneficial. Our second stage was to test several chemicals within each category to establish general behavioral patterns of Daphnia Magna that could be beneficially used to identify chemicals in the water systems.

 The patterns that resulted were in direct correlation with the internal functioning of the Daphnia. We can conclude that such advancement of research could be of great importance to solving contamination threats to populations across the globe.

2008 - EV317

COMPARISON OF FECAL COLIFORM IN GRAB AND COMPOSITE SAMPLES WITH TEMPERATURE COMPENSATION

Kirstin Denise Kramer, Whitney Marie Plein,
Burlington Community High School, Burlington, IA

IOWATER and other volunteer water quality projects use grab sampling to collect water. The purpose of this project was to determine if grab and composite samples had comparable levels of fecal coliform. An initial grab sample was collected using standard collection procedures at the same site and times as a composite sample. The composite sampler was set to collect 50mL of water every hour for 24-hours. After 24-hours the sampler was retrieved and a second grab sample was collected. Flow rate and temperature were taken for every trial. All samples were tested in the lab using a Millipore filtration system.

Temperature compensation for bacterial growth was used, but had no effect on the statistical analysis of the data. Flow rate did not seem to affect the data. In 5 of the 8 trials, grab samples taken 24 hours apart were statistically similar to each other (p>.05). In 5 of the 8 trials, grab #1 samples (taken before the 24-hour composite samples) were similar to the composite samples (p>.05). In 6 of the 8 trials, grab #2 samples (taken after the 24-hour composites) were similar to the composite samples (p>.05). In 5 of the 8 trials, the average of the grab samples were similar to the 24-hour composites (p>.05). Overall, the grabs and/or composites were similar to each other in 22 of 32 comparisons. Grabs 1 & 2 were similar 62.5% of the time. The average of the grabs was similar to the composites 62.5% of the time. More testing and analysis of the data needs to be completed before any conclusions can be made.

2008 - EV318
ANALYSIS OF EMERGING POLLUTANTS: 17-B ESTRADIOL AND TESTOSTERONE IN MUNICIPAL WASTEWATER EFFULENT, SURFACE WATER AND DRINKING WATER USING IMMUNOSORBENT ASSAY

*Richard Charles Lee, Tammy Tu,
Cookeville High School, Cookeville, TN*

Human hormones, an emergent pollutant defined by U.S. EPA, have been reported to cause endocrine disrupting effects on fish, such as wildlife hermaphroditism and feminization. Some sources of these pollutants are pharmaceuticals, personal care products, and mammal excretions. Both natural and synthetic estrogens have been identified as major contributors, especially 17-β Estradiol. Water samples from four different waste waster treatment plants and five surface streams in middle Tennessee were collected and tested using enzyme-linked immunosorbent assay kits (ELISA). A solid phase extraction (SPE) method was developed and used to extract hormones in water samples and to elute the concentrated substrate before adding them to ELISA kits. The results show 17-β Estradiol was found in effluents of WWTP and ambient water samples. Trace amounts of hormones were detected in drinking water samples from two cities. The population of a city has a direct impact on hormone levels found in effluents. As expected, more 17-β Estradiol was found in water than Testosterone. Commercial available omnifilters were tested to confirm their efficiency of removing hormones in water. The result indicated a small amount of 17-β Estradiol could be removed while placed in orbit shaker for 30 or 60 minutes. Recovery rates of samples, a quality control method, were found to have positive correlation with the samples' original levels. The study has provided a useful and insightful observation on the problem of hormone in treated effluents, ambient and tap water.

2008 - EV319
ASSOCIATION OF CATTLE FEEDLOTS WITH THE PRESENCE OF ANTIBIOTIC-RESISTANT BACTERIA IN POND ECOSYSTEMS

*Caitlin Marie Bolender, Megan Levis, Lauren Gunderson
Billings Central Catholic High School, Billings, MT*

Montana is considered a pristine paradise, home to beautiful mountains and blue-ribbon trout streams. Yet there are also three cows for every person, and the majority of Montana's cattle are administered antibiotics to promote growth, possibly threatening the environment. In this study, we examined a pond ecosystem for contamination resulting from a cattle feedlot. The first phase of our study examined pond water samples for antibiotic-resistant bacteria. Samples were plated on media containing the antibiotic terramycin. Bacterial colonies which were terramycin-resistant were then plated on media containing penicillin to test for multi antibiotic-resistance. Numerous terramycin-resistant colonies were isolated, and 75% of those tested were also penicillin-resistant. The second phase of our study focused on the analysis of coliform bacteria in the pond. We were able to quantify and differentiate both coliform and fecal coliform by the actions of bacterial enzymes, beta-galactosidase and/or beta-glucuronidase, on substrates linked to dyes. Water samples taken from near the shore showed high levels of coliform bacteria, while samples from both open water and the shore had numerous fecal coliform bacteria. Sixteen colonies which were identified as fecal coliform bacteria were replated on terramycin and penicillin plates to assay for antibiotic-resistance. Over two thirds of these bacteria were resistant to penicillin. The discovery of antibiotic-resistant fecal coliforms is compelling evidence that the pond is being contaminated by the feedlot. Widespread use of antibiotics in feedlots could lead to contamination of numerous watersheds, and may pose a significant human health risk.

Awards won at the 2008 ISEF
Fourth Award of \$500 - Team Projects - Presented by Science News

2008 - EV320
OZONE POLLUTION: ARE INVERSIONS A FACTOR?

*Lynne Olivier Chapman, Candice Fay Schwartzenburg,
St. Joseph's Academy, Baton Rouge, LA*

In today's day and age, human beings face a dilemma: how can regions reduce pollution in a society where success is measured by industrial growth? To address this problem, our research does not focus on the quantity of pollutant emissions; rather, it investigates an abnormal atmospheric condition that intensifies these emissions.

This experiment aims to determine the effect of temperature inversions on Tropospheric ozone. It was hypothesized that the days with inversions would, in fact, display higher ozone levels. Records of ozone data from 10 Baton Rouge sites were retrieved from 40 trials from summer 2005 to summer 2007. An ozone event was considered greater than or equal to 100 ppb. After inversions were identified by 40 rawinsonde soundings, a correlation tested the relationship of inversion days and ozone events; the overall correlation is 0.563.

To provide further evidence that inversions increase ozone pollution, we tested 4 factors that contribute to ozone formation: NO, NO2, NMOC, and wind speed. Measurements were obtained from records, and their hourly averages over the 40 trials were divided into 2 categories: occurring with an inversion or occurring without an

inversion. The 2 data sets of each element were analyzed with T-tests. All T-tests passed except wind speed. These results confirm that inversions intensify components of ozone, therefore generating increased ozone pollution.

Inversions cannot be forecasted; however, advancements in predicting inversions would allow prediction of abnormally high ozone. Lowering emissions of NOx and VOCs for the duration of forecasted inversions may prevent unhealthy ozone concentrations.

Awards won at the 2008 ISEF

Honorable Mention Award - American Meteorological Society
Fourth Award of \$500 - Team Projects - Presented by Science News

2008 - EV321
THE EFFECTS OF VARIOUS CONCENTRATIONS OF FLUOXETINE ON THE DEVELOPMENTAL RATES OF MEALWORMS
Katy Ann Hammersmith, Lauren Spikes,
Collins Hill High School, Suwanee, GA

In this study the effects of three different concentrations of a Fluoxetine solution were studied by examining the developmental rates of one generation of darkling beetles. The independent variable was the variation of the concentrations of Fluoxetine solutions to 0.0g/L, .21 g/l, 2.1 x 10-7 g/L, and 2.1-13 g/L. The dependent variable was the average change in mass of each experimental group and the average amount of time spent in each stage of development. This study was preceded by research found on increases in the presence of pharmaceutical drugs in wastewater surrounding urban areas. Because wastewater is not treated for pharmaceuticals specifically, many pharmaceuticals are negatively affecting aquatic ecosystems. Researchers hypothesized that with increased concentrations of Fluoxetine, the average change in mass would be lower than that of the control, and the average amount of time spent in each stage of development would be greater than that of the control. There were four groups of fifty mealworms. Each container held 1 mealworm, .25 grams of food, and one 1"x1" piece of cotton batting. The four solutions were applied by putting 1mL of the solution on the cotton batting. The samples were left for one week at a time. Data was collected once a week. At each data collection, masses were measured and observation taken. Statistical analysis showed that there were no obvious relationships between Fluoxetine and the development of mealworms. However, there did seem to be a correlation between the concentration of Fluoxetine and amount of mold growth.

2008 - EV322
CATALOGING THE WATERSHED OF FOURCHE CREEK
Catherine Eliza Fox, Andrew Finne,
Little Rock Central High School, Little Rock, AR

The purpose of this study was to collect macroinvertebrae at Fourche Creek to use as indicators of the health of the watershed. The macroinvertebrae collected at two different sites (Rock Creek and Hindman Creek) were divided into three taxa groups; sensitive, somewhat sensitive, and tolerant to pollution. macroinvertebrae were collected at three areas for each site; bank, ripple, and pool. Three samplings where preformed in each area test and the Total Index Value, scale from 0 to 30, was calculated. The Total Index Value is the combined total of the three taxa groups Index Values. The Index Value rates the diversity of the macroinvervebrae in the ecosystem. Rock Creek there was a Total Index Value of 23, while Hindman was 16. The sensitive group declined at both sites. Additional testing is required to determine the cause of the decrease in sensitivity.

2008 - EV323
AN EXCURSION TO THE CAVES: HOW DANGEROUS CAN IT BE TO VISIT THOSE TERRESTRIAL CAVITIES?
Nathalie Fuentes Ortiz, Oscar I. De Jesus Colon,
Jose Gautier Benitez High School, Caguas, PUERTO RICO

This investigation is the result of a concern about the possibility of the presence of pathogenic microorganisms in the waters inside the "Caves of Aguas Buenas" and in the river that surrounds them. The lands that conforms the hydrographic river basin of the Rio Cagüitas and the caves have been considered for the development of a tourist ecological corridor. The results of studies performed by the organization interested in this project claim that the water quality does not represent danger to human health. Today's increase in water contamination posses the problem: Are there pathogenic microorganisms in the water inside the "Aguas Buenas Caves" and in the river that surrounds them? Is it safe to use the caves and the river that comes from them for recreational purposes? The hypothesis was that there is an increment of pathogenic microorganisms in the water from the "Aguas Buenas Caves" and in the river that surrounds them. A bacteriological study was performed to different water samples from inside the caves and from the river that surrounds them in a qualified laboratory. The bacteriological water analysis revealed the presence of eight different pathogenic microorganisms. Seven of these microorganisms are harmful to humans and one affects plants. These results confirmed the hypothesis of this research and contradict the results announced by the organization interested in developing the tourist project. Action has been taken and a proposal has been written and submitted to this organization for them to reconsider their investigation process about this area.

2008 - EV324
THE QUANTITY OF IRON IN DIFFERENT GEOGRAPHIC COASTAL ZONES OF PUERTO RICO
Natalia Arelys Pagan-Perez, Paola Castello Torres, Rose Torres Hernandez
Timoteo (Tito) Delgado, Hatillo, PUERTO RICO

The purpose of this investigation was to determine which geographic coastal zone of Puerto Rico had more iron. The formulated hypothesis established that

the southern zone of the island had the most iron in its coast. To test the hypothesis five samples of sand were taken from each of two beaches from the northern, southern, eastern and western zones of Puerto Rico. The beaches that were visited in the northern zone were El Muelle de Arecibo and Carolina in Isla Verde. The beaches visited in the south were, Juana Diaz Beach in Juana Diaz, and Ponce Hilton Hotel Beach in Ponce. The western beaches were the Maní in Mayagüez and Herminia in Aguada. Finally, the eastern beaches were La Pared in Luquillo and Seven Seas Beach in Fajardo. Five samples of 35 milligrams of sand each were taken from each beach mentioned above. Each sample was taken at a distance of ten feet from one another. Once dried, the samples were filtered and were weighed in an electronic scale. The iron found in the sand samples was separated using a magnet. The particles were weighed to determine the approximate percent of iron in each geographical zone. The data obtained showed that the northern geographical zone had 13% of iron, the southern one had 41%, the eastern zone 1%, and the western zone had 11%.The data supported the established hypothesis: there is a greater quantity of iron in the southern coast of Puerto Rico with 41%.

2008 - EV325

FILTRATION OF OIL WHICH SPILLED IN TO THE SEA AFTER A TANKER ACCIDENT FROM THE SEA WATER

Esra Cikikci, Fadime Erdogan,
Ozel Yamanlar Koleji, Izmir, TURKEY

Filtration of oil which spilled in to the sea after a tanker accident from the sea water.

We have separated oil from the sea water by using a separation funnel. But we used ping pong ball instead of valve.We filled full of ping pong with water. After we put sea water-oil mixture,ping pong ball stayed between the sea water and oil. The aim is that after the water flows ping-pong ball will close the hole before the oil starts to flow. The system is easy and used well. With this system we can clean the sea before the oil damages animates.

For our system's industrial form we made a new mechanism. According to this new method we thought that instead of vertical moving system, a floating system will be more productive for energy saving. For that reason. We placed another pot under the mechanism. If we don't prevent water floating under the mechanism according to Archimed principle ping-pong ball couldn't close the hole.

In this floating mechanism water-oil mixture is taken by a cover with period regulated in the water level. This mixture is separated with ping-pong ball's help. Water which is collected in the lower pot and oil which remains above ping-pong ball are transferred with period regulated valves and diesel pumps to tanks. And then water spills to sea. So we both clean the sea and provide the recycling oil.

Awards won at the 2008 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2008 - EV326

MARSH MADNESS

Reid William D'Amico, Patrick Andrews,
Hilton Head Preparatory School, Hilton Head Island, SC

This year's study consists of three experiments:

A. Determining the effect of dock structures on the erosion of proximal pluff mud.

B. Encouraging the growth of the marsh grass proximal to a dock by using plexiglass planks instead of common wooden planks.

C. Analyzing water quality factors at locations with differing ecosystems to determine the significance of individual water quality factors on the health of the marsh.

These three experiments were combined to determine the cause of death of some local marsh grass and to test a solution for one of the factors affecting the health of the marsh grass.

It was predicted that the plexiglass planks, instead of wood, would significantly increase the health of the marsh grass. The marsh grass benefited from the plexiglass planks. There were significant increases, determined by a two sample T-Test, in density of stalks, stalks over ½ meter, and stalk diameter (Avg.), thus making plexiglass a viable alternative to the wood plank.

It was predicted that a significant amount of erosion would be occurring near the docks. The difference between the environmental controls and the close proximity to docks was large enough to deem it significant by using a two sample T-Test. This is the result of the docks causing interruption of sediment flow, forming a cyclone sweeping away most of the sediment.

It was predicted that the water quality factors would mostly be within environmental standards for marshes except for nitrate, dissolved oxygen, and pH because of the ecological makeup of the low country's marsh. The water quality factors were cross-referenced with the health of the marsh, deeming carbon dioxide, salinity, and alkalinity significant in the overall affect on the health of the marsh grass. In conclusion this data supports the theory that the development of domestic structures upon the marsh is adversely affecting the growth of marsh grass.

Awards won at the 2008 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2008 - EV327

OPTIMIZATION OF SUSTAINED POWER GENERATION IN MARINE SEDIMENT MICROBIAL PHOTOVOLTAIC CELLS

Joy Elisabeth Lee, Sumit Malik, Phillip Thomas Grisdel
Thomas Jefferson High School for Science and Technology, Alexandria, VA

This project consisted of two facets. The first was a proof of concept of a land-based self-assembling microbial photovoltaic cell; the second was optimization of the power generated by this cell. Prior to the design and implementation of the four cells constructed for this experiment, marine-sediment microbial fuel cells had been utilized exclusively in natural aquatic environments, as constant availability of resources, specifically organic detritus and dissolved oxygen, facilitated continuous power generation. A conceptual model for sustained power generation in land-based applications, without the vast resources of the aquatic environment, was developed; byproducts of the oxidation-reduction reactions, water and carbon dioxide, would be recycled by photosynthesis of aerobic microbes to regenerate the depleted reactants, organic matter and dissolved oxygen. It was hypothesized that this model, in the presence of light, would sustain power generation indefinitely, and furthermore, higher cathode surface area would result in a greater power density.

Four photovoltaic cells

were constructed within the laboratory, each consisting of a graphite anode embedded in sea sediment and a graphite cathode suspended in overlying oxic seawater. The open circuit potential was first recorded with a potentiostat, and then current was drawn at each cell's half potential. Power generation occurred in diurnal patterns, indicating a relationship with sunlight, yet maximum and minimum power generation were not concurrent with maximum and minimum light intensity, providing an area for further research. The control cell, which received no sunlight, produced no power, confirming its dependence on photosynthesis to recycle reactants and validating the cell design.

Awards won at the 2008 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2008 - EV328

IMPROVED EXHAUST SYSTEM FOR TWO-STROKE ENGINES: AN EFFECTIVE WAY TO OBTAIN BETTER AIR QUALITY

*Michael Kaergaard Madsen, Jesper Lykke Rasmussen,
Vejle Technical High School, Vejle, DENMARK*

A huge, overlooked environmental problem, is the pollution from two-cycle engines. There are more than 205.000.000 two-cycle mopeds and hundreds of millions of two-cycle engines for other applications in the world. Most of these engines are in countries like Mexico, Thailand, China, India - countries which already today fight with enormous air-pollution, and many citizens suffer from serious and lethal lung-diseases. Every single engine pollutes more than a car would ever be accepted to do, because it's simple design allows 30-40% of the fuel to get unburned into the atmosphere. The most serious problem is the exhaust-system! We have therefore focused on this to reduce the amount of unburned fuel. We changed the design to an expansion type exhaust, which uses cones with specially-fitted length to turn the exhaust wave propagation to push the unburned hydrocarbons back into the cylinder, where it is reused and much more effectively burned. After long series of design and construction development, we obtained a very promising prototype. It was tested on a small 50ccm two-cycle motorbike. These tests showed: Over a distance of 127km, 17.7% fuel was saved compared to the original two-cycle motorbike. The temperature of the ambient air plays an important role in the performance. The efficiency becomes better in warmer weather. This is extremely encouraging when we consider the countries using huge numbers of two-cycle engines: Countries with hot weather. Our plans are now to optimize our invention for "TukTuks" etc., and get it into production.

Awards won at the 2008 ISEF

Second Award of \$1,500 - Team Projects - Presented by Science News
Ricoh Sustainable Development Award of \$25,000 - Ricoh Americas Corporation
Second Award of \$3,000 - United States Coast Guard

2008 - EV329

USING RESPONSE SURFACE MODELS TO DETERMINE THE OPTIMAL VALUE OF FUEL OCTANE LEVEL, OIL LEVEL AND BACK PRESSURE TO MINIMIZE THE EMISSIONS FROM LAWN MOWERS

*Huzeifa Ismail Badshah, Steven James Schroeder,
Northside Health Careers High School, San Antonio, TX*

The purpose of this experiment was to find the optimum combination of different variables to minimize the hydrocarbon emissions from a lawn mower. The variables used were O – octane, I – oil level, and P – back pressure. The selected values of O, I, and P were tested, and the hydrocarbon emissions were collected with the aid of an analog as well as a digital sensor. The results were processed through a statistical analysis called Regression Models. Since the value predicted by the model was not completely logical, eight different combinations of high and low values were tested in Excel's Equation Solver. The optimized lawn mower was found to reduce half the hydrocarbon emissions produced by a normal lawn mower. But a side effect, for example, increasing the backpressure and lowering the oil level resulted in a higher pressure, making it terminal for the engine; hence the proposal of using catalytic converter was made. It was found that even on a normal lawn mower, a catalytic converter could reduce as much as eight times the hydrocarbon emissions. The hypothesis that the higher the octane level, higher the backpressure, and the lower the oil level seemed to be proven by the data. Although the octane level didn't make much difference, the backpressure and the oil level were the key parts in changing the amount of hydrocarbons produced. Catalytic converters will require a financial investment, but to stop the environment from growing any worse, our government should recognize the importance of the growing problem and step up to start making a difference.

2008 - EV330

THE EFFECT OF FLOATING TREATMENT WETLANDS ON AN AQUATIC SYSTEM WITH BISPHENOL-A

*Mykal Anne Eden, Joanita Mathews,
Billings West High School, Billings, MT*

Each day countless amounts of pollutants including pharmaceuticals and Bisphenol-A (BPA), are being dumped into water systems all over the world. BPA is a chemical commonly used in plastics and has been linked to reproductive and behavioral complications in wildlife. This problem has been on the rise with no direct actions taking place to resolve the issue. The purpose of our study is to investigate a possible solution by using a floating treatment wetland (FTW) to potentially remove the pollutant. Our hypothesis is that there will be no observable differences in the aggression levels of male *Callopleysiops altivelis*, commonly referred to as beta fish, living in the BPA free environment and those living in an environment rich in BPA but also containing a FTW. Aggression was measured as an average of gill flares exhibited by each group during a series of two minute trials conducted over a ten day period. This was repeated and the data was averaged for each individual day. With exposure to a FTW and the pollutant BPA, fish behaved in a similar manner to the fish in the absence of both the FTW and BPA. This demonstrates the removal of the pollutant by the FTW.

2008 - EV331

THE EFFECT OF LEAD POLLUTION ON BLOOD

AbdulElah Marwan AlGosaibi, Faisal Alabdulkareem,
Riyadh Schools, RIYADH, CENTRAL, SAUDI ARABIA

Lead is an environmental contaminant that is used significantly in modern industry. The purpose of this project is to study the effect of Lead toxicity on experimental Wister rats which are exposed to 2% Lead acetate in drinking water. The applicability of obtained results for human blood will be examined in the future advancement of this study. In this project, 32 Wister rats were divided into 4 groups of 8 rats. Group 1 was used as control and was given tap water. Groups 2, 3 and 4 were treated with 2% Lead acetate in their drinking water for 1, 2 and 3 months respectively. The following parameters were monitored: Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), alkaline phosphatase (ALP). In addition, Hemoglobin absorption spectrum and dielectric measurements were also monitored. Results showed that rats exposed to Lead for longer period of time experience significant decrease in plasma total protein and significant increase in other parameters as compared to control. This pertains to toxic liver damage and correlates to the development of fibrosis. In addition, results showed that the Hemoglobin spectra displayed well-known bands at 220-280-340-410-540. This band corresponds to aliphatic amino acids, aromatic amino acids, aromatic amino acids and other acids in liver. This indicates partial loss of Hemoglobin molecule stability. Moreover, free radicals produced in the presence of heavy metals could lead to anemia.

2009 - EV001

EFFECT OF MEDICATIONS ON DAPHNIA MAGNA

Allison Ainsley MacKay
Vero Beach Senior High School, Vero Beach, FL

There is currently much concern about the potential effects of medications that contaminate groundwater on aquatic organisms. This experiment determines if dilute solutions of various medications comparable to concentrations found in groundwater have an effect on the heart rate of *Daphnia magna*, a common aquatic micro-organism that is the basis of the food chain in many aquatic environments. In this experiment, dilute solutions of medications were prepared by crushing a pill and dissolving it in distilled water. Serial dilutions were performed until the desired concentration was achieved. Twelve *daphnia* were placed in a Petri dish filled with the medication solution. Under a microscope, *daphnia* heart beats were counted. This protocol was repeated for each medication solution. Based on a statistical analysis of the data, the hypothesis that none of the medication solutions would affect *daphnia* heart rate can be rejected. Each medication lowered the heart rate in the *daphnia* except for propranolol which elevated the heart rate. In this experiment, many different classes of medication present in ground water were studied, including pain relievers, anti-depressants, an antibiotic, a hormone, stimulants, and beta-blockers. Because heart rate was affected by such a wide variety of medications, multiple organ systems in *daphnia* could have been adversely affected. Heart rate may be a marker for more global distress in the organism. Because the *daphnia* heart rate was clearly affected, it is possible that *daphnia* behavior and survival could be altered, potentially affecting the lower part of the aquatic food chain significantly.

2009 - EV002

DEGRADATION OF ANTIBIOTICS IN WASTE WATER

Jan Justra
Gymnasium, Brno - Reckovice, Brno, CZECH REPUBLIC

After antibiotics go through metabolism they become part of waste water. Until now antibiotics have not been separated from water, so they have been getting into the environment and have caused some imbalances in natural ecosystems there. I found out that antibiotics are decomposed by the effect of sun rays, in particular by the UV radiation. I supposed that it would be possible to destroy antibiotics by using UV radiation. I had learned that the biggest amount of energy is absorbed in the range from 200 to 220 nm of the wave length. So I used a UV lamp with the most similar wave length (254 nm). Every time I measured the content of antibiotics in the water, then I exposed the water with antibiotics to the UV radiation and after that I measured the content in the sample again. I obtained values which I put into tables and graphs. I discovered that antibiotics are decomposed almost linearly in different samples with different pH values. The only exceptions were samples with the pH of 7, in which antibiotics were decomposed much better than in the other samples. I succeeded in decomposing almost 50 % of the entire dose of the antibiotics. Due to this success in laboratory conditions I have suggested a practical solution of decomposition of antibiotics in waste water for one model sewerage plant. I have suggested placing mercury vapour lamps in activating reservoirs. This model situation might be used generally for most cases of sewerage plants.

Awards won at the 2009 ISEF

Scholarship Award of \$1,000 - National Collegiate Inventors and Innovators Alliance/The Lemelson Foundation

2009 - EV003

GRAPE EXTRACTS AS POSSIBLE THERAPEUTIC TREATMENTS FOR PLANT AND BACTERIAL TOXINS

Srikar Patlola Reddy
Lake Highland Preparatory School, Orlando, FL

This experiment's purpose was to block AB toxins from entering the cytosol through a pore in the endoplasmic reticulum (ER). AB toxins move through retrograde vesicular traffic and reach the ER. At this point, the toxins act as misfolded proteins and trick the ER-associated degradation (ERAD) pathway into not ubiquitinating these unfolded toxins. The toxins then travel to the cytosol and attack their various cellular targets, blocking transcription and translation of proteins while other toxins raise cAMP levels. Although the AB toxins' targets are different, the whole family uses the same pathway to get past ERAD. The A

subunit is the catalytic part of the toxin that actually acts as the misfolded protein and does the damage within the target cell, whereas the B subunit is the structural part that physically binds to a plasma membrane protein. The toxins used for fluorescence-based toxicity assays were exotoxin A (ETA) and ricin. Fluorescence was measured in an experiment based off a specific protein called GFP, where both ricin and ETA were mixed with specific grape compounds: grape seed and grape pomace to block the toxins and was hypothesized to cause higher fluorescence in Vero GFP cells measured by a plate reader. The control group was the toxin by itself with just media. The grape compounds blocked the toxicity, and grape seed was more effective than grape pomace. Also, from the results of a gel the reason the grape extracts inhibited toxins was not because the A and B subunit separated prematurely.

Awards won at the 2009 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2009 - EV004

QUANTITATIVE ASSAY OF ENVIRONMENTAL CS-137 IN ONCORHYNCHUS CLARKI PLEURITICUS AND ONCORHYNCHUS MYKISS MUSCLE TISSUE AND SOIL FROM FALLOUT IN A MOUNTAIN ENVIRONMENT

Jeffrey Michael Hibbert
Lone Star High School, Otis, CO

Radioactive particles were dispersed across the entire biosphere due to atmospheric nuclear weapons testing, mostly during the 1950's and 1960's. One radioactive element that was a large portion (~6%) of the sum total of all radioactive particulate deposited from nuclear weapons testing is Cesium-137. The objective of this research is to determine residual Cesium-137 activity in different elements of a mountain environment. The hypothesis for this project was that the radioactivity would decline more rapidly than decay alone for the lake fish tissue. Another hypothesis is that Cesium-137 would be present in measurable quantities in the soil surrounding a mountain lake. Soil samples were taken in three different locations based on distance from the shore. Fish were caught using fly fishing techniques to harvest muscle tissue. All environmental samples were run through a GeLi detector to determine activity. Once GeLi results were obtained, a calculation was done to determine the radioactivity per gram in the samples. Results show that all samples contained measurable amounts of Cesium-137. Radioactivity was found at highest levels in soil samples. It is also shown that Cesium-137 levels have decreased over a 40 year interval. Though Cesium-137 was detectable it is not found in levels exceeding the EPA limits. Based on the results, both hypotheses were supported. The hypotheses stated that Cesium-137 would be in measurable quantities in the soil and that radioactivity would decline more rapidly than by decay alone in fish tissue.

2009 - EV005

VARIATIONS ON DISSOLVED OXYGEN IN LENTIC AND LOTIC ECOSYSTEMS

William Li
South Fork High School, Stuart, FL

Dissolved oxygen is a very important indicator of a water body's ability to support aquatic life. The amount of dissolved oxygen the water is able to hold depends on several factors. What effects do salinity, pH, and temperature have on dissolved oxygen in lentic and lotic ecosystems? It is hypothesized that if salinity and temperature decreases, then the amount of dissolved oxygen present will increase because freshwater and cold water holds more DO than salt water and warm water, respectively, but pH is hypothesized to remain independent of any change towards DO since it is only a measure of how acidic or alkaline the water is. A brief summary of the procedure is as follows. Submerge the TRACER to 25cm under the surface of the water 600cm off shore and record for salinity, pH, and temperature. Collect the water sample. Immediately add 8 drops of Manganous Sulfate Solution and add 8 drops of Alkaline Potassium Iodide Azide. Allow the precipitate to settle. Add 1.0g of Sulfamic Acid Powder. Fill the titration tube to the 20 mL and titrate it with Sodium Thiosulfate and 8 drops of Starch Indicator Solution. Read result from the Titrator barrel. Record as ppm Dissolved Oxygen. The resulting analysis presents an indirect relationship between salinity and temperature and amount of dissolved oxygen. As salinity and temperature increased, the amount of dissolved oxygen decreased. Dissolved oxygen remained independent of any change in pH. Therefore the results support the hypothesis. Based on this study, salinity, pH, temperature and dissolved oxygen relationships can be found in any body of water in the world. This information could be used for the study of aquatic life forms such as the production of phytoplankton in the world. Phytoplankton are good indicators of change in their environment, since they depend upon certain conditions for growth. Phytoplankton also exert a global-scale influence on climate and are of primary interest to oceanographers and Earth scientists around the world.

2009 - EV006

THE EFFICIENCY OF FIELD SAMPLING TECHNIQUES IN DETERMINING THE DISTRIBUTION AND ABUNDANCE OF AMPHIPODS IN DEEP PRAIRIE WETLANDS

Megan Marie Miller
Lincoln High School, Thief River Falls, MN

The purpose of this project was to examine the efficiency of field sampling techniques in determining the distribution and abundance of amphipods in deep prairie wetlands. Twenty wetlands were sampled to get an overall picture of the amphipod population, using activity traps and sweep nets. Five samples were collected with both field techniques in near shore habitats. The experimental hypothesis states if amphipod samples are collected from wetlands using activity traps and sweep nets then the samples using the sweep net method will give a more accurate representational picture of the distribution and abundance in deep prairie wetlands. The wetlands were tested in both June and August and were broken down into two different habitats: wetlands with Planktivores, Benthivores, and Piscivores and wetlands with Planktivores and Benthivores only. This was due to higher number of amphipods found in wetlands with Piscivores. The hypothesis was accepted since more amphipods were collected with the sweep net than the activity trap in all wetlands. The activity traps even gave false negative results of 30% in June and 60% in August. This experiment indicated that the sweep net collected more amphipods than the activity traps while using the same amount of time and effort. Amphipod numbers have decreased dramatically over the last 20 years. Appropriate wetland

sampling techniques are essential in determining the types and amounts of invertebrates found. Looking at amphipod migration could ultimately help water quality issues plaguing the world. It must also be done efficiently in these serious economic times.

Awards won at the 2009 ISEF

Award of three \$1,000 U.S. Savings Bonds, a certificate of achievement and a gold medallion. - United States Army

2009 - EV007

IS SEAGRASS GROWTH AND DISTRIBUTION AFFECTED BY ENVIRONMENTAL CHANGES?

James J McPhee

Academy of Environmental Science, Crystal River, FL

Research examined if natural pattern changes in water depth, temperature, salinity, turbidity, substrate, canopy height, and current flow affect seagrass growth and distribution. Data was collected at four randomly chosen seagrass beds in the Gulf of Mexico, near Crystal River, Florida. Sites were chosen and Global Positioning Satellite (GPS) coordinates used for relocation during six random test dates. Using a quadrat counting device and the Braun Blanquet Density Score method; three seagrass types were counted: *Syringodium filiforme* – Manatee grass, *Thalassia testudinum* – Turtle grass, and *Halodule wrightii* – Shoal grass. This researcher logged thirty five “in-situ” hours. At site 1; closest to the mouth of Crystal River; the only species found was Shoal grass; in mud and gravel substrate, low current flow, and low salinity of 26 parts per thousand (ppt). Furthest from the mouth of Crystal River; site 4 had higher salinity measurements (30 ppt), mud-silt substrate, higher current flows and counts indicating all three seagrasses. Shoal grass grew in a variety of conditions being the hardy seagrass in the study; at 57.7% of the total seagrass, Turtle grass- 37.7%, and Manatee grass - 4.8%. A ten degree drop in water temperature led to detritus deposits on the seagrass; increasing turbidity from 0 Jackson Turbidity Units (JTU) to 40 – 100 JTU. An unexpected discovery of invasive algae within the seagrass beds was recorded. Results demonstrate seagrass distribution is affected by natural pattern changes in salinity, substrate, and current. Continued research of seagrass communities is vital to maintaining healthy marine ecosystems.

2009 - EV008

ACID MINE DRAINAGE REMEDIATION USING WET SCRUBBER FGD MATERIAL

Benjamin Elliott Lewis

Jackson High School, Jackson, OH

Acid Mine Drainage (AMD) is a major problem in southeastern Ohio. Currently steel slag is shipped from out-of-state to our local area for water remediation. However, a more economically viable solution is to use Flu Gas Desulfurization (FGD) by-product from wet scrubbers at local coal plants. An apparatus was built to simulate the leach bed system used by the Raccoon Creek Watershed Group (RCCW) nearby to treat AMD with pond water percolated through steel slag. Water runs through the bottom of the apparatus to rise up through the FGD and the water output is collected above the leach bed. Various water types were created for experiments, including various percentages of pond water plus AMD and the mixing of these waters with pond water percolated through FGD, following the remediation procedures at RCCW. The first set of experiments tested the FGD-treated pond water combined with different percentages of untreated pond water and AMD to test the effectiveness of this FGD leach bed. All water types were tested before and after each experiment for pH, conductivity, and alkalinity. Each experiment was repeated three times. The final experiment tested the remediation effects with direct percolation of AMD through the FGD instead of the mixing of FGD-treated pond water with AMD, as performed at RCCW. The treated water in all cases showed increases in pH and a reduction in conductivity. This positive result shows that FGD has potential in the remediation of AMD as a cheap local alternative to steel slag.

2009 - EV009

A NOVEL MERCURY FILTER

Sharis Nicole Steib

Saint James High School, St. James, LA

You are a product of your environment. With high Hg levels prevailing across the world, something needs to be done to counter this disaster. Blind River, a river in my own parish, is one of the forty-eight waterways present on the Louisiana Mercury Fish and Consumption Advisories list. To remedy this, I decided to create a filter that extracts Hg from water using a substance that is naturally occurring, biodegradable, easily obtained, and inexpensive: crawfish shells. Employing US EPA Method 50B Mercury Cold Vapor Analyzer, I tested the effectiveness of my filter. Early trials indicate significant amounts of Hg that were extracted from the Hg spiked water, filtered through my filtration apparatus. Hopefully, this filter will have a great impact on the environment by lowering the detrimental Hg levels while not producing any harmful by-products.

Awards won at the 2009 ISEF

Third Award of \$150 - Patent and Trademark Office Society

2009 - EV010

EFFECTS OF NANO METAL OXIDES ON SENTINEL ORGANISMS IN THE AQUATIC ENVIRONMENT

Jamie Elizabeth Molloy

Divine Savior Holy Angels High School, Milwaukee, WI

Nanomaterials are becoming an increasingly integral part of a variety of products—especially sunscreens. Sunscreens easily make their way into water sources. This project examines the effect of two metal oxides, titanium dioxide (TiO₂) and zinc oxide (ZnO), frequently used in sunscreens, on the sentinel

aquatic organism *Daphnia magna* and on representative plant life, *Lactuca sativa* L. var. Buttercrunch. Sunscreens that appear clear on skin use a nano-form of the metal oxides. To study the difference in particle size, both nano and regular forms of each oxide were tested at a variety of concentrations.

In Phase One of the experiment, the metal oxides ZnO nano, ZnO regular, TiO2 nano, and TiO2 regular, along with a control, were each mixed into a 500 mL beaker of water holding 30 *Daphnia* each. After 48 hours, the live *Daphnia* were counted in each of the five beakers. Concentrations from 2 parts per million (ppm) to 50 ppm were used. While there is no statistical difference between the nano and regular-sized forms, both oxides killed significantly, especially zinc oxide.

In Phase Two, the same oxides were mixed with 2 mL of water and poured on unbleached filters in five Petri dishes (one was a control). Five lettuce seeds were placed on each filter; the radicles of the germinated seeds were measured after 120 hours. Concentrations from 500 ppm to 12500 ppm were used. Zinc oxide stunted growth, but particle size made no difference with either oxide.

Awards won at the 2009 ISEF

Second Award of \$350 - North American Benthological Society

2009 - EV011

LEACHING AND NITRIFICATION OF AMMONIA (NH3) THROUGH SOIL, SAND, AND CLAY.

Sarah Rebekah Warren
West Lafayette High School, West Lafayette, IN

The ability of plants to absorb nutrients from the soil will depend on the texture and pH level of the soil. Water moves many nutrients through the soil. This process is called leaching. Fertilizer can move through some soil types. If clay holds more water molecules because of lack of draining and leeching, then clay will hold the most ammonium compared to the Sand and Soil. Three vertical plastic tubes were set up each containing either soil, and or clay. A solution of Ammonia and diH2O was run through and the leached solution was tested using nitrogen testing strips. The nitrification of the Ammonia to NO2- and NO3- was inconclusive but the Ammonia levels in the diH2O that moved through were considerably less in the clay than the soil and sand. If clay retains more nutrients then it would be the better choice of soil

2009 - EV012

EVALUATING ESTROGEN AND ESTROGEN MIMICS IN PUBLIC WATER SOURCES USING A YEAST CELL-BASED BIOASSAY

Kim Mai Tuan Le
duPont Manual High School, Louisville, KY

Estrogens are vital hormones in the human body for controlling growth and differentiation of certain organs in both females and males. Altered levels of estrogen have been linked to various health problems like cardiovascular diseases and several cancers. Many chemicals in the environment have been known to act as estrogen mimics. Some mimics are beneficial while others can be extremely harmful depending upon the dose. This study was conducted to investigate whether there are estrogens and their mimics in public water sources around Louisville, KY. The hypothesis was that a test system consisting of yeast cells containing a plasmid producing the human estrogen receptor protein (the sensor) and a second plasmid producing beta-galactosidase (the reporter) would detect elevated levels of estrogen and/or their mimics. This bioassay was used to measure estrogenic activity of control known estrogenic compounds. Thirteen water samples from various locations around the city were tested. Samples were concentrated and extracted in either aqueous or ethanolic solutions. Each sample was tested in three trials. The hypothesis was partially supported by the results. Several of the water samples exhibited significant induction of beta-galactosidase (data with p value less than or equal to 0.05). This suggests that these samples contain estrogen-like substances recognized by the bioassay. Further study will consist of collection of more samples as well as possible purification and characterization of suspected mimics. If my studies are confirmed, and estrogen mimics are indeed in water from the Ohio River, perhaps improved water processing steps should be established.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2009 - EV013

EFFECT OF MIXED-CULTURE OF TYPHA DOMINGENASIS AND PHRAGMITES KARKA ON THE EFFICIENCY OF SUBSURFACE FLOW CONSTRUCTED WETLAND (SFCW) FOR SEWAGE TREATMENT

Usama Ahmed Awan
Pak Turk International Schools and Colleges, Khairpur Mir's, Sindh, PAKISTAN

Today in addition to urgent health issues we know that untreated sewage is the leading cause of global problems such as oxygen depletion, fish kill and ecological degradation of rivers and lakes, increasing pollution of our drinking water. Natural processes have always cleansed water and systems have been constructed to process for water quality improvement.

Subsurface flow constructed wetlands have same basis as of natural wetlands for solving environmental problems but unlike many natural wetlands it is subsurface flow so it prevents all sorts of bad malodors and mosquitoes breeding. The subsurface flow constructed (SFCW) system with mono and mixed-culture of *Typha domingensis* and *Phragmites karka* can be applied for sewage treatment.

Mono-culture of each plant did not show good result on SS, BOD5, ammonium and phosphorus removal but when mixed-culture of *Typha domingensis* and *Phragmites karka* is applied to treat the sewage, the highest results of sewage treatment is obtained. The project proves that difference on the plant species might affect the nutrients removal efficiencies; SFCW with mixed-culture is more effective than SFCW with mono-culture.

All systems were operated under various hydraulic retention times (HRTs) of 6, 3 and 1.5 days to observe the system efficiency and performance during 60 days cultivation. The experiment proved that mixed-culture of *Typha domingensis* and *Phragmites karka* had the highest SS, BOD5, ammonium-N2 and total phosphorus removal efficiency than mono- culture under all HRTs operation tested (6, 3, 1.5 days).

2009 - EV014

STUDY ON THE ABSORPTION OF LEAD IN SOIL BY LANTANA CAMARA L. PARASITIZED BY CUSCUTA JAPONICA

Jingwen Huang

No.65 High School, Guangzhou, Guangdong, CHINA

Lead uptake in soil by Lantana camara L. and Lantana camara L. parasitized by Cuscuta japonica was investigated in this study. Lead concentrations in the plants and soils treated with different levels of lead were determined by flame atomic absorption spectrometry. The results show that: 1. Lantana camara L. could absorb lead in soil. Lantana camara L. parasitized by Cuscuta japonica performed better than Lantana camara L. alone in lead absorption and could remedy the soil seriously polluted by lead to the extent of meeting the national criterions on the lead concentration in soil. 2. The absorption became strong along with the increasing of the lead concentration in soil at the beginning, but when the lead concentration in soil reached a certain level, the absorption tended to be stable. 3. The absorbed lead was mainly accumulated in roots, less in stems and least in leaves. 4. The absorption rate was varied in different growth stages of Lantana camara L. The fastest absorption occurred in the stage of 60-100 days. 5. Lantana camara L showed very high tolerance to lead in soil. Lead at low concentrations could stimulate its growth in a certain period, and along with the time went on, lead concentration increased, the tolerance to lead in soil tended to be weak.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2009 - EV015

THE EFFECT OF GLOBAL WARMING'S RISING CARBON DIOXIDE LEVELS ON THE DISAPPEARANCE AND DISSOLUTION OF CALCIUM CARBONATE CORAL REEFS

Nicholas Chien-Juei Lee

Sherando High School, Stephens City, VA

This project is on the impact of rising carbon dioxide on the disappearance of coral reefs due to ocean acidification. The hypothesis for this experiment was "if there are higher levels of atmospheric carbon dioxide, then there will be a greater degree of dissolution of calcium carbonate coral." A model system was designed using air tight containers with sample bottles containing dH2O and coral exoskeleton. The atmospheric CO2 concentration was maintained at 5%, 10%, 15%, and 20% and compared with the control (ambient air). The degree of dissolution of calcium carbonate coral was conducted biweekly by measuring the pH and conductivity of the aqueous solution at which time the concentration of CO2 was reestablished. At the end of the two month period the amount of exoskeletal coral loss was measured. The exposure of higher levels of atmospheric carbon dioxide resulted in increased solution acidity, conductivity, and greater loss of coral's calcium-carbonate based exoskeleton. By using ANOVA analysis and student t-tests, the weight loss and conductivity results were considered statistically significant. The results are consistent with the initial hypothesis that the rise in atmospheric CO2 results in acidification of the ocean causing dissolution of calcium carbonate coral. This model confirms rising carbon dioxide from global warming will have a significant impact on coral reef habitat. The phenomenal coral dissolution shows that rising atmospheric carbon dioxide levels has a direct and distinct negative effect on calcium carbonate based coral habitat. Our model can be further applied as a potential acceleration model of what can happen to our environment if atmospheric carbon dioxide continues to increase as proven by the rise of atmospheric carbon dioxide from 280 ppm in the pre-industrial era to 380 ppm in the modern day.

2009 - EV016

THE EFFECTS OF 2-4-DICHLOROPHENOXYACETICACID

Samuel Joseph Stafki

Perham High School, Perham, MN

Invasive species are becoming an increasing problem in Minnesota, and controlling them has become a top priority. Eurasian watermilfoil is being controlled in some places using 2-4-dichlorophenoxyacetic Acid. The question this project addresses is: What are the effects of 2-4-D on invertebrate species that live in an aquatic ecosystems? Because 2-4-D is widely used for aquatic weed control, it was hypothesized that 2-4-D will not have any effect on the invertebrate species Daphnia Magna and Hydra Fusca. 6 Petri Dishes were obtained and separated into groups of 2. All 6 Petri Dishes were filled with 40 ml of lake water .004 ml of 2-4-d was injected into 2 dishes using the micropipettor and .04 ml of 2-4-d was also injected into 2 other separated dishes. The last 2 dishes were untreated for control. 10 invertebrates were placed in each dish using the eye dropper. The invertebrates were then placed in a fume hood for an hour, and then taken out and examined with a magnifying glass for mortality from the transfer. From there on mortality rates were recorded over 24 hour periods. Once recorded, all invertebrates were humanely disposed of and a new set of 10 daphnia and hydra were placed in the dishes. As shown in the data mortality in the experiment was nearly double the number dead in control. In conclusion the hypothesis was proven incorrect and it appears 2-4-Dichlorophenoxyacetic Acid has an extremely negative affect on the invertebrate life of an aquatic ecosystem.

2009 - EV017

AN ASSESSMENT OF SILVER NANO-PARTICLES ON THE METABOLIC ACTIVITIES OF DAPHNIA MAGNA

Chanelle LeNai Whitehurst

Elbert Edwin Waddell High School, Charlotte, NC

To date, silver nano-particles (particles synthesized between the ranges of 20nm or smaller) have been revered for their uncanny ability to eradicate harmful pathogens, and minimize growth of these organisms in everyday products. They are being regarded as logical candidates for a plethora of medicinal purposes in the realm of nano-biotechnology. However the effects of these particles in the environment have yet to be conclusively studied. This experiment aims to

synthesize a possible futuristic environment with accumulated silver nano-particles and expose a model organism to these various simulated environments in order to ascertain any consequences and repercussions of having these materials introduced into the environment. This project assesses the effect of synthesized silver nano-particles on a biologically sensitive, *Daphnia Magna*, and its bacterial symbionts. Through direct observation of standard metabolic activities such, as enzyme catalysis, heart rate, and growth/development in *daphnia*, and qualifying the presence of specific bacterial types, we can infer the direct impact of silver nano-particles on organisms and possibly their environment. This project is consistent with the biotechnology/nanotechnology, and environmental science fields.

2009 - EV018

INVESTIGATING EPIGENETICS: METHYLATION AND POLLUTION-INDUCED GENE EXPRESSION IN THE INVERTEBRATE DUGESIA TIGRINA

Amy Elizabeth Van Scoyoc
East Hampton High School, East Hampton, NY

This project created a model for analyzing epigenetic expression as induced by environmental factors, specifically acid precipitation. Epigenetics is a field that interprets chemical gene-regulators, such as methylation tags, which attach directly to DNA to silence or express genes. Since methylation is heritable, the environment could have profound effects on microevolution. The investigations of this experiment were twofold; to discern whether methylation occurs in the invertebrate *Dugesia tigrina*, and if the anthropogenic factor of sulfuric acid impacts methylation and/or behavior in cloned individuals. There have been no previous methylation-toxicology studies performed on invertebrates using H₂SO₄. Methylation-sensitive enzyme restriction was completed using M_{cr}BC- endonuclease which discriminates methylated cytosines in DNA. Electrophoresis portrayed fragmented banding, thus displaying methylation in *Dugesia tigrina*. This poses that planaria can be used to monitor epigenetic changes due to H₂SO₄. Since planaria are regenerative, they can be cloned for comparative methylation studies. Cloned planaria were exposed to either a calibrated 10ppm H₂SO₄ solution or pH7 control water. Planaria exposed to the solution portrayed significant behavioral changes. To determine the presence of molecular methylation change, the worms underwent ms-enzyme restriction. The banding of control and experimental clones would be theoretically identical without methylation alteration, therefore any difference in fragmentation would be due to the sulfuric acid. However, the DNA was not concentrated enough to produce definitive bands, indicating the need for a larger sample size. This project indicates that cloning planaria for methylation analysis is an efficient model for deciphering the influence of anthropogenic pollutants on animal gene expression.

Awards won at the 2009 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2009 - EV019

AN ANALYSIS OF MICROBIAL DIVERSITY AND WATER CHEMISTRY IN KARST SPRINGS: EDDY COUNTY, NEW MEXICO AND CULBERSON COUNTY, TEXAS

Terryl G. Bell
Carlsbad High School, Carlsbad, NM

Hydrogen sulfide emissions occur in spring systems in southern Eddy County, New Mexico and Culberson County, Texas. Sulfur oxidizing/reducing bacteria were thought to be present due to the change in smell, observation of rock, and observation of water chemistry fluctuations. Determination of the sulfur bacteria's ability to improve the water chemistry or increase the quantity of ions in solution, preventing external growth and promoting self-growth, was the topic of the study. Water samples were tested for pH, reduction potential, and total dissolved solids. Chemical analysis determined which agars were used. Agars of LB, LB + NaCl, S6, and EMB indicated the general growth of bacteria, halophilic growth, sulfur bacteria presence, gram negative bacteria, gram positive bacteria, and *Escherichia coli*-like bacteria. Bacteria colonies grew on sulfur based media indicating that bacterial representation was widespread with a broad spectrum of bacterial types including sulfur bacteria as gram negative, gram positive, and *E. coli*-like. Bacterial diversity demonstrated trends with the chemical variations of the springs.

2009 - EV020

COMPARISON OF THE EFFECTIVENESS OF FORMALIN, HYDROGEN PEROXIDE, AND ULTRA VIOLET WATER PURIFICATION FOR THE CONTROL OF SURFACE PATHOGENS ON FATHEAD MINNOW EGGS

Jay B. Gulshen
Camdenton High School, Camdenton, MO

Warm water fisheries throughout the United States have approximately a 50% mortality rate among fish before their eggs even hatch. This mortality is mainly due to pathogenic growth (particularly fungi) that suffocates and infects eggs. In order to counter pathogens, fisheries use chemical treatments, traditionally, formalin and hydrogen peroxide. However, with the environmental concerns surrounding these treatments, a new solution is needed; the alternative solution tested in this study was Ultraviolet (UV) water purification to determine if UV purification could be as effective at lowering the infection rate amongst eggs.

In order to compare the effectiveness of these three treatments, an original apparatus was constructed to simulate a commercial fishery. Fathead minnow (*Pimephales promelas*) eggs were used in four test groups (UV, formalin, hydrogen peroxide, and a control (no treatment)). Data on the condition of each egg (healthy, infected) was collected 24 hours after the last chemical treatment and 48 hours before the projected hatch time.

In both collections, UV purification was shown to significantly lower the infection rate amongst eggs in comparison to the formalin, hydrogen peroxide, and control groups.

The results from this study show that using UV water purification can decrease the infection rate, and thus the mortality rate amongst eggs in warm water fisheries. This improvement in the biological efficiency could significantly increase the profit yield of commercial fisheries. Not only that, but using UV purification would diminish the role of hazardous chemicals in fisheries, decreasing the danger these chemicals pose to the watershed through runoff.

Awards won at the 2009 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2009 - EV021

A COMPARATIVE STUDY OF THE MERCURY CONTENT OF THE BEAR, JORDAN, AND WEBER RIVERS AND ITS EFFECTS ON THE WILDLIFE AND THE GREAT SALT LAKE CHRISTIE HEWLETT WEBER HIGH SCHOOL, PLEASANT VIEW, UTAH

Christie Hewlett

Weber High School, Pleasant View, UT

Water quality is vital to maintaining a healthy ecosystem. Concentrations of methyl mercury exceeding 25 nanograms per liter of water are found in the Great Salt Lake (GSL) in Utah, which far exceeds the water standard for safe fish consumption of 1 nanogram per liter of water. The question addressed in my investigation was, what is the source of mercury that is contaminating the GSL?

The GSL has three major inputs, the Bear, the Jordan, and the Weber Rivers. I collected water samples from the rivers and tested for mercury, ammonia, dissolved oxygen, and pH using proper sampling techniques. This testing was conducted to see if the rivers were a major source of mercury contamination.

The highest results from the data sampling is as follows: Jordan River mercury (mean 2.54 ppt), Jordan River ammonia (mean 0.153 mg/L), Weber River dissolved oxygen (mean 12.23mg/L), and Bear River pH (mean 8.17 pH).

My results indicate that the rivers are not a major source of mercury contamination to the GSL. However, the GSL has a major mercury problem. According to tests conducted by the U. S. Geological Survey, waterfowl living in the vicinity had mercury levels in breast and liver tissues that increased from 1 ppm when having first arrived at the GSL- to 18 ppm after living in the vicinity for six months. More research must be conducted to identify the sources of mercury in order to protect the wildlife and the GSL from the known detrimental effects of mercury contamination.

Awards won at the 2009 ISEF

Scholarship Award of \$12,500 per year, renewable annually - Florida Institute of Technology

Genius Scholarships - Sierra Nevada College

2009 - EV022

ACIDIC DRAIN WATER FROM ACID SULFATE SOILS & THE ADDITION OF AGRICULTURAL LIME

Samuel Dylan Wightman

Mullumbimby High School, Mullumbimby, New South Wales, AUSTRALIA

The Tuckean Swamp in north-eastern Australia is a site of acid sulfate soils that, when drained, result in sulfuric acid and metal oxides that render the soil unsuitable for agriculture and adversely affect the chemistry and biodiversity downstream. This study investigated the effect of Agricultural Lime on the pH of drain water from the swamp and on the concentrations of dissolved heavy metal ions. Samples of acidic drain water were neutralized with Agricultural Lime (CaCO3). A minimum practical concentration was calculated to achieve the required results. The Australian and New Zealand Environment Conservation Council (ANZECC) Guidelines (2000) were chosen as a standard for water quality. Measurements of pH and heavy metal concentrations were taken over time. Agricultural Lime increased the pH of the test water, most dramatically in the first hour. The dissolved heavy metals decreased in concentration as the amount of Agricultural Lime increased and the pH increased, with iron precipitating out first at approximately pH 4.07 followed by aluminium at pH 4.73 and zinc at pH 6.09. The other metals studied did not alter significantly over the pH range and the copper concentration was not reduced to the minimum ANZECC Guidelines for Aquatic Ecosystems. Actual amounts of Agricultural Lime used were higher than the theoretical amounts calculated probably due to organic matter present in the samples. These results indicate that Agricultural Lime has potential to reduce the acidity and concentrations of some toxic heavy metal ions in drain water from degraded acid sulfate swamps.

2009 - EV023

RAPID HABITAT AND WATER QUALITY ASSESSMENT IN RURAL AND URBAN WATERSHEDS

Tammy Tu

Cookeville High School, Cookeville, TN

study focuses on the water quality in three unique watersheds. The watersheds were selected to analyze the conductivity, geological formations, and rapid habitat assessment. From the three watersheds, samples were collected from 1st, 2nd and 3rd orders to compare the effect of urbanization on water quality in different order of streams. Total suspended solids (TSS) test was used to analyze the impact of rainstorms on the water quality. The TSS results were converted to turbidity and then compared with the EPA ecoregion 71 standard. All twenty-one samples were above the EPA Spring standard during storm event. Conductivity readings were collected during and before rainstorm. The data was compared and it showed that conductivity readings were higher before the rainstorm which have been the consequence of diluting effect from rainstorm. Conductivity was also used to analyze the affect of urbanization. Conductivity readings for both pigeon roost and spring creek were compared. It resulted that pigeon roost had higher conductivity readings than spring creek had. Pigeon roost is 76% urban while spring creek is only 9% urban. Geological factor, such as contact with limestone, has major influence on conductivity readings. Spring creek, where majority of headwater are from spring, showed highest readings while comparing to other non-impacted headwater, such as Blackburn. Conductivity was compared to the rapid habitat assessment score and there was a significant relationship between the two. As proven from this study, a higher conductivity reading will have a lower habitat assessment score due to the quality of habitat surrounding the sampling sites.

2009 - EV024

IMPLEMENTATION OF THERMAL PLUME RISE IN SILAM ATMOSPHERIC DISPERSION MODEL

Riinu Ots

Hugo Treffner Gymnasium, Tartu, ESTONIA

The aim of this study is to develop for SILAM air quality model an external module for calculation of rise of hot exhaust gases from industrial stacks and to study the sensitivity of the regional-scale model output to the thermal rise. The results of computations are validated against campaign measurements of fly ash deposition. The stages of this study are (i) plume rise calculations, (ii) sensitivity runs of SILAM with plume rise algorithms of different precision for a real site and time: fly ash from oil-shale-fired power plants, Estonia, December 2002; (iii) comparison of computed fly ash deposition fluxes with measured ones. For plume rise calculations a MathCAD program is written, based on the formulas by Briggs (1984). Time-dependent weather conditions (boundary layer height, vertical distributions of wind, temperature, potential temperature, turbulent diffusivity) are taken into account. Partial penetration of the plume through the capping inversion above the boundary layer is considered. SILAM model runs (horizontal resolution 5 km, vertical – 5 layers up to 300 m) are made (1) without plume rise (emissions at stack height); (2) with fixed typical (independent from current weather conditions) plume rise heights; (3) time-dependent thermal rises, applying the developed MathCAD program. Deposition fluxes calculated with time-dependent plume rise differ up to 2 times from those with initial stack height – thus, inclusion of plume rise in SILAM would be necessary. In comparison with measured deposition, the calculations cached the size order, but all the options (1, 2, 3) resulted in some underestimation.

Awards won at the 2009 ISEF

Trip to attend the China Adolescents Science and Technology Innovation Contest in July. - China Association for Science and Technology (CAST)
Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2009 - EV025

ARTIFICIAL SELECTION FOR POLYSTYRENE DEGRADATION IN BACTERIAL COMMUNITIES

Michael Robert Wallace
Tucson High Magnet School, Tucson, AZ

Polystyrene is a major environmental problem because it can be recycled but most recycling companies don't accept it, it usually can only be recycled back into what it originally was, or it is hard to store. So, as a result, it is either thrown away, burned, or dumped into the ocean. The theory of community genetics suggests that a collection of microorganisms can perform a function that an individual species cannot do by itself. The goal of this project was to apply the theory of community genetics to the problem of polystyrene degradation. Soil samples from ten sites were collected and diluted with Bushnell Hass broth. One milliliter of each sample was added to 49ml of Bushnell Hass broth along with 0.5g of polystyrene in a 250 ml flask. After one week of incubation each polystyrene sample was massed. Six bacterial communities that degraded the greatest mass of polystyrene were selected for further study. Three generations of the top six bacterial communities were exposed to an environment where the main carbon source was polystyrene. Within a 95% confidence interval, 77.77% of the samples digested various amounts of polystyrene. A negative polystyrene mass trend indicates that additional generations of bacteria will further digest the polystyrene.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel
Alternate for trip (DO NOT ANNOUNCE) - American Committee for the Weizmann Institute of Science

2009 - EV026

THE REMEDIATION OF EUTROPHICATION WITH POTASSIUM SALT TARGETING MICROCYSTIS SPP.

Yao Sing Wong
North Quincy High School, Quincy, MA

Eutrophication is a process in which the rapid growth of algae and cyanobacteria in ponds decreases the dissolved oxygen concentration, thereby suffocating freshwater organisms. Three major consequences of eutrophication are: buildup of sediments and detritus, competition for nutrients and sunlight, and decrease in dissolved oxygen concentration. Microcystis, a genus of cyanobacteria, adds a whole new dimension to eutrophication by producing toxins, such as microcystins, that are poisonous to both freshwater organisms and humans. Although there are available treatments for eutrophication, these treatments inhibit the growth of other organisms, such as fish, in addition to the growth of Microcystis. This experiment seeks potential treatments that target Microcystis without affecting other organisms. Two possible treatments were potassium chloride and aeration. It was predicted that the synergy of the two treatments would best eliminate the various consequences of eutrophication and improve water quality. Nitrogen cycles were generated in five groups of modeled ponds in order to create eutrophication. Measurements on percent transmittance, dissolved oxygen concentration, nutrient concentration, and pH were used to determine the effectiveness of the tested treatments. Additionally, pictures of freshwater plants were compared and statistical analysis was performed on the data. The data demonstrated that the combination of the two treatments best eliminated Microcystis and the other major consequences of eutrophication without harming other organisms.

Awards won at the 2009 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2009 - EV027

DISSOLVED OXYGEN VS. THE POPULATION OF BLUE CRAB

Brenilyn Saldivar Andal
W.E.B DuBois Environmental Science, Baltimore, MD

The goal of this research project was to determine the relationship of dissolved oxygen and the population of the blue crabs in the Chesapeake Bay. Extensive research was conducted to determine the amount of dissolved oxygen in Chesapeake Bay waters. The overall question of this project is that "What is the relationship between the amount of dissolved oxygen and the population of blue crabs in the Chesapeake Bay?" Thorough investigation was done through the internet using the different websites from the Maryland State Department of Natural Resources (DNR) and the Chesapeake Bay Foundation regarding the decrease of the population of blue crabs and the Bay's hypoxic problem. The hypothesis was tested based on the data, graphs, illustration, and the written reports found at research sites. The overall research conclusion was that there is decreasing amount of dissolved oxygen in the Bay and that does really affect the population of the blue crabs. The population of the blue crabs is decreasing as the amount of dissolved oxygen decreases. More so, many researchers think that the population of blue crabs will continue to decrease in great number, if the amount of dissolved oxygen does not increase. This project concludes with the review of current efforts to conserve and restore the Chesapeake Bay blue crabs population.

2009 - EV028

DOWN THE DRAIN: THE EFFECT OF TOOTHPASTE ON FRESH-WATER PROTISTS

Lara L. Martin
Success Academy, Cedar City, UT

Almost two billion dollars worth of toothpaste is purchased each year and consequently washed down the drain in the USA. This research project examines whether toothpaste has an effect on organisms at the bottom of the food chain in fresh water ecosystems. The effect of Triclosan, an antibacterial compound now being added to toothpaste, was also tested. Toothpaste samples with and without triclosan were thoroughly mixed with water collected from a natural water source. The toothpaste mixtures were then serially diluted in the natural water and incubated at room temperature for 24 hours. Following incubation, samples were taken from the bottom of each tube and examined immediately under a microscope. Because the living protists moved in and out of the field of view, five photographs were taken of each sample in thirty second intervals. The number of living protists was determined by averaging the numbers of protists in the photographs. My results show that toothpaste, even at very dilute concentrations, kills naturally occurring protists in fresh water ecosystems. Furthermore, toothpaste containing triclosan at levels that are found in water coming from sewer plants, is even more toxic to fresh water protists.

2009 - EV029

THE USE OF BIOLUMINESCENT BACTERIA TO DETECT ENVIRONMENTAL CONTAMINANTS

Li Sallou Boynton
Bellaire High School, Bellaire, TX

The narrow detection range of conventional chemical specific tests necessitates the development of an efficient and versatile assay for the detection of a broad range of water contamination. Thus, research was conducted to explore the effect of six contaminants on the bioluminescence of the bacterium *Vibrio fischeri*, including CuSO₄, ZnSO₄, NaNO₃, HgCl₂, Atrazine (herbicide) and Permethrin (pesticide). A decrease in *V. fischeri*'s bioluminescent properties was correlated to the presence of contamination. Bacteria were cultured in both liquid flasks and agar plates until they reached late exponential phase of growth. Contaminants were then added according to EPA values and cultures were monitored for 150 minutes in 30-minute intervals. A unique detection method was used to evaluate light intensity: cultures were photographed at 30-second exposure in a light-proof box containing a digital camera connected to a PC. Each image was analyzed using the Image J's Batch Measure Macro to obtain its mean light intensity value. Data was normalized, and in liquid flasks combined with optical density (measured with a spectrophotometer at 600 nm), to produce standardized results. The average of multiple trials verified the adverse effect of all contaminants on bioluminescence within 150 minutes of introducing the contaminants. In liquid flask trials, light intensity decreased by 42 to 70%. In agar plate trials, luminescence decreased by 64 to 87%. The use of this cell biosensor could improve public health by serving as a fast, economical, and versatile method to detect a broad range of toxins that often feed into our drinking supplies.

Awards won at the 2009 ISEF

A Scholarship of \$50,000. - Intel Foundation Young Scientist Award
Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by Intel
One all expense paid trip to London International Youth Science Forum, three \$1,000 U.S. Savings Bonds, \$500 from the Association of the United States Army, a gold medallion and certificate of achievement. - United States Army
First Award of \$3,000 - Air Force Research Laboratory on behalf of the United States Air Force

2009 - EV030

NATURAL ORGANICS CONTROL AGGREGATION OF MERCURY SULFIDE NANOPARTICLES IN FRESHWATER SYSTEMS

Eileen Kao Jang
North Carolina School of Science and Mathematics, Durham, NC

Mercury (Hg) is an environmental contaminant that is neurotoxic to humans, particularly to individuals exposed through consumption of fish. In aquatic environments, Hg-sulfides, such as HgS nanoparticles, are precursors to methylmercury, the form of Hg that bioaccumulates in fish. Current knowledge is limited regarding processes through which HgS nanoparticles persist. The goals of this study were to: 1) synthesize uncapped HgS nanoparticles, 2) characterize these nanoparticles, and 3) test aggregation rates of nanoparticles in solutions simulating natural conditions. A novel aqueous synthesis process for uncapped nanoparticles was developed using a controlled precipitation process. The resulting metacinnabar-HgS(s) was characterized through transmission electron microscopy, energy dispersive x-ray spectroscopy, and x-ray diffraction spectroscopy. Using dynamic light scattering, the aggregation rate of HgS nanoparticles was found to increase as salinity increased. Furthermore, the aggregation rate decreased in the presence of cysteine, an organic acid prevalent in sediment porewater. Through comparison of cysteine to a structurally-similar organic acid, serine, it is believed that the sulfhydryl group in cysteine is responsible for controlling aggregation rates. By studying the biogeochemical processes of these ubiquitous nanoparticles in aquatic systems, this

research has deepened the understanding of mercury in its aqueous phase and furthered the emerging field of nanogeoscience.

Awards won at the 2009 ISEF

Second Award of \$750 - American Geological Institute

Second Award of \$150 - Association for Women Geoscientists

Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2009 - EV031

EFFECT OF CORTICOSTERONE ON THE EXPRESSION OF INSULIN RECEPTOR MRNA IN XENOPUS LAEVIS (AFRICAN CLAWED FROG)

Anita Vasudev Saraf

Alfred M. Barbe High School, Lake Charles, LA

of experiments were conducted to see the effect of a hormone and an herbicide on the expression of Insulin Receptor mRNA in the African Clawed frog. The hormone corticosterone and the herbicide Atrazine were used. Three tissues were tested in the experiment: the brain, the spleen, and the skeletal muscle. Four main steps were done to complete both trials: preparation of the tissue, Polymerase Chain Reaction, Gel Electrophoresis, and sending the DNA off to sequencing.

In trial one, the effect of the hormone on insulin receptor expression was tested on all three tissues. The skeletal muscle and brain tissues showed that the corticosterone decreased expression of insulin receptor mRNA. Corticosterone had no effect on insulin receptor mRNA in spleen tissue.

The second trial using the herbicide Atrazine was only tested on the skeletal muscle tissue. Similar to the results in trial one, the skeletal muscle had decreased expression of insulin receptor mRNA after Atrazine exposure.

The experiments illustrated that the herbicide and hormone can affect some of the African Clawed frog's tissue. Literature reveals the use of Atrazine can result in a deformed or undeveloped frog. These findings may demonstrate the danger of using Atrazine as an herbicide in the United States.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2009 - EV032

HOW THE ADDITION OF AMENDMENTS (FERTILIZER AND NUTRI-BREW) AFFECTS THE GROWTH OF ZEA MAYS (CORN) ON THE SOLVAY WASTE BEDS

Sara Lynn Coffey

Liverpool High School, Liverpool, NY

The objective of this study was to determine if amendments (Miracle Grow fertilizer and Nutri-Brew) would improve the growth of Zea Mays (corn) on the Solvay waste beds. Corn was selected for this study because it can adapt rather easily to its growing environment and it also can be used as a food source or biofuel. This test was conducted by obtaining soil from the Solvay waste beds and testing the growth of the control (waste bed soil only) against the growth of the waste bed soil and different combinations of the amendments. Results suggest that optimal corn growth occurs when there is a mixture of 75% Nutri-Brew and 25% waste bed soil. However the control group that contained only waste bed soil and no amendments yielded comparable corn growth. This study is significant because it shows that there is potential for corn growth on the Solvay waste beds despite the difficult growing conditions, and that the use of Nutri-Brew can be beneficial to growth on the waste beds. The increased growth of corn can also be beneficial for phytoremediation of the soil.

2009 - EV033

SINK OR SOURCE: THE ROLE OF STREET SOLIDS IN HEAVY METALS CONTAMINATION OF RIVER WATER

Benjamin Chang Sun

Red River High School, Grand Forks, ND

Purpose: Evaluate how street solids adsorb/desorb heavy metals and investigate how the process affects river water quality

Hypothesis: Street solids are one of the sources of heavy metal pollution to the river water.

Tasks

•Collect and characterize city street solids

•Carry out an adsorption study to find various adsorption characteristics (e.g., rate, maximum amount, particle size, and other factors affecting adsorbability)

•Carry out a desorption/leaching study while varying certain conditions (pH, leaching duration, type of water, number of leaching repetitions)

Results/Discussion

•The data shows that particle size distribution in the street solids varies greatly but the densities of the fractions in each solid are similar. The density decreased with particle size, and similar trends were found in all the solid samples.

•The adsorption study showed that the fastest adsorption occurs within five seconds of contact. As particles size decreases, the adsorption ability increases, suggesting a correlation between adsorption and particle surface area. The data also suggested that there is a limited availability of surface sites for the adsorption of heavy metals and the process can reach a state of saturation.

•The leaching results from normal solids (non-heavy metal spiked) showed a very small percentage of the total heavy metal content in the solids was leached out, indicating a chemical bond of these metals with other elements. The leaching data from the spiked solids, however, showed a much higher percentage of desorption strongly suggesting the loose binding (adsorption) of metals to the surface of the solids. Each element's desorption percentage also differed.

•Matrix type has a negligible effect on adsorption as well as desorption.

Awards won at the 2009 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

Tuition Scholarship Award in the amount of \$8,000 - Office of Naval Research on behalf of the United States Navy and Marine Corps

2009 - EV034

NATURE'S WAY OF PURIFYING WATER

Nicholas Porcincula Knoblich
Ashley Public School, Ashley, ND

Is all Solar Distilled Water the same? I purchased two WaterSafe test kits at www.filterwater.com. The problem is Logical and Defendable because the Results can only be obtained by executing the procedure. Anyone can obtain these test kits.

I Purchased my test kits and constructed my solar distiller

I then collected my water sample, which were Lake, pond, River, and Graywater (I made)

I Tested the water samples 3 times for Nitrate/Nitrites, Chlorine/Hardness, pH, Alkalinity, Phosphate, Lead/Pesticides, And Bacteria.

I then Distilled the same water and tested it for the same parameters

I recorded my findings....

Similarities were that the Nitrates, the Lead/Pesticides, and bacteria had most of the similarities before the water was Distilled, differences before Distillation were that the Hardness and pH were off. After Distillation the Results were all the same and no difference....

When I Began my experiment my hypothesis was that if you take any type of water and distill it, the results will be the same. As I look at my current results from which I Conducted the Nitrate/Nitrites, Chlorine/Hardness, pH, Alkalinity, Phosphate, Lead/Pesticides, And Bacteria tests. I found that my Hypothesis is correct. My results showed that before distillation there were some Similarities and some differences. After Distillation the Results from the same parameters turned out exactly the same.

2009 - EV035

ANOTHER ONE BITES THE DUST

Megan Dawn Telehey
Trinity Christian School, Williston, ND

The purpose of my project was to find the most effective and environmentally friendly way to kill aedes aegypti mosquitoes. I thought that the egg and the vegetable oil would be the most effective and environmentally way to kill them.

I started out by testing all of the treatments for environmental friendliness with a soil/water testing kit. In the kit, there were four tests: pH, phosphorus, potassium, and nitrogen. I found that all of my treatments were environmentally friendly (except for the egg, which was smelly and disgusting-obviously not environmentally friendly).

Next, I got 1,000 eggs from vector control to use. Then, I got 10 live traps from them. I put 500 milliliters of hot water and 1 gram of guinea pig food in each of the live traps. I let them sit three days and then I put in the eggs. They were layed on strips of paper, so I cut 1/4 in. squares of the paper (approximately 100 eggs per live trap). I waited a few more days, then I applied the 9 treatments: vegetable oil, vectolex, vectobac, monomolecular oil, cinnamon oil, egg, lime juice, yeast, and altosid. I also left one of the live traps neutral. For liquids I put in 1 milliliter of the treatment and for the solids I put in 1 gram of the treatment. I watched the mosquitoes every other day for 30 days and recorded how many died, became adults, and how quickly they died.

My conclusion is that the vegetable oil was environmentally friendly, but the egg wasn't. Neither of the two were the most effective. The most effective was the monomolecular oil and the cinnamon oil.

2009 - EV036

FOUNDRY SAND: WASTE OR BENEFICIAL PHASE IV

Kayleigh Sue Warner
DeKalb High School, Waterloo, IN

The project is a result of experimentation using foundry sand and Blount soil mixture to determine optimal growth. The general belief of my community was sand exposed to chromium, manganese, nickel, and iron in the castings presented a danger to the community.

To determine the levels of these elements I tested both sample and control plants. Using Atom Absorption Peckin-Elmer 2380 I was able to determine the sand had a lower amount of iron with 2.72 grams of iron per Kg of sample plant compared to 5.69 grams of iron per Kg of control plant, a lower amount of chromium with 0.05 grams of chromium per Kg of sample plant compared to 0.09 grams of chromium per Kg of control plant, a lower amount of nickel with 1.30 grams of nickel per Kg of sample plant compared to 1.37 grams of nickel per Kg of control plant, and a lower amount of manganese with 0.93 grams of manganese per Kg of sample plant compared to 1.00 grams of manganese per Kg of control plant.

The contributions are twofold. First by disproving the community belief that the sand contains toxic elements by using the Atomic Absorption Peckin-Elmer 2380 machine. Secondly by conducting eighteen five foot by five foot reps using different percentages of foundry sand and Blount soil mixtures the results showed that a 15-20% foundry sand to Blount soil mixture made a 8% soybean yield increase.

2009 - EV037

A PROTOTYPE SEWAGE TREATMENT PLANT

Nicholas Leo Kinzer
Lakeview High School, Columbus, NE

A prototype sewage treatment plant was designed, built, and tested that would not require chemicals or electricity and still produce an environmentally friendly effluent by removing biosolids and aerating the water thus increasing the dissolved oxygen (DO) and reducing turbidity.

Water was collected from a fish aquarium to create sample sewage water. A wheel with four, 17 centimeter long by 6 centimeter wide Lexan spokes was constructed and attached to a motor. The spokes had holes cut into them and wire mesh screen was placed over the holes to catch biosolid particles. A tray cascade system, with three trays set 5 centimeters away from the one below it, caused the water to cascade and bubble and thus increase the DO and oxidize ammonia into nitrates.

No chemicals were used and yet ammonia was dropped from 4.1 to 2.0 ppm (a 51.2% reduction), the dissolved oxygen increased from 3.1 to 5.5 ppm (a 43.6% increase), and the turbidity dropped from 145.6 to 25.3 ppm. An 82.6% reduction in turbidity was reached compared to 98.6% at a publicly owned treatment works (POTW). In the future, a second wheel could be attached to the first so that a stream or river current could power the whole system. With the need for no chemicals or electricity, the device would be practical for third world countries, fish farms, or refugee camps where sewage can damage the surrounding water ecosystems.

2009 - EV038

PHOTODEGRADATION OF THE ANTIMICROBIAL TRICLOSAN IN AQUEOUS SOLUTION

Patrick George Maguire

De La Salle High School, Concord, CA

Triclosan, the active ingredient in antibacterial soap, may be harmful to the environment. There have been studies illustrating the development of toxic chemicals under ultraviolet light in water and the affects of the chemical on ecosystems and certain organisms. The main objective of this project was to determine whether ultraviolet light affects the antimicrobial triclosan in different aqueous solutions. A failure of triclosan to degrade will be a hazard to the environment.

I took a relatively quantitative approach in the determination of triclosan in three different solutions. I wanted to determine if triclosan degradation is significantly different in certain solutions over a 24 hr period. The triclosan samples were exposed in an exposure chamber with an ultraviolet light source. Triclosan was detected by enzyme linked immunosorbent assay (ELISA). To measure the absorbance for ELISA, I analyzed the samples with a spectrophotometer.

The data illustrated degradation of triclosan in each of the three aqueous solutions. There was no difference at a significance level of $p<0.05$ in the degradation of triclosan in the different types of solutions, although there were trends in the data. The rate of disappearance of triclosan averaged 29.42 ng/ml.

In order to show significance in the degradation of triclosan between solutions, there would have had to be more replicates. Triclosan does degrade under ultraviolet light. What happens if an aquatic ecosystem does not receive much ultraviolet light or if the products of the degradation are toxic? Precautions should be taken in these areas to promote a healthy environment.

2009 - EV039

THE EFFECT OF SELECTED DISINFECTANTS ON THE PHYSIOLOGY OF CALIFORNIA BLACK WORMS

Alisha April Blair

North Toole County High School, Sunburst, MT

urpose of this experiment was to determine if the addition of selected disinfectants into a California black worm's habitat would affect their physiology. Black worms are an invertebrate commonly used in toxicology studies because of their ability to tolerate chemical contamination. Disinfectants, my variable, are relevant because disinfectants are commonly used around the country and world. Where, after use they are washed down the drain and into the environment. I have chosen two disinfectants; Lysol, commonly used in many homes and businesses, and ZEP, the disinfectant currently used in my school.

I first ran toxicity tests to find a dilution that was not toxic to the worms. Once that dilution was discovered, I made two cultures of the 99.979% dilution, one with Lysol, one with Zep, and a control, which was pure water. I put 30 worms in each culture, checking them daily for changes in appearance and mortality for five days. At the beginning of the experiment I checked VCR's (vascular contraction rates) to establish a control rate. After five days I terminated my experiment, took one last observation and recorded VCRs of 10 worms from each culture.

In conclusion, I discovered that the disinfectant had a significant effect on the survival rate of the worms, as well as their vascular contraction rates. There was a greater effect in the ZEP disinfect because their VCRs were significantly lower than those of the Lysol. The disinfectant also affected the color and behavior of the worms.

Awards won at the 2009 ISEF

Genius Scholarships - Sierra Nevada College

2009 - EV040

THE RISE IN OCEAN ACIDITY: NO BASIC SOLUTION, A SECOND YEAR STUDY

Kara Ricky Hustad Dastrup

Kapaa High School, Kapaa, HI

Since the start of the industrial revolution, carbon dioxide emissions have skyrocketed to never before seen levels. Research shows that the more CO₂ in the Earth's atmosphere, the higher the atmospheric temperature. Research also tells us the more CO₂ absorbed by the ocean, the more acidic the ocean water. This acid that forms when CO₂ bonds with water, known as carbonic acid, eats away at calcium carbonate. Many oceanic creatures' shells and homes as well as coral reefs are made out of calcium carbonate.

The ocean has been referred to as a "Carbon Sink," meaning it can store CO₂ for an extended period of time. This raised the question as to whether or not the ocean could store the excess CO₂ forever. Based on my previous research it was noticed that the increase in temperature had a direct correlation with the increase in acidity.

Based on these results, another question was raised as to if CO₂ gas was being admitted into the atmosphere during the heating process. An experiment was created to test the CO₂ levels of the water vapor throughout the heating process. The trials' data supported the hypothesis, thus leading to the conclusion that if the temperatures of the solutions are increased, then carbon dioxide gas will be released, thus perpetuating the rise in Ocean Acidity.

2009 - EV041

TAR CREEK –MEASURING THE RECOVERY OF A SUPERFUND STREAM USING MACROINVERTEBRATES

Nicholas Lee Shepherd

Miami High School, Miami, OK

Tar Creek is located in Northeast Oklahoma. It channels its way through chat piles and picks up acid mine run-off from the now-extinct mining industry. Multiple, ongoing studies have indicated high levels of Lead, Zinc, Cadmium and Manganese which have been known to accumulate in the tissues of small birds and mammals in the Tar Creek Flood Zone. The link between heavy metal sediments and macroinvertebrate colonization is understudied for the Tar Creek watershed. This project evaluates the recovery process of Tar Creek as it travels from the Picher minefields towards the Neosho River by evaluating the colonization of macroinvertebrates at three sites along the flood zone.

 Fresh Leaf Litter (FLL) test apparatus were prepared by constructing wire

gauze traps. The traps were filled with fresh leaf litter and placed at three locations along Tar Creek. The FLL devices were left undisturbed for a time frame of 2, 4 and 6 weeks. The leaf litter was washed and the macroinvertebrates were collected and classified.

 The macroinvertebrates diversity of the colonized FLL devices was evaluated for diversity and total numbers. The samples were picked and analyzed using standard macroinvertebrate picking and classifying techniques.

 This study found many more macroinvertebrates at each site then hypothesized. Group 1 taxa macroinvetebrates were found though out the study which was unexpected. This study indicates Tar Creek has substantially recovered from the time it was the top superfund site of the nation. More studies of this type should be continued to document the recovery.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2009 - EV042

IF WATER IS GREEN, CAN IT STILL BE CLEANED? PHASE II

Kimberly Ann Hulm

Strasburg Public School, Strasburg, ND

The purpose of my project was to see if a Centrifuge had an impact on the trace elements found in different water samples and also to see if the Bacterial Count would decrease after all the cycles were completed.

 Before I could start my experiment, I had to collect seven different samples of water which were Dugout Water, Lake Water, Ground Water, Distilled Water, Tap Water, Well Water, and Snow. After I had gathered all of the necessary supplies and tools that I would need to conduct my experiments, I had begun my testing. I would fill the Centrifuge with eight test tubes, all containing the same sample. Then I would check how much Total Chlorine, Free Chlorine, Copper, Iron, Phosphate, Mercury, Hardness, Alkalinity, Lead, and Arsenic. Next, I would take a sample of the water that I was testing and put a swab of it in a Petri Dish. After I recorded all these results, I would place the cap on the Centrifuge and set the stopwatch for one minute. I would use one minute as my trial time for all the tests so that each would be given the same amount of time in the Centrifuge. Instead of using each speed, I would test in increments of 20 RPMs. After the cycle was completed, I would take a sample of it and test for the trace elements again. I would do this after each speed, except I would only check for Bacteria and Arsenic before the cycle and after all the cycles were completed.

 I would do this same test for all of the samples and once the testing was done, I would analyze my data. The data confirmed that the Centrifuge did decrease the amount of Bacteria present and the trace elements identified. In conclusion, the Centrifuge had a massive impact on the samples of water. I ultimately believe that the Centrifuge could be used as a potential source for water purification.

 If I were to continue on with my project, there are several things that I would do to improve it. Firstly, I would increase the trial time. Secondly, I would increase the samples temperature and see if that would have an impact on the Bacteria and trace elements present in the different samples.

Awards won at the 2009 ISEF

Second Award of \$1,500 - Air Force Research Laboratory on behalf of the United States Air Force

2009 - EV043

THE WAR ON CO2

Tyler W Akins

Fayette Academy, Somerville, TN

In Phase I, an investigation of the possibility that certain plastics could remove CO2 from the atmosphere was inspired by the "Green Bags" which absorb ethylene gas extending the life of fruits and vegetables. Various plastics (polyethylene) were tested and data indicated VLDPE (Very Low Density Polyethylene) recorded the greatest decrease in the CO2. The simple chemical reaction of sodium bicarbonate and a 5% acetic acid was used to generate the CO2. Numerous variables were identified that should be addressed and lack of a consistent standard was identified.

 Phase II experimentation focused on eliminating variables and establishing a standard with an electronic balance for accuracy. Experimentation was expanded to include the "Green Bags" and the CO2 absorbing mineral, olivine. Data indicated no CO2 absorption from these materials and noted an actual increase in CO2 from the "Green Bags".

 Phase III experimentation narrowed the focus to VLDPE film. All variables were eliminated with the exception of the human element produced by the physical placement of the balloons. The standard was followed and a repetitive test was conducted providing a mean. Data indicates a notable reduction of the CO2 mass in the balloons. Further research of the moecular structure of the polyethylene molecule revealed molecular bonds with 110 degree angles and numerous molecular branches. The increase in space from the normal 90 degree angle could explain the decrease in CO2 mass. The extra spacing might allow room for the Co2 molecule to rest in the chain. Access to an electron microscope could provide valuable data about this spacing hypothesis.

2009 - EV044

THE EFFECTS OF PESTICIDE AND FERTILIZER ON DAPHNIA MAGNA

Allison Beth Frederick

Hilton Head Preparatory School, Hilton Head Island, SC

This project displays the effects of runoff water contaminants on Daphnia magna. Daphnia are small freshwater crustaceans that are transparent and feed on algae and bacteria. Runoff is collected water off roads that may contain fertilizers and pesticides. Testing was conducted by culturing Daphnia, then separating into the following 12 categories: 3 control, 3 mixture of fertilizer and pesticide, 3 fertilizer, and 3 pesticide, all with culturing water. Data was taken over 14 days by using a microscope to record heart rate and a centimeter grid to calculate swimming distance. After several attempts at creating a stable culture of Daphnia, and decreasing contaminant amounts, experimentation was successful. The group that was harmed the most by contaminants was the mixture of fertilizer and pesticide. Heart rate was greatly decreased by the solution with an average of 268.29 beats per minute (BPM). Swimming activity and surviving Daphnia also sufficiently decreased. The control group maintained the most stable results with 297.14 BPM average, all Daphnia living, and activity rate high. It was

predicted that the pesticide solution would make heart rate, swimming activity, and surviving Daphnia decrease, which was proved incorrect. Instead, the mixture of pesticide and fertilizer displayed the most adverse results. This probably happened because the mixture was more concentrated than just the individual pesticide solution. A reaction might have also taken place between the fertilizer, pesticide, and Daphnia. In comparison to the known heart rate of Daphnia, 300 BPM, the control was close, with an average of 297.14 BPM.

2009 - EV045
SECOND HAND SMOKE ON CILIA

Patrick Ralph Lee Worthey
East Noble High School, Kendallville, IN

The project was conducted to assess the effects of second hand smoke on cilia and the longevity of cells exposed to second hand smoke. It was hypothesized that the prolonged exposure to second hand smoke and or its components would adversely affect ciliated protozoa cells.

 Second hand smoke samples were obtained in water and on cloth. A smoke chamber was also created to duplicate a smoking environment. Nicotine solutions of .2%, .02%, and .002% were also created. Data consisted of testing the time it took for the cilia to fully extend after the recoiling action by Stentor sp. Life span tests were also conducted to assess the effects of the different smoke solutions. These consisted of different types of second hand smoke: smoke collected from local bars, also an air tight chamber eight inches away from a burning cigarette. Once these tests were conducted the Stentor were place on a slide and a nicotine solution was placed on the edge of the cover slip.

 Test data showed that there were significant changes in the extension time of cilia at the 2%, .2%, .02%, and .002% nicotine solutions and groups 2, 3, and 4 when compared to the control group. Data also showed that the higher nicotine concentration in the solutions created the lower the longevity of Cilia on Stentor.

 In conclusion the exposure of nicotine from both secondhand smoke and the nicotine solutions significantly decrease the ability to function and longevity of cilia.

2009 - EV046
GOT BROWN WATER?

Tambriya Denesia Barney
Simmons High School, Hollandale, MS

How would you like to drink brown water? Most people wouldn't. My region's municipal water supply is discolored due to tannins in the ground water from an ancient cypress swamp. Studies have shown the expense of removing this discoloration would be exorbitant. The purpose of this study was to prove that inexpensive water filtration systems can be developed to improve the color. A series of six trials was conducted, using two water filtration systems: simple carbon filtered and an intricate thermal water filtration system. Tap water served as the control in this study. The water was filtered through a simple homemade water filter (made of gravel, sand, activated charcoal, and plastic bottles) and a more advanced heated filtration system (also using charcoal, but with additional steps to remove impurities). Both methods removed the tannins, but the thermal system removed more of the discoloration. Both systems were inexpensive. The simple filtration system cost less than five dollars and the thermal system could be built for less than fifteen dollars. Many of the items I used were recycled or commonly found. My conclusion was that our municipal water supply could be treated inexpensively at home or at the source using the methods I used in my procedure to remove tannin.

2009 - EV047
GOOD UP HIGH, BUT BAD NEARBY!: THE OZONE PROJECT NAVASOTA HIGH SCHOOL, NAVASOTA, TEXAS

Andrew Stephen Paiyou
Navasota High School, Navasota, TX

rpose of my experiment was to measure and see which place,the High School or Elementary School, sustained the most ozone pollutants. I hypot hesized that the buses go to the elementary school first, then the elementary school will devolp the highest ozone reading in the afternoon. The way I did this was using homemade and bought ecobadge test card, a one hour test card, and a one 8hour test card on each location at each school. I left them out for their set amount of time required.I used a color chart to read the homeade card and a Zikua cardreader to read the ecobadges. I repeated thiis for four days (including weekdays and weekends). I also recorded weather data foreach day. I graphed all the data. My data was high in the High School and low in the Elementary School. The data pretty much stayed the same for the four days of testing. As a result of my experiment, I have learned that my hypothesis was wrong. The High Scool was in fact the most ozone polluted, instead of the Elementary School. This could be because the High School is out in the open with major highways surrounding, and that the Elementary School has trees surrounding half of it. I will be completing a secound round of testing comparing a control site to one site at each school.

2009 - EV301
THE INFLUENCE OF TEMPERATURE DIFFERENTIATION ON EMBRYO FEMALE-TO-MALE SEX REVERSAL IN MEDAKA FISH, ORYZIAS LATIPES.

Benedict Leo Scheuer, Bethany Rosemore,
Cloquet Senior High School, Cloquet, MN

Fluctuating water temperatures, as a result of global climate change, has become a critical problem in various bodies of water (Korner et al., 2008). Many animals have their gender determined by temperature and Medaka fish could potentially be influenced as well (Rhen et al., 1999). The question is, what influence does temperature differentiation have on embryonic female-to-male sex reversal in Medaka fish, Oryzias latipes. The hypothesis is, if Medaka embryos are exposed to temperature fluctuations, within normal range, then phenotypic female-to-male sex reversal in Oryzias latipes will increase. To perform the experiment, three different temperatures of 26°, 29°, and 32° Celsius were maintained in 12 tanks: four tanks for each temperature. Eggs were then added

to each tank. Once the fry hatched, they were raised in 26° C water until the genders could be determined phenotypically. The male-to-female ratios were then observed and the data was analyzed with SPSS and a Univariate Analysis of Variance (ANOVA) was done. The results showed that as temperature increased the percentage of males increased as well. When comparing all temperatures, a t-test showed there was significant difference with $p < .01$. T-tests done also showed there was a significant difference in gender ratios among all of the temperatures except between 29° and 32° Celsius. Between those two temperatures there was a p-value of $p < .231$. This suggests a sex change threshold before those temperatures. This project will prove beneficial because the survival of aquatic species affects entire ecosystems and ultimately the entire planet.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2009 - EV302

PREVALENCE OF NITRATES IN COMMUNITY GROUNDWATER

*Benjamin Reuben Suhr, Colin Marklowitz,
Cochrane-Fountain City High School, Fountain City, WI*

Nitrate levels in drinking water need to be below 10 mg/L in order to be safe for human consumption. Consuming water with nitrate exceedances may cause methemoglobinemia, commonly known as Blue-Baby Syndrome. Buffalo City, Wisconsin is the largest city in the state of Wisconsin without a sewage waste treatment plant. The researchers hypothesized that the average nitrate levels in Buffalo City groundwater would exceed the health standards. Spectrophotometric methods were utilized to analyze nitrate concentration in samples. Before gathering samples, a calibration curve was prepared using samples with known nitrate concentrations. Stratified random samples were taken from thirty Buffalo City homes. Each sample was tested and the absorbance reading interpreted using a calibration curve to obtain the concentration of nitrates in each sample. The results obtained supported the hypothesis; with every sample tested showing higher nitrate levels than 10 mg/L, and some as high as 19 mg/L. Average concentration was determined to be 15.04 mg/L, 50% above safe levels. Nitrate concentration levels were analyzed using GIS software to determine geographic trends. These results led to the conclusion that the water in Buffalo City could potentially be harmful to its residents, and a sewage treatment plant is advisable.

2009 - EV303

SUSCEPTIBILITY OF ALFALFA TO PETROLEUM

*Amber Jean Erickson, Shelby Elizabeth Little,
Alden-Conger High School, Alden, MN*

This project in its present form is the result of Alfalfa and its reaction to petroleum. The process begins with testing alfalfa's growth after applying different percentages of oil based solutions. After the solutions were added to the soil observations were made each day and the height of the plants was recorded. This experiment was to prove the hypothesis that the alfalfa would be able to grow fairly strong in small percentage solutions. Part of the hypothesis that was formed failed when the experiment performed at a solution of ten percent, died off. In the studies, it was found that alfalfa can not withstand solutions of ten percent or more. Once exposed to the petroleum, the alfalfa becomes weak at the base of its stem and extremely fragile. Some success was found in the experiment when the alfalfa that was exposed to the one percent solution grew better than the constant group of alfalfa.

2009 - EV304

HE.L.P. HEAVY METALS LOW COST PHYTOEXTRACTION

*Francesco Giovanni Pietro Marcuzzi, Sabrina Grassi, Massimiliano Andreetta
Istituto Tecnico Industriale Arturo Malignani, Udine, Udine, ITALY*

The scope of our project is to decontaminate soils polluted by heavy metals with a new and cheaper technique involving specific plants.

We decided to analyze the Torviscosa site, located in Northern Italy, departing from its lung cancer statistics, higher than the surrounding areas, due to the past activities of a chemical industry.

In this site we found the presence of a particular plant, *Thlaspi caerulescens*, which is a hyperaccumulator plant specialized in absorption of two elements. The second one we used is *Nicotiana tabacum*: it is a crop plant utilized and spread in this research field, being able to grow up in a multi-contaminated matrix and to produce big amounts of biomass.

The procedure consists in letting them grow up in different samples of polluted soils, treated with three levels of nitrogen fertilization. When their life cycle ended, we analyzed the collected leaves samples.

Lab results showed the amount of polluting elements extracted by each plant. *Thlaspi caerulescens* showed particular accumulation skills while *Nicotiana tabacum* produced more biomass.

Plants confirmed their attitude to grow up in a multi-contaminated soil and to absorb polluting elements with nutrients. For these reasons we might apply this technique to reclaim a polluted matrix. Phyto DSS v.7.0, an electronic simulator, graphically illustrates the trend of many reclamation aspects.

We eventually hypothesized to insert some genes into plant's cells in order to improve accumulation and growth attitude.

2009 - EV305

BETTER THAN EXPECTED AN ENVIRONMENTAL STUDY OF THE BIOLOGY POND

*Ashley Carole Fields, Allison Dixon,
Ballard High School, Louisville, KY*

In September of 2008, a state senator offered to pay for any chemicals needed to improve the health of the area known as the Biology Pond. The Biology Pond is not just an architectural design element intended to enhance the appearance of the school; it serves as a retention basin to help prevent flooding in the area. The pond has a reputation for being dirty; therefore the purpose of this project was to determine if remediation was required and to determine the public

impression of the area. Public impression was determined via a survey on surveymonkey.com; a simple 10 question survey was sent out to over 800 people. Interestingly, only 92 people responded to the survey which showed that people do not really care about the pond. The field testing involved the use of a Hydrolab DataSonde 4a which tested for temperature of the water, pH, dissolved oxygen, DO%, turbidity and chlorophyll-a. The readings for these tests, although not necessarily normal, were quite satisfying for this project. This quantitative data shows the Biology Pond to be healthy and not in need of chemicals for remediation. However, this is not to say that the pond does not need some improvement. People need to be more aware of the pond and what happens to it; the reputation needs a makeover.

2009 - EV306

INVESTIGATION AND HANDLING PROPOSALS OF MICROBIAL CONTAMINATION IN PUBLIC TRANSPORTATION VEHICLES IN SHANGHAI

Haijun Guo, Qing Xu, Ao Yang
Shanghai Luwan Senior High School, Shanghai, CHINA

Microbial contamination in public transportation vehicles such as buses, subways, and taxis can cause various respiratory diseases among passengers. This investigation seeks to determine the extent of this public health problem in Shanghai; identify the distribution and species of these microbes; and propose countermeasures to decrease the microbial contamination in the public transportation system.

 The air impacting method was employed to collect 7,680 samples from 1,280 vehicles. The average total number of bacterial colonies (BT) detected in taxis and buses were 12,806 and 7,595 cfu/m3, which exceed the national air quality standard (GB/T18883-2002) by 512% and 304% respectively. The BT value for subway cars was within the standard. Hemolytic streptococcus was detected in all three types of vehicles investigated. Results from 16S rDNA analyses show that the dominant genera were Bacillus, Micrococcus and Staphylococcus. Multiple data analyses indicate that the total number of microbes is highly correlated with the passenger density in subways and buses (r=0.878, 0.872). For taxicabs, the correlation between humidity and BT is a U-shaped Quartic Curve. Open-window intervention experiment results show that increased ventilation in vehicles can decrease BT by 43% and 36% in taxis and buses, respectively.

 A bacteria killing UV apparatus was invented to control the BT in vehicles. Tests in taxicabs show it is effective within 30 min with a BT killing rate of up to 83%.

 The Shanghai Transportation Microbe Index and Health Platform was constructed to allow the public to obtain information about microbial contaminations in public transportation system.

Awards won at the 2009 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News
Second Award of \$200 - Patent and Trademark Office Society

2009 - EV307

EVALUATING THE EFFECTS OF ENVIRONMENTAL TOXIN 4-NONYLPHENOL AND ESTROGEN ON U937 HUMAN IMMUNE CELLS USING MICROARRAY ANALYSIS

Celline Kim, Esop Baek,
Manhasset High School, Manhasset, NY

Breast cancer has become the 2nd most common type of cancer and the 5th leading cause of cancer death worldwide. It is the most commonly reported type of cancer among women in Long Island. Research has suggested that environmental contaminants may play a role in the onset of breast cancer. 4-Nonylphenol (4-NP), a suspected endocrine disrupter, has been found to be ubiquitous in Long Island's environment, particularly in areas where breast cancer is prevalent. A disturbing suggestion is 4-NP's controversial ability to mimic the hormone estrogen in the body. Thus, the purpose of this experiment was to analyze the effect of 4-NP on human genes associated with the estrogen signaling pathway using the Applied Biosystems 1700 Chemiluminescence Microarray Analyzer. 4-NP (5uM) and estrogen (5uM) and were found to have significantly similar effects on the expression profiles of several major genes associated with the estrogen-signaling pathway, confirmed through Spotfire software and RT-PCR. Hence, we concluded that 4-NP plays a key role in the development of breast cancer by mimicking estrogen and disrupting hormonally-mediated processes.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2009 - EV308

WATER QUALITY THROUGHOUT THE MARYLAND CHESAPEAKE WATERSHED

Kevin Takiar, Daniel Nola,
Sherwood High School, Sandy Spring, MD

he years, there has been a sharp increase in the amount of pollution in the Chesapeake Bay. One factor that has been hotly debated is whether the bay receives its contamination from the numerous tributaries of its watershed, or whether it is polluted independently. Our experiment tests water potability of these smaller water bodies throughout Maryland. By our definition, the most potable water is the least contaminated, most drinkable water, as determined by eight key factors. After thorough research, we chose the eight factors that appeared most frequently in scientists' water quality studies. In our experiment, we intended to test water potability and discover trends in the results. In agreement with the public's opinion, we hypothesized that the water will be more potable in the west and less potable in the east, toward the bay, since this is the direction of water flow. To test this, we designed an experiment in which we collected samples from eleven various sources and tested eight key water quality factors including pH, nitrates, phosphates, dissolved oxygen, hardness, copper, chlorine, and iron. Our results and ensuing T-tests proved that there is statistically no correlation between water quality and the longitude for seven out of the eight factors. It was still evident in the data that the Chesapeake Bay had the least potable water; this suggests that water flowing east into the bay is not the underlying problem. The problem is not as much what flows into the bay from smaller water bodies, but rather how people and industries are polluting the bay

directly. This means we should focus restoration efforts on the bay itself, rather than the Potomac, Patuxent, or Susquehanna Rivers. Currently, scientists and the public are moving restoration efforts west. Our experiment suggests that this would not be the best course of action. Perhaps a longitudinal study testing water quality throughout the year would further prove this.

2009 - EV309
REMOVAL OF LEAD FROM WATER USING AQUATIC PLANTS AND MICROWAVE OVEN

*Shahar Gvirtz, Yadid Algavi,
Amit Gush Dan, Givat Shmuel, Gush Dan, ISRAEL*

Lead is a key element in many industrial products such as batteries, paints and cables. Nevertheless, at high concentrations, lead is harmful both for humans and nature. During the production of many materials, lead ions are discharged into water, mostly in the form of the bivalent ion, Pb2+.

 A new method for removing lead ions from water using dried aquatic plants (Salvinia and Pistia) was investigated in our research.

Various amounts of dried plants were added as "water filters" into solutions with different concentrations of lead ions and the final concentration of lead in these solutions was determined by EDTA titration. It was found that the addition of the plants to the solutions resulted in the reduction of lead ions into solid metal (Pb), which is then absorbed by the plants leafs. The structure of the lead particles absorbed in the plants was analyzed by X-ray diffraction and the location of these particles in the plants was examined using scanning electron microscopy.

Furthermore, it was found that the oxidation-reduction process between the plants and the Pb2+ and the absorption by the plants, were significantly enhanced by microwave radiation. Even one minute of radiation in a microwave oven produced similar results as several days of absorption process without it.

In conclusion, this method posse a promising prospect to a cleaner, healthier future. This technology can be used to remove lead ions from both industrial and home sewage and the reuse of this metal.

Awards won at the 2009 ISEF
Fourth Award of \$500 - Team Projects - Presented by Science News

2009 - EV310
AN ANALYSIS OF TIDE INTERACTION WITH ENVIRONMENTAL TEMPERATURE TO FIND PRECURSORS OF A RED TIDE BLOOM

*Max Keach Breitenbach, Matt Fruge,
Bellarmine Preparatory School, Tacoma, WA*

The principal objective of this experiment was to find whether environmental precursors could be found to predict a toxic algal bloom of Alexandrium catenella, or red tide. Atmospheric and water temperature data was analyzed along with tidal fluctuations over the course of a summer in order to establish a connection between a period of warm, calm weather and a toxic algal bloom. Water temperatures were collected from Hobo Data Loggers from April through August in two-week periods. The instruments were placed in Quartermaster Harbor, attached to a metal pipe at various heights. The data were exported into Microsoft Excel and compared with atmospheric temperature data from www.weatherbug.com and tide tables from www.protides.com. Atmospheric temperature slowly rose throughout the data collection period but had less effect on the water temperature than the extreme tidal fluctuations. Water temperature rose after the lowest tide point. Solar-warmed water rushes back in following this point, raising the water temperatures. Analysis proved hypothesis—tidal fluctuations have a direct correlation with, and air temperatures have a limited correlation with water temperatures.

Awards won at the 2009 ISEF
Genius Scholarships - Sierra Nevada College

2009 - EV311
3-DIMENTIER POT
*Wan Husni Najihah binti Wan Ahmad, Syamilah binti Mahali, Nurul Nadia binti Safian
Kolej Tunku Kurshiah, Seremban, MALAYSIA*

Due to the changing of climate, plants cannot grow well, thus will cause a decrease in food production. There are several limiting factors that will affect the growth of plants such as sunlight, water and nutrients. Nowadays, there are several systems that have been invented that promote healthy growth in plants, but they do not tackle all the limiting factors and costly. 3-Dimentier Pot is the best solution of all the problems and it is absolutely cheap. It is equipped with three layers of pots which are not overlapping each other that maximize the sunlight received by each plant. By combining three methods of planting which are aeroponics, hydroponics and terrestrial farming, it ensure that each type of plants can be planted using suitable methods and the water used can be recycled. For irrigation, water is sucked from the water reservoir using pump and pulled upwards by capillary action to be distributed to the post at the above layers. This irrigation system is unique as it functions like a tree and has xylem-like vessels in the main tube that enable the water to be pulled against gravity. Liquid nutrients will have to be mixed with water in the water reservoir to supply adequate nutrients for plants growth. To reduce the tendency of blockage in tubes due to material deposits, filters are fixed at the mouth of the collecting tubes. Besides, this system will function automatically because it has timer and float sensor to determine the time interval for irrigation. This will reduce the risk of over irrigation or wilting of the plants. The water reservoir is equipped with float sensor that will regulate the movement of water inside and outside to avoid overflowing. With the size of 0.3 X 0.3 X 0.5m, 3-Dimentier Pot will be able to produce more crops when compared to growing plants on the same surface area in a common hydroponics set. This will also help people that have limited time and space to grow healthy plants easily as it can function automatically. As a conclusion, 3-Dimentier Pot is the best solution of agriculture problems today.

2009 - EV312
LOW COST ENVIRONMENT FRIENDLY METHOD TO REMOVE THE REMAINING THIN LAYER OF SPILT OIL AFTER REMOVING THE THICK LAYER

FROM THE SURFACE OF THE SEA

T. H. Nishadi P. Ekanayake, Saru Chathurika Sithumini, Fathima Nazeela Mazahim
Southland College, Galle, Southern, SRI LANKA

Oil spills from ships is a major problem in marine environment. The impact on the environment caused by an oil spill of 176 metric tons from a ship called MV AMANATH SHA on 07th September 2006 was the main reason to plan this project. The oil spill occurred in deep sea, 9 Km away from Koggala close to Galle harbor in Sri Lanka.

The existing techniques used to remove most of the floating oil are not suitable to use under certain environment conditions. A 0.1mm thin oil layer will remain on the surface of water under these conditions, even after removing the thick oil layer. A low cost, environment friendly method to remove this thin oil layer has not been proposed yet, though it is great necessary to most of the third world countries like Sri Lanka.

Plant materials have been used to purify water in many events in Sri Lanka. Therefore a concept has been developed that the thin oil layer can be removed using easily available plant materials such as Straw, Banana reeds, Refuse of coir and Saw dust.

A 0.1mm oil layer has been formed in an artificial marine environment and a floating raft containing various absorbents was used to remove the oil layer. The absorbed oil mass of each absorbent was calculated once in 2 hours for a period of six hours.

After six hours the absorbed oil per centigrade of each material were, Banana reeds - 92.016% , Saw dust – 80.173%, Refuse of coir – 71.917%, and straw – 76.451%. Moreover, the absorption rate of Straw and banana reeds were decreased at the beginning and then increase.

Through this study, the possibility of various natural absorbents to remove the thin oil layer removing after an oil spill has been proved. The factor affecting the absorption rate and the disposal of materials after using for the absorption process have also been studding.

2009 - EV313

A COMPARISON OF THE EFFECTS OF ADDED URBAN STRESSES ON NATIVE AND NON-NATIVE SOIL MICROBIAL COMMUNITIES

Alice Rose Glasser, Emily Derks,
Tucson High Magnet School, Tucson, AZ

For all life growing in soil, the available nutrients that sustain that life are dependent in large part on the ability of soil microbial communities to utilize carbon and nitrogen. Urbanization can lead to the spread of anthropogenic contaminants such as heavy metals, which are washed into the soil from roads, machinery, and industrial sites. It would be expected that when the soil is contaminated, microbe metabolism would decrease. However, this experiment hypothesized that if microbes had been exposed to urban stresses, like heavy metal contaminants, over the course of urbanization, adaptation would be possible, thus the urban soil microbial communities would respond better to more added stresses than the microbes in rural soil would. Soil samples from a rural site, an urban site with native vegetation, and an urban site with vegetation watered by road runoff from rain were collected. Treatments of heavy metals, water, carbon, and nitrogen were added to separate samples and incubated. CO2 concentrations were measured as an indication of microbial metabolic activity in the presence the additions. Microbial activity in the urban roadside-runoff site's increased the most, which suggests that microbes from disturbed urban environments have adapted, and thus are able to better maintain normal activity under stress.

Awards won at the 2009 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2009 - EV314

CARBON: RENEWABLE ENERGY

Jorge Elias Araujo Ferraz, Diallyson Wiltter de Moraes Maia, Cesar Henrique Rocha Freitas
Colegio Estadual Manoel Vila Verde, Inhumas, GO, BRASIL

The society has faced several problems related to environmental problems. Problems that were getting worse day by day, polluted gases is one of faced problems.. Carbon dioxide (CO2) became a huge global problem. The whole world is interested in inhibiting their emission in the atmosphere or to "kidnap" - to the capture and storage - these impossible emission to avoid.

For this project contribute with the minimization of this problem, we tried to work with carbonic acid and from the manufacture of dry batteries using electrodes such as copper and aluminum elements, principles of electrochemistry.

So the main objective of this project is to minimize the maximum possible, the emission of polluted gases in the atmosphere and in a conscious produce renewable energy.

From the analysis taken with carbonic acid, we can realize its potential energy from experiments produced by a dry battery that will be less polluting the environment.

2009 - EV315

CARBON SEQUESTRATION: STUDY WITH EXOTIC AND NATIVE TREES FROM SOUTHERN BRAZIL

Camila Blume Zilles, Duhanne Virtgyne Machado Scharlau, Jenifer Teixeira Severo
Instituto Federal de Educacao, Ciencia e Tecnologia, Sapucaia do Sul, RS, BRASIL

Considering that native trees from Southern Brazil have a heavier biomass per unit of volume than exotic trees, the goal of this research was to verify if native trees are able to fix a higher amount of carbon in their biomass than exotic trees.

We selected well-known exotic species of trees that are cultivated nowadays for ornamental purposes or for their fruits. The chosen native trees naturally grow in Southern Brazil. The quantification of the biomass and fixed carbon was determined in 15 samples of species of exotic trees and 15 species of native trees, both ornamental and fruit trees, aged 10 to 20 years. Branches from the crowns of trees were collected and heated in the oven to 103°C, in order to obtain the value of their biomass. Due to their irregular shape, the volume was calculated by the method used in the Archimedes' Principle, and standardized for all species in 20cm³. The amount of carbon fixed in the tree branches was obtained by multiplying the amount of biomass (dry weight) by the factor 0.5. Results obtained showed that the native trees reached a higher level of carbon fixation (over 12g per 20cm³ of dry weight of wood), while in the exotic species, only two results of carbon fixation exceeded 12g/20cm³. The average concentration of carbon fixed in the exotic species studied was 10.96g in 20cm³ of analyzed volume. In native species, the average concentration of carbon

storage was 11.78g in 20cm³ of volume analyzed.

2009 - EV316

THE EFFECT OF ULTRAFINE DIESEL EXHAUST PARTICLES ON THE FUNCTION OF NORMAL AND DIABETIC CARDIOMYOCYTES

Yelee Lee, Tejaswini Nallanagulagari,
Upper Arlington High School, Upper Arlington, OH

disease is the number one killer in the United States. For years, scientists around the world have reported that on days when fine-particle air pollution increases, there is a substantial increase in morbidity and mortality in heart attacks. Air pollution is mostly anthropogenic, or human-caused. Diesel exhaust particles (DEPs) are present in ambient air pollution and can pass through the lining of blood vessels and cause direct effects on the heart. In this experiment, the effect of ultrafine diesel exhaust particles on normal and diabetic rat cardiomyocytes was observed in stimulated cells and the indices examined included return velocity, peak height, and time to 10.0% cell length. The extracted heart cells were observed through an inverted fluorescent microscope with the IonOPTIX Myopacer field stimulator set at 0.5 Hz. The IonOPTIX MyoCam transferred the image onto the IonWizard program, which measured the contractions of the cell through on-line edge detection and analyzed the data. This process was repeated for normal and simulated diabetic heart cells (cultured in a high-glucose solution). Normal and diabetic cells were treated with ultrafine DEPs suspended in buffer for five minutes. Statistical analyses were performed using Microsoft Excel 2007 and 2-Sample T-tests to obtain p-values. There was a significant difference between normal and particle-treated cells. The glucose had a slower return velocity, peak height, and time to 10.0% cell length, indicating that the cells were impaired.

2009 - EV317

IS SALT ACCUMULATING IN THE RIGHT OF WAY OF HIGHWAYS?

Jennifer Lynn Ratzlaff, Victoria Ann Rezac,
Avon High School, Avon, SD

During the winter months icy roads in the northern United States are often salted. Though salt is an effective deicer it can also contaminate the environment by increasing the salinity of the surrounding soil and water. Is this a serious environmental problem? We tried answering that question on a road we knew to be heavily salted in winter, namely South Dakota Highway 50. In late fall, we obtained soil samples at 0, 3, 6, and 9 feet perpendicular to this two-lane road and repeated the process for the intersecting, unsalted roads. The soil samples were mixed with water and tested for salinity along with electrical conductivity. In addition, residual salt levels from the pavement were measured after deicing from a winter storm.

The salinity of all soil samples was less than 1 part per thousand. Our testing also revealed the conductivity of salted roads was not significantly higher than adjacent unsalted roads. Generally, the conductivity of the samples increased as the distance from the road surface increased. Salt levels from the pavement indicate the potential for contamination does exist. Research is ongoing to test salinity and conductivity levels after the spring snow melt. To date, the results of this experiment indicate the use of salt as a deicer is not a significant problem in our area.

2009 - EV318

ANTIOXIDANTS IN GREEN TEA AND THEIR EFFECTS ON DIMINISHING TUMOR GROWTH IN CERATOPTERIS RICHARDII

Milana Fuzaylova, Gabriella Baldwin,
Forest Hills High School, Forest Hills, NY

Experimentally, the antioxidants in green tea and their effects on diminishing tumor growth in *Ceratopteris richardii* were analyzed. *Agrobacterium tumefaciens* played the role of the tumor which was used to test if plant cancer can be treated with green tea. In many areas of the world, the yearly agricultural productivity is affected by plant infections such as crown gall disease. *Ceratopteris richardii* served as the model plant organism into which the *A. tumefaciens* was inoculated. Green tea was used to investigate whether or not the injected tumor on the *C. richardii* would diminish or show reduction in growth and development. Watering plants with green tea regularly in addition to regular water may hinder and possibly prevent the development of tumors and infections in plants. The outcome of this experiment was determined by the photomicroscopy taken as well as results collected throughout the experimentation process. These anatomical and physiological changes can help us understand and establish criteria for ceasing the spread of plant tumors. This may further lead to the greater distribution of plants struggling to survive under harsh environmental conditions.

2009 - EV319

A COMPARATIVE STUDY OF WATER SOLUBLE TOXINS PRESENT IN SOIL SAMPLES COLLECTED FROM THE FORMER BIG WEST OIL REFINERY IN KEVIN, MT

Cory Arthur Lazenby, Justin Nagy,
North Toole County High School, Sunburst, MT

In this experiment, we worked to determine the toxicity levels of soil samples collected from selected transects (test sites) from the former Big West Oil refinery in Kevin, MT. To do this, we began by obtaining soil samples from three pre-determined transect points. We brought the soil samples back to the lab and strained distilled water through them. Each soil sample was weighed to 70 grams and strained with water through cheese cloth to accomplish this. When the water samples were the same temperature, we tested them using a standard toxicity test. This test consisted of using environmentally sensitive organisms called *Daphnia magna*. There were ten samples for each transect point. If they were found to be toxic, we did another ten samples at a 25% dilution. We placed one *Daphnia magna* in each sample cup and let them sit for six hours. After six hours, we observed each test chamber and recorded if the *Daphnia magna* inside was dead or alive. At the end of testing, we found one toxic sample in transect A (Asphalt Pit Area) and C (refinery process area), and two in transect B (gas loading area). None were found toxic at the 25% dilution level. This means that the soil samples didn't contain enough water soluble toxins to cause

significant fatalities among the 10 Daphnia in each group. We also found no significant differences in toxicity between each of the transects.

2009 - EV320

ANALYSIS OF NET POTENTIAL METHANE FLUXES IN VERNAL POOL ECOSYSTEMS: REVEALING BIOGEOCHEMICAL GREENHOUSE GAS PRODUCTION AND EMISSION

Michael Graham Baker, Larry Beaver,
Louisville High School, Louisville, OH

Methane (CH₄) is a major greenhouse gas and contributor to climate change, and wetlands have been proven to contribute 15-45% of atmospheric CH₄. Vernal pools, unique wetland habitats, have remained relatively unstudied in their contribution to production of this gas on a biogeochemical basis. Thus, the purpose of this study was to understand the underlying processes that drive methane production in varying conditions. It was hypothesized that methane emissions would change in the later trial with the growth of methanogens and that the microbial populations would produce higher rates in the vernal areas. Three vernal and nonvernal sites were chosen from disturbed, riparian, and upland habitats and brought to ideal anaerobic or aerobic conditions for the study of net potential gas flux. These ideal conditions allowed for the understanding of the microbial processes, and reduced analytical variability. Each sample's gas emissions were extracted at fixed time intervals from field sampling, and were analyzed on a Gas Chromatograph for CH₄, CO₂, and N₂O. The concentrations that were given in the GC Solution Software were then converted to rates of production/emission in nmol/g soil/ hr. In an ANOVA test with the above mentioned fixed effects, it was found that, in trial one, more methane was produced in the vernal areas. It was also proven that there were higher rates of production in trial two, while habitat served as an interaction effect. Thus, it was found that methanogens produced more CH₄ in the vernal areas, reflecting the underlying biogeochemical processes that drive the greenhouse gas production in these unique ecosystems.

Awards won at the 2009 ISEF

Third Award of \$1,000 - Team Projects - Presented by Science News

2009 - EV321

THE EFFECTIVENESS OF CARBON WATER FILTERS ON ESCHERICHIA COLI AND PHARMACEUTICALS

Lorne Dean Muir II, Nathan Weeks,
The Classical Academy, Colorado Springs, CO

The purpose was to test if carbon water filters are effective against pharmaceuticals, as well as members of the total coliforms groups. If common household filters are applied to waters containing pharmaceuticals and total coliforms, then the maximum water effluent (zero) according to clean water standards will be exceeded, except the pharmaceuticals, which do not have a standard. Testing the effectiveness of filters in removing bacterial and pharmaceutical contaminants required several steps. To test filters against bacteria, spiked bacterial samples were created using serial dilution. Contaminated water was pumped through a faucet. 100 milliliter grab samples were collected at the end of ten seconds three times with each of the three filters. A similar process was repeated using 9.5 and 40 liters, taking grab samples at specified intervals. For the pharmaceutical test, a concentrated aspirin solution was tested using 7.5 liters using "Filter A." Results were compared to the controls to analyze the effectiveness of removing contaminants. The data collected did support the original hypothesis. On average, "Filter A" had approximately 3.03 E. coli per 100 milliliters, "Filter B" 71.7, and "Filter C" 20.08. On average, over 97% of the bacterial influent was removed. "Filter A" allowed pharmaceuticals into the effluent at levels comparable to the control after 7.5 liters. These findings lead us to believe that although these filters were overall ineffective according to the EPA/NSF standards, the amount of bacteria was reduced considerably when compared to the controls, therefore reducing the likelihood of getting sick.

2009 - EV322

REDUCING RUNOFF USING PERMEABLE PAVEMENT IN CONJUNCTION WITH MICROBIAL BIODEGRADATION

Maximilian Eugene Wolff, Nidhi Arashinagundi,
Southside High School, Greenville, SC

The purpose of the science fair project was to test if permeable pavement could be used to lessen parking lot runoff without contaminating the groundwater or compromising the structural integrity of the pavement. The experiment was carried in three different sub-experiments. The first experiment was to test the permeability of the different pavements used to see if the Open Graded Friction Course (OGFC) was more permeable than regular pavement and how much rainfall it would take for runoff to occur on both pavements. The second test involved testing the durability of the OGFC by running the sample through an Asphalt Pavement Analyzer (APA). The APA tested the structural integrity of the samples through simulation of real-life pressure conditions. The third test was to detect if the use of Pseudomonas and Bacillus would consume the used motor oil that would presumable permeate through the pavement. The hypothesis was that the permeability and durability of the OGFC would be greater than that of the regular pavement. Also, it was hypothesized that the oil eating microbes would greatly reduce the amount of oil in the pavement samples. The data collected supported the hypotheses stated above in certain aspects. The permeability test shows that the permeability of the OGFC would be greater than that of the regular pavement. The APA test showed that the regular pavement was slightly more durable than the OGFC, but the difference was negligible. The microbial biodegradation test showed that, overall, the oil eating microbes did reduce the amount of oil. In the future, changes that could be made to behoove this experiment include using more accurate measuring tools, different sample thicknesses/types, and a wider variety hydrocarbon eating bacteria.

2009 - EV323

LICHEN AS INDICATORS OF HUMAN IMPACT

Christian Thomas Bursleson, Amberleigh Thompson,

Fernley High School, Fernley, NV

We live in a small community that has more than doubled in population in the past ten years. Places that our parents can remember as being remote and accessible only on horse or by foot are now sporting roads and houses. We researched options for assessing the impact the increase in human activity is having on our air quality and chose to evaluate lichen in our area. Lichen are colony organisms which, because of their unique composition, are very sensitive to atmospheric pollution. This can retard their growth or even prevent lichen colonies from developing at all. We hypothesized that there would be more and larger lichen colonies and greater species diversity in remote areas as compared to areas with regular human activity.

We developed a rubric for recording information about lichen colonies and mapped our community using a grid system. We randomly selected grids to sample and collected four sets of data from each grid using a hoop to standardize sample size. We recorded information about location, proximity to human structures, and both qualitative(color, species) and quantitative (average length and width) data for each colony observed. We used Chi-square and t-tests to analyze our data and found statistically significant differences in species distribution, number of colonies, and average size of the lichen colonies relative to proximity to human activity. This supports our hypothesis that the increase in human activity has negatively impacted lichen colonies in our area and may indicate an air quality problem.

Awards won at the 2009 ISEF

Fourth Award of \$500 - Team Projects - Presented by Science News

2009 - EV324

THE EFFECTS OF BISPHENOL-A AS AN ENDOCRINE DISRUPTER ON CLAVULARIIDAE ANTHOZOANS

*Wyatt J. Hajda, Danielle Sabo,
Basha High School, Chandler, AZ*

c currents curl into each other forming Gyres which collect large amounts of plastic. Bisphenol-A is an important component to the production of polycarbonate (PC) plastics and resins. BPA is currently being investigated as an endocrine disrupter for its ability to interact with hormone receptors. There is a vast range of phenomena associated with BPA and the endocrine system. However, The associated environmental impact is not fully understood. In particular, what are the effects on oceanic gyres. Clavulariidae anthozoans were selected, due to their abundance in reef systems, as a model organism to explore the hypothesis that "Clavulariidae anthozoans that are exposed to aquariums containing BPA will exhibit a stressful physiological response than clavulariidae anthozoans exposed to aquariums without BPA. Four individual salt water aquariums sustained Clavulariidae anthozoans for a period of 6 hours with filter systems containing BPA ranging from 0-75 wt% by mass. Each aquarium was observed every 24 hours for 96 hours for; Ammonia Ratio, Orthophosphate, Nitrite, Nitrate, pH, Alkalinity, and general qualitative changes. Each of the test groups exhibited similar nitrate and nitrite concentrations as a function of time. However, the concentration of orthophosphates in the aquariums increased. This increase caused an increase in Algae with increasing amounts of BPA. The sudden increase in Algae shifted the ammonia, pH, and alkalinity concentrations as a function of time and concentration of BPA. Further research is needed to explore the path BPA takes to change orthophosphate levels, and BPA's effects on larger ecosystems.

2010 - EV001

THE PYROLYTIC SYNTHESIS OF BIOCHAR AND BIOFUEL FROM BIOWASTE: AN ANALYSIS OF ITS POTENTIAL TO AMEND FUEL CRISIS AND FOOD SECURITY

*Andrea Aleah Pugh
Saginaw High School/Saginaw Arts and Sciences Academy, Saginaw, MI*

The purpose was to produce biochar from biowaste, determine if the biochar can amend the soil improving quality, improve plant growth, and can be produced during the pyrolysis process used to make the biochar. The hypothesis was that biochar will amend the soil improving the soil quality which will encourage the plants with the highest concentration of biochar to grow tallest, and that biofuel will be produced during the process that can be captured.

Biochar produced was rich in nitrogen, low in phosphorus, and moderate in potassium. The pH levels were acidic with an average of 4.7. Initial elemental analysis of the samples with Biochar added by ICP shows that the soils were amended by the addition of the biochar. After the addition of Biochar the levels of nitrogen and phosphorus appeared to be in the optimal level however the potassium was on average low. The soybeans planted in the Biochar treated clay and sand samples did not germinate. Biochar treated top soil samples did germinate and grew. Syngas was released during both the initial research with the kiln pyrolysis and with the pyrolysis apparatus made in the lab. The syngas released could possibly have enough energy to cycle the process. The liquid that was produced during pyrolysis was captured and showed that it had a boiling range of 34C –186C. In conclusion, results did support the hypothesis. The soil quality not the growth of the plants was not dependent upon the concentration of Biochar added. The hypothesis on the biowaste ability to produce a fuel and capture it was supported. It is clear that Biochar has amending potential. Optimizing the production and growing technique will prove this to be a viable source of fuel and food security.

Awards won at the 2010 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2010 - EV002

STABLE CARBON AND OXYGEN ISOTOPIC SIGNATURES OF CLIMATE CHANGE FOUND IN FOSSILS FROM INNER MONGOLIA

*Linda Wang
Lawton Chiles High School, Tallahassee, FL*

The purpose of this experiment is to use fossilized animal remains to reconstruct the animal's diet and gauge the climate in which it resided. In this project, ostrich eggshell samples were taken from two sites: Auerbar and Gashunyinadege in the Tunggur area of central Inner Mongolia. The samples from Auerbar

have an estimated age of 6-7 million years (Late Miocene period) and the samples from Gashunyinadege have an estimated age of 17-18 million years (Mid Miocene period). Samples were cleaned, weighed into individual vials, and analyzed by a mass spectrometer to determine the stable carbon and oxygen heavy-to-light isotopic ratios. Standards were used to calibrate the results. Further analysis of these ratios, recorded as (delta)13C and (delta)18O values, indicates that ostriches in Inner Mongolia consumed only C3 plants and lived in an environment consisting of C3 vegetation (trees, shrubs, and cool-season grasses) ~17-18 million years ago, and that the climate then was relatively mild. Results also indicate that, at ~6-7 million years ago, ostriches in Inner Mongolia had variable diets ranging from a pure C3 diet to a mixed diet consisting of a small amount of C4 grasses (warm climate grasses), and that the climate in the area was more arid and warmer at ~6-7 million years ago than at ~17-18 million years ago. These findings are important because they contribute to a better understanding of climate change on a global scale over a long span of time.

2010 - EV003

EFFECTIVENESS OF NATURAL ALUMINOSILICATES IN THE REMOVAL OF HEAVY METAL CONTAMINANTS FROM SOLUTION

Joseph Sean Sylvester
Greybull High School, Greybull, WY

The objective of this project was to determine how natural aluminosilicate structures can reduce the concentrations of harmful contaminants. It was hypothesized that these structures would be able to accomplish this task because of the natural ability of aluminosilicates to adsorb materials. Ten grams of each of the aluminosilicate structures was placed into beakers. Aluminosilicates used during this experiment were: Zeolites, Clear Treat 2300, Clear Treat 2310, Clear Treat 2161, and 2154. Next forty milliliters of solution with a known concentration of 30 ppm was added to each of the beakers and allowed to react for thirty minutes. A cover was then placed on top of each beaker to reduce the amount of evaporation that could occur. The solution was allowed to react for 24 hours without disturbance. After 24 hours, the aluminosilicates were filtered, the filtrate was collected and placed into a container and sealed. Each sample was analyzed using atomic absorption spectrophotometry. Each of the samples was tested three times and averaged. A cross analysis was performed between the control, which gave the line of absorption, and the samples. The difference between the control and each of the individual tests showed the adsorption potential of each aluminosilicate structure. The most effective means of reducing lead solutions was Clear Treat 2161, which reduced lead concentrations by up to 97 percent. The most effective means of reducing arsenic was Clear treat 2310. This compound reduced the concentrations by up to 65 percent. Aluminosilicate structures did show the ability to reduce concentrations of these dangerous elements. In some cases, below EPA allowance of 10 ppm. This could be a very simple solution to a very complicated problem.

2010 - EV004

BIOMIMETIC INSULATION: INSPIRED BY THE EASTERN TENT CATERPILLAR AND WHITE-TAILED DEER

Madeleine Layla Skaller
Brewster High School, Brewster, NY

In the previous stages of this investigation, research was done which proved that eastern tent caterpillar silk-tent weaving templates are successful in providing a woven pattern that minimizes the effect of heat loss in man-made structures. The second part of the investigation sought to determine the ideal bore size of a hollow fiber for maximum thermal insulation efficiency. Various methods were used to model hollow hair fibers with varying inner diameters but constant wall thickness. The main species used as inspiration for this research was the white-tailed deer, whose hairs are hollow. Though no actual deer hair was handled during experimentation at any point, the collected data proves that a smaller inner diameter in a hollow fiber is the most efficient in preventing heat transfer. Several trials were done to ensure accuracy and tests were conducted under heated and cooled conditions to model natural environmental temperature fluctuations. This research lays a basis for creating a superior form of insulation to be used in homes based around the principles of biomimicry, innovation inspired by nature.

2010 - EV005

LICHENS AS WEATHERING AGENTS OF SANDSTONE

Danielle Taljaard
Bethlehem Voortrekker High School, Bethlehem, Free State, SOUTH AFRICA

The purpose of this research is to determine what role lichens play in the soil forming process, also known as the rock cycle. A hypothesis was developed that lichens play an active role in the weathering process of sandstone and thus contribute to the soil formation process. Three research methods were employed, namely a literature study by gathering information on the subject from the internet, books and other sources; practical research by visiting several areas in Golden Gate Highlands National Park, South Africa, where observations were made of the different types of lichens that exist in the park and where the sandstone weathering caused by lichens was examined and thirdly information and data were gained from researchers who have studied the weathering of sandstone in the park. Scars on the sandstone that was caused by lichens were measured to determine width and depth accurately. The results of my research show that lichens actively contribute towards the weathering of sandstone and through the data gathered I determined that weathering takes place at a vertical penetration rate of 0.1mm per year. It also became evident through the research results and observations made that lichens play an important role in the soil forming cycle and as such contribute to the rock cycle, as lichens slowly disintegrate and dissolve the rocks mechanically, chemically and biologically. It was found true especially in the case of endolithic lichens. My hypothesis that lichens actively contribute towards the weathering of sandstone and thus contribute to the sand formation process is tested and proven correct.

2010 - EV006

THE EFFECTS OF URBANIZATION: WHAT ARE THE EFFECTS OF LAND USE ON BENTHIC MACROINVERTEBRATE BIODIVERSITY AND WATER QUALITY IN THE ELM CREEK WATERSHED?

Karin Lynette Sather
Champlin Park High School, Champlin, MN

I assessed how land use affects stream health. This knowledge can be applied beyond my community as urbanization is expanding world wide. I tested the hypothesis that stream water nutrient levels will be affected by land uses. I believed that the greatest increase would occur in the older housing development segment of my testing. As nutrient levels rise, I expected that the biodiversity of macroinvertebrates would decrease because certain species only survive in high quality water. I tested 13 sites in the Elm Creek watershed for soluble reactive phosphorus, total phosphorus, total dissolved nitrogen, and total organic carbon as well as benthic macroinvertebrate biodiversity. I found that there is not significant evidence to support the conclusion that a certain land use negatively affects the health of Elm Creek. The data does support the conclusion that the park reserve is effective in improving water quality and macroinvertebrate biodiversity. Also, seasons have a significant effect on water quality parameters. The presence of impermeable surfaces surrounding the creek may cause elevated nutrient levels. The most alarming results of the experiment were the high levels of phosphorus and the rate at which the water quality decreased is greater than the rate at which the nutrients were removed from the water. In the future I would like to investigate Elm Creek over a longer span of time to observe the effects of seasonal changes on the conditions of Elm Creek or look at the effectiveness of buffer zones in combating the effects of impermeable surfaces.

2010 - EV007
AN EXAMINATION OF SILVER NANOPARTICLES: ANTIMICROBIAL EFFECTS AND MITIGATION

Wyatt Neal Palser
Otis High School, Otis, CO

Silver nanoparticles exhibit antimicrobial effects, these nanoparticles are being added to plastics, textiles, and building materials. The purpose of this research was to examine the chemistry of silver nanoparticles through antimicrobial effects and the potential impact on microbial cycling of nitrogen in the environment. The research consisted of two hypotheses; the first was that silver nanoparticles will restrict the growth of nitrogen cycling bacteria and E. coli because silver nanoparticles are known to be antimicrobial. The second was that gray water will minimize the antimicrobial effects that silver nanoparticles have on nitrogen cycling bacteria and E. coli because the gray water may aggregate the silver nanoparticles. Microbial nitrogen cycling bacteria and E. coli were cultured in the presence of silver nanoparticles and a solution of silver nanoparticles and gray water. Qualitative bio-chemical testing was performed on the nitrogen cycling cultures; zones of inhibition were measured on the E. coli cultures and were found to be statistically significant. It was found that gray water mitigated the antimicrobial effects of silver nanoparticles in the initial phases of testing, and that silver nanoparticles had no long term effect on nitrogen cycling bacteria. A limit of inhibition of E. coli bacteria growth was observed with varying concentrations of silver nanoparticles and gray water. Both research hypotheses were supported by the data.

2010 - EV008
USAGE OF LOLIUM SP. AND PASPALUM SP. TO DECREASE LEAD CONTENT AGAINST AIR POLLUTION

Sheeraz Munir Soomro
PakTurk International Schools and Colleges Khairpur Branch, Khairpur Mir's

llution in developing and developed countries has increased dramatically in recent years due to the rise in air pollution. This situation has impact on human health, plants, agriculture lands, etc. Lead (Pb) is the one of the prominent toxic gases. Lead is the heaviest of the non radioactive metals. But natural processes always cleanse air. The ability of invasive species to tolerate or accumulate lead can be utilized for natural processes.

For this purpose three different traffic roads varying in traffic densities, junction of Sukkur, junction of Theri and junction of Priji Got and two different invasive species, Lolium sp. and Paspalum sp. have been selected. Samples have been collected 3 months (September to November, 2009). During 3 months, samples have been taken once in a month.

In the experiments, Lolium sp. did not show good result to decrease lead content but highest result is obtained in Paspalum sp. The project proves that difference on the plants species might affect decrease of lead content in air. Paspalum sp. is more effective then Lolium sp. to decrease lead content in air.

2010 - EV009
ACID MINE DRAINAGE REMEDIATION: A NOVEL APPROACH, PHASE II

John Tyler Barnes
Northwestern High School, Kokomo, IN

The purpose of the experiment was to determine a remediation method for acid mine drainage (AMD) using chitosan and hydrogen peroxide (H2O2). The hypothesis was if each treatment was tested on AMD, then chitosan would be more effective based on pH, iron content, and transmission of light. AMD collected from a drainage ditch near Brazil, Indiana, was treated with 0.8% chitosan, 0.5% H2O2, and 0.25% H2O2 in 5 replicate samples. After one week, the pH, iron content, and DR2000 spectrophotometer readings (wavelength=590nm) were taken. After chitosan treatment, the AMD was pH 5.0, an increase from pH 3.5. The result was highly significant (t=∞>t0.001=5.041). The iron content decreased 92.8% from 2500ppm to 180ppm. The result was highly significant (t=189>t0.001=5.041). The transmission of light increased 101.3% from 47.6% to 95.8%. The result was highly significant (t=134>t0.001=5.041). After 0.5% H2O2 treatment, the pH remained 3.5. The iron content decreased 90.4% to 240 ppm. The result was highly significant (t=226>t0.001=5.041). The spectrophotometer showed 97.8% transmission an increase of 105.5%. The result was highly significant (t=153>t0.001=5.041). Ultraviolet (UV) light added to the H2O2 produced no significant change from no UV light. Varying pH levels of the AMD produced no change in trends of data for treatments tested. The hypothesis was supported because the chitosan treatment was more effective than H2O2. Bacillus subtilis survived in 0.8% chitosan treated AMD of pH 3.0 and 3.5. Euglena gracilis could survive in all treated AMD except 0.5% H2O2 treated AMD of pH 2.0. All organisms died in control AMD.

Awards won at the 2010 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2010 - EV010

COLOR METHOD AND APPLICATION IN WATER QUALITY DATA ANALYSIS

Linbo Shao

Hangzhou Xuejun High School, Hangzhou, Zhejiang, CHINA

Water quality data analysis is a complex problem of multi-valued multi-point data analysis. This project proposed a method to analyze the water quality of a water area visually and effectively, and made it much easier for the public to understand the situation of water quality. It was named the Color Method. This method was based on the RGB color model which had three components (Red, Green, and blue) and each could represent one factor of the water quality pollution. Thus it represents three factors at the same position. Then the total raw data were transformed into the Color Map, which was the result of this method. Although the Color Method could represent 3 factors, the water quality parameters may be much more. So after data of each sampling stations being standardized, firstly, 6 parameters were sifted out of more than 30. Secondly, the data were reduced into 3 main factors by Factor Analysis. Thirdly, a Color Function was proposed to convert the data into color. Thus the colors of sampling position were determined, and then the whole area was filled with color by Filling Function. Furthermore, some approaches were put forward to compare these colors, which was helpful in analyzing the Color Map. A c++ program made the Color Method process automatically. At last, gave some examples such as the analysis of water quality in Xia-Zhu-Hu Lake in Zhejiang to prove the feasibility of the color method.

2010 - EV011

THE IMPACT OF ORGANIC POLLUTION FROM THE NITRA RIVER ON THE DIVERSITY OF CILIATES IN THE CHOTINA TRIBUTARY

Silvia Hnatova

Gymnazium Parovska 1, Nitra, SLOVAKIA

The primary aim of my project was determining the impact of organic pollution from the Nitra river on the diversity of ciliates in the Chotina, a tributary of the Nitra river. For this purpose I first compared the diversity of ciliates (Ciliophora) in the Nitra and in the Chotina. I collected 10 samples between August and October 2009. Six species of ciliates occurred in the samples from the Nitra, and 11 species occurred in the samples from the Chotina. The diversity of ciliates and the presence of bioindicators confirmed my hypothesis – the Nitra river is more polluted than its Chotina tributary. The experimental part included adding boiled water from the Nitra into unboiled water from the Chotina. In these samples I observed the impact of pollution from the Nitra river on the diversity of ciliates in the Chotina. I compared the diversity of ciliates in the experimental samples with the diversity of ciliates in the control samples, namely, those collected from the Chotina. The diversity of ciliates in the experimental samples compared to that of the control samples decreased to a total of 6 species, 4 of which also occurred in the samples from the Nitra river. Only those species more tolerant to organic pollutants survived in the experimental samples, namely: Paramecium caudatum, Colpidium colpoda, Colpoda cucullus, Chilodonella cucullus, Campanella umbellaria and Spirostomum ambiguum. The experimental part demonstrates that organic pollution from the Nitra river causes decrease of the diversity of ciliates and kills species less tolerant to organic pollutants.

2010 - EV012

DARTER COMMUNITIES: THEIR STATUS IN TURBIDITY IMPAIRED WATERS OF THE GREATER BLUE EARTH RIVER BASIN

Lina Wang

Loyola High School, Mankato, MN

The purpose of this project was to help shed light on whether darters can accurately be used as indicators of water quality. My null hypothesis is that richness of darter species will be inversely correlated with annual load estimates of turbidity.

 The experiment procedure was performed by taking water quality data from the Minnesota Pollution Control Agency (MPCA) website. The darter samples were collected at various sites located on the LeSueur, Watonwan, Big Cobb Rivers, and Perch and Minneopa Creek in the surrounding areas of Mankato, MN, USA. The fish were caught, identified, measured, and released. The data was run through a simple linear regression analysis computer program. The x-axis showed the water quality data from the MCPA and the y-axis showed the percentage of one species found at each site. The p-value and R-value were calculated from the regression graph for further analysis.

 In conclusion, it is believed that darter species richness is not inversely correlated with annual load estimates of turbidity alone. The results showed that even as turbidity increases, many darter species were found to be present.

2010 - EV013

CHIMNEY FILTER FROM ACTIVATED CARBON AND CELLULOSE FIBER

Kevanie Anne Mones Damit-og

Wicox-Hidreth Public School, Wilcox, NE

Throughout the years, air pollution due to vehicle emissions has been steadily increasing. Modified filters such as catalytic converters have been created to decrease such effect. However, what the public overlooked is the problem with regards to smoke emissions from house chimneys. Just like smoke from cigarette, fumes from burning wood also have carcinogenic properties.

 This project aims to lessen harmful particulate and chemical concentration from wood smoke released in the atmosphere through mechanizing a simple filtering device from activated carbon and cellulose fiber. The porous property of carbon and the strength of cellulose fiber made it possible to create such device.

 Cellulose fiber was obtained from dried corn stalk using diluted acid hydrolysis and with the treatment of sodium hydroxide. This was done to eliminate other impurities such as lignin and hemicellulose. On the other hand, the activated carbon was obtained by burning scrap wood chips and treating it with calcium chloride.

 When tested, resulting smoke emission showed a

decrease in the concentration of some of the harmful chemicals it contained using analytical device that analyzes smoke emission composition. Through the results and discussions, it was therefore concluded that it is feasible to mechanize a filtering device from materials that are locally available. Also, there is a significant difference between the chemical concentration produced from a chimney with the filter and a chimney, which does not.

Although the sign of pollution has not fully taken its toll on Nebraska, problem with regards to wood and smoke emission would soon arise. If such problems were not taken cared of ahead of time, it would be harder to find a solution when the problem strikes.

2010 - EV014

THE MITIGATION OF CO2 BY THE EFFECTS OF COCCOLITHOPHORID BIOFIXATION

William Li

South Fork High School, Stuart, FL

This project explores the CO2 fixing abilities of coccolithophores to produce carbon sinks. Coccolithophores have the ability to produce external coccoliths, calcified cells, made of CaCO3 from CO2. Instead of releasing the CO2 when they die, they seal it permanently within their coccoliths, which sink to the bottom of the ocean, producing limestone. In this experiment the algae will be put under different concentrations of Fe (NO3)3, Iron (III) Nitrate.

If the iron concentrations of the algae environment are tested at (164.8 ppm), (329.6 ppm), (494.4 ppm), (659.2 ppm), (824.0 ppm), and controlled (0.04 ppm) seawater, then it will be possible to determine which iron concentration will be most beneficial to coccolithophorid growth and reduce CO the most. The coccolithophores with the addition of the highest concentration of iron (824.0 ppm) is expected to increase algae growth and reduce CO the most.

The Coccolithophores are cultivated inside air pumped liter bottles, equally distributed into smaller bottles, supplemented with Iron concentration buffers, and placed on a bottle rotator for a set amount of time and then removed. The remaining CO2 level is captured by a CO2 sensor probe on a Vernier LabQuest.

The highest concentration of 824.0 ppm of Iron (III) Nitrate found to be better for the reduction of CO2, which meant efficiency. Although this is supported in this experiment, further experimentation should be proceed to test higher concentrations because, like everything else in nature, there is a limit to which there is too much that it becomes harmful.

2010 - EV015

A STUDY OF MACROINVERTEBRATES AS INDICATORS OF WATER QUALITY IN A MONTANA STREAM

Harold Blake Whitford Jr.

Box Elder High School, Box Elder, MT

This study of a Montana stream examined the populations of macroinvertebrates to determine water quality. If correct, the number of specific macroinvertebrates can be used as bio indicators of water quality in any given stream or river.

One selected stream, Big Sandy Creek in Rocky Boy, was tested in three different sections. The sections were also tested using a LaMotte test kit which included pH, dissolved oxygen, and nitrate tests. A YSI meter was also used to measure the temperature, pH, and salinity.

A kick-seine was used to obtain macroinvertebrates, which involved a collector to get into the stream section, post the kick-seine to the very bottom, and kick up as much sand, dirt, and rocks as possible. The kick-seine was removed and debris, rocks, and sand were sorted through.

Macroinvertebrates were then collected and preserved in alcohol. When the testing was finished the specimens were brought back to the lab. The collected specimens were examined using a dissecting scope. Macroinvertebrates were separated and counted according to the species, then classified by degree of pollution sensitivity: sensitive, somewhat sensitive, and tolerant of pollution. The numbers were then graphed.

The results show, though not a big difference, that more sensitive macroinvertebrates were found upstream and decreased sensitivity moving downstream. The number of the classified macroinvertebrates were then compared to the water tests and used to determine the water quality.

Compared to the water tests, macroinvertebrates show that the stream has a moderate water quality with a more diverse healthier population upstream.

2010 - EV016

DETERMINING THE EFFECTS OF GREYWATER ON THE EFFICIENCY OF NITROGEN REMOVAL IN SEPTIC SYSTEMS

Mary Maxine Luber

Camdenton R-3 High School, Camdenton, MO

6, Missouri State legislation was passed that changed the guidelines for on-site sewer and septic systems (RSMo 701). This bill prohibits the installation and utilization of household greywater systems. Blackwater, waste collected directly from toilets and garbage disposals, and greywater, waste collected from sinks, showers, drains, and clothes washers, usually coincide in a normal septic system. Greywater systems, alternatively, separate the two types of waste. The objective of this research was to explore the possibility that household greywater systems should be utilized in the state of Missouri.

Experimentation was conducted by the replication of a greywater system alone, a blackwater system, and a system containing greywater and blackwater. The fifteen one-gallon buckets that served as small scale models of residential septic tanks contained synthetic greywater and wastewater formulas to reproduce a Missouri household system. This protocol was performed in order to study the effects of greywater on a blackwater septic system through nitrogen removal. Nitrogen levels (nitrate, nitrite, and ammonia) were determined using a Hach DR/890 colorimeter.

The findings of this research indicate that it is feasible that groundwater contamination by residential septic system runoff could be reduced by utilizing a separate blackwater and greywater system. The results of this study put into question the rationale behind RSMo 701, which was designed to reduce groundwater contamination. The effectiveness of nitrogen removal in septic systems is reduced by allowing chemicals found in greywater to be introduced to blackwater during this nitrogen degradation process.

Awards won at the 2010 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

Second Award of \$3,000 - King Abdul-Aziz & his Companions Foundation for Giftedness and Creativity

2010 - EV017

THE EVALUATION OF TYPHA SP. AS AN EFFECTIVE OIL ABSORBENT

Peranika Enzri

Mara Junior Science College Balik Pulau, Pulau Pinang, MALAYSIA

Abstract

Water pollution can result in serious environmental and economic damage. One of the alternative methods to deal with it is by using an oil absorbent agent. Until now, only a few works concentrate on the utilization of natural source as an oil absorbent agent, for example ceiba petandra

Thus in this work, we conducted some experiments in order to investigate the ability of typha sp. to absorb oil from the mixture of oil an water without showing traces of water. Two types of sample has been prepared namely untreated and treated typha sp. with toluene , A few parameters has been chosen such as mass of typha sp used , treated and untreated typha sp., and type of water in used, which is tap water and seawater. In order to determine amount of oil absorb by typha sp, gravimetric and FTIR analysis was conducted.

It shows that treated typha sp with toluene shows better capability as oil absorbent compared to untreated typha sp with the amount of carbonyl group existed in typha sp. is around 70% and the mass increase is about 121.84g. In seawater, the 20g treated typha sp. shows the best result where the time taken to completely sucked is 2 minute and 6 seconds.The ratio of the oil and water mixture is 1:5. In tap water, the 30g treated typha sp. shows the best result where the time taken to completely sucked is 3minute and 15 second.

 Thus it can be concluded that the typha sp has almost the same effectiveness as ceiba petandra sp.

2010 - EV018

THE EFFECTS OF GROUND WATER IN AQUIFERS AND SURFACE WATER ON DRINKING WATER QUALITY IN SCHOOLS

Brianna Marie Schumann

Ovey Comeaux High School, Lafayette, LA

For most Americans, lack of good quality water has never been a concern. There are many threats to water quality in Louisiana; things are not nearly as bad as people most often believe. Water quality in Louisiana is managed under two broad areas: surface water and groundwater. The main goal of this research project was to test drinking water quality in local high schools: from tap and fountain water. To accomplish the main goal, water samples were collected from nine different schools being supplied from three different water sources: Chicot Aquifer, Mississippi Alluvial River Aquifer, and surface water from Bayou Black in South Louisiana. Samples from the schools were collected first thing in the morning before anyone had a chance to use the source.

The following data was collected at each site: temperature of water, dissolved oxygen, pH, salinity, conductivity, total dissolved solids, hydrogen sulfide, total available chlorine, and taste. The samples were analyzed for the following: E. coli, total nitrates, metals, phosphates, total hardness, calcium and magnesium hardness, and total suspended solids. Student ttest (p<0.05 is considered significantly different) was performed and graphs were made to analyze the data. I found that the age of the school had no affect on the water impurities that were tested. This could be that the older schools were tore down and rebuilt or the plumbing was updated. There was not a significant difference in water impurities when the school's fountain water was compared to that same school's tap water. There was a significant difference in water impurities for each Parish.

Awards won at the 2010 ISEF

Second Award of \$150 - Association for Women Geoscientists

2010 - EV019

THE UPTAKE OF ENDOCRINE DISRUPTING CHEMICALS

Benjamin Waring Armstrong

Monte Vista Senior High School, Monte Vista, CO

The excess birth control hormones that are being introduced into the environment around the world may be poisoning organisms of all types and sizes. This project was designed to test if the endocrine-disrupting chemicals being discharged into aquatic environments are being introduced into the terrestrial ecosystem. An experiment was designed to determine if Wisconsin Fast-Grow Plants would uptake 17β-estradiol from contaminated water. The chemical was successively diluted which produced four different solutions ranging in concentration from 3X10-3 g/L to 3X10-9 g/L. The plants where then grown using the water concentrated with 17β-estradiol. After growing for thirty-four days several physical characteristics were recorded including germination time, biomass, and amount of fully matured plants. It was found that 17β-estradiol delayed the initiation of germination, increased the total biomass of the samples, and reduced the amount of fully matured plants. These plants were extracted with newly created procedures using different variations of ethanol, HCl, hexane and ethyl acetate. These extracted samples were then analyzed with the use of High Performance Liquid Chromatography (HPLC). 17β-estradiol was detected in three out of four treatments ranging from 1.6ppm to 11.36ppm. The detection of 17β-estradiol in plants raises important questions about the potential of harmful chemicals reaching humans through the terrestrial food chain.

Awards won at the 2010 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

Award of three \$1,000 U.S. Savings Bonds, a certificate of achievement and a gold medallion. - United States Army

2010 - EV020

A STUDY OF THE EFFECTIVENESS OF PHARMACEUTICAL FILTRATION METHODS FROM WATER

Shane Matthew Sellers

Latta High School, Ada, OK

Virtually everyone is routinely exposed to minute amounts of pharmaceutical contaminants present in drinking water, yet the impact upon human health is

uncertain. The purpose of this investigation was to determine to what degree do household filtration systems actually remove these pharmaceutical contaminants.

 This study focused on three different types of filters, reverse osmosis, charcoal, and a leading glass manufactures' microfilter. Each filter was challenged with three different medications which are appearing as contaminants in our common water supplies. The medications used were Acetaminophen, Fluoxetine, and Norethindrone (estrogen in birth control pills). The hypothesis of this project was that many pharmaceuticals can be removed from water supplies using common household filters. One tablet of each medication was crushed and added to 1000 mL of distilled water. This solution was filtered using each of the filters. After filtration, the solutions were then analyzed using a high performance liquid chromatography mass spectrometer (HPLC-MS) to determine the residual drug amounts remaining.

 The results showed the reverse osmosis filter removed virtually all of the medications. The carbon charcoal filter removed over 50% of each medication, and the filter removed minuscule amounts. The Norethindrone was easiest to remove, which was predictable due to the larger molecular size of this compound. The Fluoxetine was most difficult to remove with only 60% of it being filtered out of the water utilizing the common carbon charcoal filter. New and improved filters need to be developed to minimize human exposure to nonprescribed pharmaceuticals.

2010 - EV021

PHYTOREMEDIATION OF HEAVY METAL CONTAMINATION: UTILIZING FRESHWATER AQUATIC PLANTS TO REMOVE LEAD, CADMIUM, AND ZINC

Lacey Taylor Jobe
Grove High School, Grove, OK

The purpose of this project is to determine if freshwater aquatic plants are phytoremediators for Lead, Cadmium, and Zinc. Hypothesis I states that Lemna minor, Philotria angustifolia, Porella navicularis and Nasturtium officinale will reduce levels of Lead, Cadmium and Zinc from freshwater. Hypothesis II states that all plants will reduce the level for Lead at a greater level than Cadmium and Zinc. Hypothesis III states that Nasturtium officinale will remove heavy metals at a greater level than the other aquatic plants.

Set up test groups labeled A, B, C, and D. Test for Lead, Cadmium, and Zinc on days 1, 3, 5, and 7. Weigh plants before and after testing.

Hypothesis I is accepted as all plants decreased the levels of Lead. Cadmium levels decreased in the beakers containing Nasturtium officinale, and Zinc levels decreased in all beakers by day 7. Hypothesis I is rejected for Cadmium because levels increased in beakers containing Lemna minor, Philotria angustifolia, and Porella navicularis. Zinc levels increased in beakers containing Porella navicularis on day 5, and increased in beakers containing Nasturtium officinale on days 3 and 5. Hypothesis II is accepted for, Lead levels decreased in beakers for all plant types. Cadmium levels increased in beakers containing all plants with the exception of Nasturtium officinale, and Zinc levels increased in beakers containing Porella navicularis on day 5, and Nasturtium officinale on days 3 and 5. Hypothesis III is rejected for since, Nasturtium officinale removed the least amount of Lead from the water.

Awards won at the 2010 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2010 - EV022

IS CHLOROPHYLL A SURROGATE MARKER FOR WATER POLLUTION IN LAKES?

Conrado Andres Asenjo-Molina
Academia del Perpetuo Socorro, San Juan, PUERTO RICO

Freshwater pollution is a major problem affecting the water resources used for recreation and water consumption. Water pollutant such as fertilizers and sewage water, which are rich in nitrogen and phosphorous, cause plant and algae growth (eutrophication) of lakes and rivers water. Eutrophication is difficult to measure but since chlorophyll is found in plants and algae it may be used as a surrogate marker for eutrophication and pollution.

The purpose of this investigation is to determine if chlorophyll can be used as a surrogate marker for pollution caused by nitrogen and phosphorus contaminants as well as fecal coliform bacteria contamination.

I compared the levels of nitrites, phosphorus, turbidity and fecal coliform bacteria in five Puerto Rican lakes and compared them with the chlorophyll levels of each lake. The data collected showed that all five lakes were contaminated with fecal coliform bacteria but the levels of chlorophyll did not correlate with them. Also neither the nitrite nor phosphorus levels correlated with the chlorophyll levels in the water samples taken from these five lakes. Turbidity level had no relation with the chlorophyll level.

The results of this experiment cannot sustain the hypothesis that chlorophyll can be used as a surrogate marker for determining water pollution. Additional studies with larger samples must be done to clearly establish the role of chlorophyll as a true marker of water pollution.

2010 - EV023

THE NEW FILTER! HONEYCOMB OF APIS MELLIFERA

Yailene Marie Bueno
Nuestra Señora de La Piedad, Isla Verde, Puerto Rico, San Juan, PUERTO RICO

This experiment was done as an alternative, in case of an emergency or disaster, so our most important resource, water, will not become scarce. The purpose of this investigation is to obtain drinkable water using a natural resource method. It was proposed that if a honeycomb " Apis mellifera" is exposed to non drinkable water, it will be able to purify and make contaminated water drinkable.

To verify the hypothesis, samples of the Lake Blasina and bathroom tank water were selected. Two different tests were done: 1) filtering the water with honeycomb, 2) submerging the honeycomb inside the contaminated water for a 24 hour period. Afterwards a sample of 1ml of the waters, will be mixed gently with the Coliscan easygel, and then poured into a sterilized Petri dish. After 48 hours, the data observed will be recorded, and compared with initial samples of both waters, with the honeycomb treated water samples. After using the process of submerging the honeycomb for 24 hours, it was proved that the initial tests of the Lake Blasina, subtracted the number of coliforms from a total of 240 coliforms to 0%. Also the sample of the toilet tank water using the same procedure mentioned before subtracted from a total of 2 coliforms to 0%. The hypothesis was proven.

2010 - EV024

GETTING CARRIED AWAY IV: INVESTIGATING ENVIRONMENTAL CONSEQUENCES OF SOIL TREATED WITH POLYACRYLAMIDE AND POLYVINYL ALCOHOL

Cameron Bradley Strong

The Woodlands College Park High School, The Woodlands, TX

Properties of absorbent, hydrogel polymers on soil allow for a significant decrease in the effects of soil erosion. Two polymers polyacrylamide (PAM) and polyvinyl alcohol (PVA) effectively prevent soil erosion. The use of these synthetic polymers in the soil demands investigations into possible environmental consequences.

 The first environmental factor tested was the growth of plants, represented by Brassica rapa, in treated soil. The experimental design allowed for comparisons of plants in untreated soil versus soils treated with various levels of polymer and for effects on germination. The experiment showed that there was no considerable difference in plant growth patterns based on soil treatment, polymer concentration, or when the polymer treatment began.

 The second factor tested was aquatic organisms, represented by the algae Selenastrum capricornutum, affected by polymers in soil run-off. Stock algae were grown in aquacultures for several days before polymer treatments were introduced. Data for algae growth was recorded using a spectrophotometer. Over time the algae in each aquaculture grew at a comparable rate regardless of treatment.

 The third factor tested was soil bacteria, represented by Pseudomonas fluorescens. Agar gels were treated with polymers and set before introducing the cultured bacteria. Observations of the bacteria indicated different growth patterns of colonies, though the presence of polymers did not prevent, deter, or advance bacteria survival.

 The use of these polymers in the soil does not generate negative environmental consequences. This experiment aids in confirming beliefs that the polymers either are not capable of bioaccumulation or pose minimal toxic risk to life in the environment.

Awards won at the 2010 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2010 - EV025

THE COMPARISON OF DETRITUS, LARGE WOODY DEBRIS, AND BIOMASS PRODUCTION IN UPPER GREEN RIVER BASIN KENTUCKY

Aimee Michelle Turner

Ballard High School, Louisville, KY

Purpose. This project measured detritus, large woody debris, and biomass production above lake and below dam during fall. Comparisons made among sites to identify differences or similarities and how these might affect mussel populations.

 Procedures. Following were used, multiple timed trials for capture of detritus using identical size net each time, counting and measuring large woody debris greater than 1m, and collecting and centrifuging water samples to measure biomass production.

 Results. Data show detritus levels at Site 4 are about 50 to 500 ml higher than next closest sampling site. In seven of nine samples, detritus measurements at Site 4 are more than three times greater than next closest sampling site. Comparing three downstream sites to each other, Site 1 has three of four highest measured samples. Site 3 was consistently very low for detritus. Numbers of large woody debris were not enough to strongly indicate that the dam is a factor of any kind. Measurement of biomass production did not reveal any strong trends.

Conclusions. Major finding is that the amount of detritus entering the lake 40 km above dam at Site 4 is more than triple the amount 105 km below dam at Site 1 in seven out of nine samples. Fall contribution of leaf litter drops to almost nothing below dam in late November, but is still important upstream of lake. While depressed below the dam, detritus increases with distance as do mussel populations and species.

2010 - EV026

THE EFFECT OF EVERGREEN COVERING ON THE PH OF POND WATER

Danielle Elizabeth Krouper

St. Clair High School, St. Clair, MO

A common practice recommended by the Missouri Department of Conservation is to put evergreen trees in lakes to provide covering for fish. The purpose of this experiment was to determine whether this practice had an effect on the pH of lake water. Evergreen material was placed in aquariums containing a mixture of lake and tap water. The pH was monitored over a period of 20 days. Over the 20 days, the water became slightly more acidic. After taking into account relative size, it was concluded that evergreen covering of lakes probably would not have a significant enough effect on the pH of lakes to alter the aquatic environment.

2010 - EV027

ENVIRONMENTAL TOXIN 4-NONYLPHENOL AND AUTOIMMUNE DISEASES: USING DNA MICROARRAY TO EXAMINE GENETIC MARKERS OF CYTOKINE ACTIVITY

Celline Kim

Manhasset High School, Manhasset, NY

Recently, many organizations including the FDA and CDC have increased awareness of hormonal toxins such as Bisphenol-A and 4-Nonylphenol (4-NP). 4-NP is an environmentally dispersed xenoestrogen that is used as a surfactant in industrial, agricultural, and domestic consumer products. The potential for human exposure to 4-NP is high because of its widespread use. The goal of my project was to evaluate 4-NP as a potential contributing factor in the development of autoimmune diseases by investigating its effects on cytokine gene expression. I hypothesized that 4-NP would play a negative role in autoimmune diseases by dysregulating cytokine gene expression. The U937 lymphocytic cell line was treated with 4-NP (5uM) and estrogen (5uM). Using DNA microarray and conventional RT-PCR, it was determined that 4-NP significantly up-regulated proinflammatory cytokines (toll-like-receptor (TLR)-6, TLR-10, interleukin (IL)-1, IL-5, IL-6, IL-8, IL-17C, IL-23A, IL-8RB, IL-receptor-associated-kinase (IRAK-2), tumor-necrosis-factor-receptor (TNFR)-5, and TNFR-10), while estrogen

caused insignificant increases. Simultaneously, 4-NP significantly down-regulated the expression of anti-inflammatory cytokines (IL-4, IL-4R, and IL-10) and estrogen had insignificant effects. Based on these data, I concluded that the hormonal toxin, 4-NP, may play a more important contributory role in autoimmune diseases than natural estrogen by eliciting effects up to 4 times more potent than natural estrogen. Overall, my project demonstrated that exposure to 4-NP may contribute to increased autoimmune susceptibility and/or exacerbate existing autoimmune conditions. These effects may be especially harmful in females, as estrogen plays a dominant role in their physiology.

Awards won at the 2010 ISEF

Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by Intel
First Award of \$200 - Patent and Trademark Office Society

2010 - EV028

CAN DRUGS BE FOUND IN STREAM SYSTEMS?

Alison Kristine Tune
Springfield High School, Springfield, OH

Because of increases in pharmaceuticals entering water systems, I hypothesized drugs would be found in streams in Springfield, Ohio with greater amounts downstream rather than upstream. Quikscreen testing kits were used to sample water from two Springfield stream systems. For Buck Creek, the upstream test site was by the reservoir, and the downstream in Snyder Park. For the Mad River, the upstream test site was by Forever Sports, and the downstream by the waste water treatment plant. The final test site was Chapman's Creek, by the Tremont City Landfill. At each site a cup-full of water was poured into a Quikscreen cup. Results were read after five minutes. A strong line showed none of the chemical was present, and a faint line or very faint line showed the chemical was present. A little oxycodone was present in Chapman's creek. In downstream Mad River, Buck Creek, and Chapman's Creek, some methamphetamine was present. Marijuana was present at all testing sites. Overall, downstream waters were more contaminated. In addition, Chapman's Creek contained barbiturates and tricyclic antidepressants. Because Chapman's Creek flows by the landfill situated above Springfield's aquifer, drugs could leach from the landfill into the creek, and into the water supply. From the research, antidepressants have adverse effects on wildlife, especially fish. The most significant improvement that I would make to this project is to test the water in a lab using a mass spectrometer to find the concentrations of the drugs in the water.

2010 - EV029

CHEMICAL AND ENVIRONMENTAL DEGRADATION OF OSELTAMIVIR PHOSPHATE

Ashley Marie Thelen
Mitchell High School, Mitchell, SD

When ingested by humans, the antiviral compound oseltamivir phosphate (i.e. Tamiflu™) is converted to its active metabolite oseltamivir carboxylate (OC) by the liver and excreted through urination. Current sewage treatment technologies are unable to break down OC. The treated effluent is released into waterways. This could expose waterfowl thereby risking the development of drug-resistant strains of seasonal and avian flu due to selective pressures. I have determined an easy, effective, and consumer friendly method to break down the OC before it enters the sewer system. Concentrations of oseltamivir found in residential wastes were exposed to chemicals found in the home or environmental factors encountered in waterways. The method to determine remaining OP levels after chemical or environmental treatment uses a quantitative colorimetric analysis of oseltamivir relying on an extractable colored ion-pair complex with bromochlorophenol blue (565 nm, pH of 7.0). A range of chemical concentrations were tested. In addition, environmental factors such as short and long wave UV light exposures, algae, and daphnia were tested. In concordance with my research, chemical factors, specifically ammonium hydroxide (household ammonia) worked significantly better than other chemical and environmental factors in the degradation of oseltamivir. The ammonium hydroxide tested at a 1:2 ratio eliminated 48% of the oseltamivir. This would provide an easy and inexpensive method to reduce oseltamivir contamination.

Awards won at the 2010 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel
First Award of \$3,000 - Air Force Research Laboratory on behalf of the United States Air Force

2010 - EV030

VIRAL CONTAMINATION: A FIELD EVALUATION ON THE PRESENCE OF VIRUSES IN TREATED SEWAGE FROM WASTEWATER TREATMENT FACILITIES

Kassandra Wilson
Weber High School, Ogden, UT

Of the numerous environmental issues being actively researched, water quality is one of the most important. Wastewater treatment plants (WWTPs) have government regulations designed to remove contaminants from the water. These contaminants include: viruses, bacteria, chemicals, solids, etc. One of the most challenging sewage contaminants to remove is viruses. The purpose of this experiment was to determine the level of viral contamination in the effluent (out-flowing) water of 10 Northern Utah WWTPs. It was hypothesized that viruses would not be present because the treatment process should completely remove them. To test this, 10 ml wastewater samples were collected from 10 WWTPs and at 13 treatment stages. Samples were plated with E. coli broth, incubated for 24 hours, and viral plaques were then counted. The results did not support my hypothesis. Effluent samples from eight of the ten plants showed viral contamination. Two of the WWTPs had 100% removal of viruses, when comparing influent and effluent samples. To determine the efficiency of viral removal throughout treatment stages, samples were collected and tested. The data shows that through each treatment stage the number of viruses decreased, but the overall treatment process did not consistently eliminate the viruses. It appears that additional treatment methods are necessary to more efficiently

remove viruses from sewage water. It is vital that these viruses be removed to provide clean and safe water, protect our environment, prevent disease transmission, and ensure human health.

2010 - EV031

HOW DOES URBANIZATION AFFECT AQUATIC BIOTA?

Lucy Caroline Leonard
Henry W Grady High School, Atlanta, GA

Urbanization, the development of land into residential, commercial and industrial properties, can alter watershed conditions, negatively affecting the aquatic biota of streams (i.e. aquatic insects, mussels, crustaceans). I hypothesized that as urbanization of a watershed increases, the number and abundance of aquatic macroinvertebrate species would decrease. Streams with different levels of urbanization, the independent variable, were identified using the Urban Intensity Index (UII) developed by the U.S. Geological Survey (USGS). The dependent variables, number and abundance of species, were measured by taking three samples of the aquatic biota in each of five streams ranging from low to high levels of urbanization.

The results strongly supported the hypothesis. The mean number of species declined consistently as urbanization increased, as did the mean and total number of individuals per stream. Certain species decreased as the urbanization increased, but some species stayed the same or increased as the urbanization increased, suggesting a higher tolerance to urbanization. It appears that aquatic biota can serve as a good indicator of stream quality and watershed condition, which means that the health of streams can be measured by sampling its aquatic macroinvertebrates.

2010 - EV032

EVALUATION OF HYDRAULIC CONDUCTIVITY FROM GRAIN SIZE ANALYSIS AND SLUG TEST IN ARAHAZAR, BANGLADESH

Ho Chit Siu
Bronx High School of Science, Bronx, NY

Arsenic in the groundwater in the region around Bangladesh and West Bengal is a major health concern where 50 million people depend on shallow aquifers for drinking water. Chronic arsenic exposure through ingestion of contaminated water causes a plethora of disorders in the human body. The “flushing” of aquifers by withdrawal and recharge of groundwater has been shown to gradually lower arsenic concentrations. Flushing occurs primarily in regions where aquifers have relatively high groundwater flow, as determined by hydraulic conductivity and hydraulic gradient. This study assessed hydraulic conductivity of shallow aquifers in Araihaazar, Bangladesh at four sites through grain size analysis of samples ranging in depth from ~1-30m followed by hydraulic conductivity calculation utilizing the Hazen and Kozeny-Carmen models. These results were then compared to in-field slug testing at the same sites from previous studies. The elemental composition of the samples was then found by x-ray fluorescence. Predictions from the Kozeny-Carmen model were found to be within an acceptable five-fold difference of slug test values, while providing 35% greater accuracy than the Hazen model. Elemental analysis showed high concentrations of trace metals near the surface, with concentrations decreasing with greater depth. Kozeny-Carmen modeling allows for higher spatial density aquifer hydraulic conductivity assessments that properly describe a highly heterogeneous aquifer- an advantage over slug testing. Model predictions may be used alongside elemental analyses to determine regions of greatest water flow and least contamination which could allow for easier aquifer assessments to find safe groundwater for people affected by groundwater poisoning.

2010 - EV033

DOES T.F. GREEN AIRPORT'S DE-ICING AFFECT WATER QUALITY?

Nathan Edward Andrews
Bishop Thomas F. Hendricksen High School, Warwick, RI

This research project deals with point source of watershed contamination to Buckeye Brook and Warwick Pond of Warwick, RI. The question that I am trying to answer is “Does T.F. Green Airport’s De-icing Affect Water Quality”.

 Visit each site and take samples. Take the temperature and perform a visual examination. Fill a brown bottle, a DO bottle and fix the O2, take a sample with the “mighty grab” at each site. Prepare them for testing. Perform the following tests: propylene glycol, iron, DO, and pH. Record data.

 My data supported my hypothesis. All test sites that flow out of the airport and are in the airport’s watershed showed a decrease in water quality. This was judged by testing pH, dissolved oxygen, and iron content. These sites were: Buckeye Brook Lakeshore Drive, Warwick Pond, Old Catch Basin, and Buckeye Brook Warwick Avenue. Glycol test results showed that directly before Buckeye Brook enters T.F. Green Airport at Airport Road, no glycol content. Where Buckeye Brook directly exits the airport at Lakeshore Drive, glycol was detected. In conclusion, T.F. Green Airport is discharging contaminated water, namely contaminated with propylene glycol, into the Buckeye Brook and Warwick Pond Watershed.

 The amount of glycol detected at Buckeye Brook Lakeshore Drive and Buckeye Brook Warwick Avenue in both the sediment and the water was 15ppm. The glycol can be detected as far as where Buckeye Brook meets Narragansett Bay. The presence of glycol in these water systems has a negative effect on the ecosystem and water quality. There were elevated levels of iron in the water, lowered levels of dissolved oxygen, and a lower pH all in comparison to the samples taken from Spring Green Pond and Buckeye Brook Airport Road. The propylene glycol causes nuisance bacterial growths, which lower the dissolved oxygen levels in the water. Dilution is not the solution to pollution.

Awards won at the 2010 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel
Third Award of \$2,000 - King Abdul-Aziz & his Companions Foundation for Giftedness and Creativity

2010 - EV034

SOURCES OF SEDIMENTARY ORGANIC MATTER IN NY, JAMAICA BAY REGION

Elaine Gomez
Union City High School, Union City, NJ

Jamaica Bay, located on the southern shore of Long Island, became a 9,155 acre national wildlife refuge in 1972 and is managed by the National Parks Service as part of the Gateway National Recreation Area. The area is a shallow estuary full of diverse habitats, salt marshes, upland fields and woods. The National Parks Service studies the Bay with great curiosity, being that a rich history has left the area in very poor conditions. The sediment of the bay reflects the dynamics of the area, and what is learned from the sediments is applied to answer questions regarding marsh loss and site-remediation. The focus of this research is to determine the source responsible for the organic content of the sediment by non-discriminating flash-pyrolysis through the vinylguaicol-indole ratio (VGI) for each sample location of the Bay. The insides of the bay, where most of the marsh islands reside have low VGI ratios, when they were expected to be high. The roots of marsh plants hold soils of wetland areas together preventing erosion during the submergence of water. There is a lack of terrestrial plants in the sections where they would be expected the most, contributing to the fact that current marsh loss is occurring. A second calculation, the 'Carbon-Preference- Index' was taken to verify results; both the VGI and CPI calculations follow the same trend, emphasizing current wetland loss. New York has lost more than half of its native wetland areas and the benefits they provide. The state faces the challenge to preserve the remaining 40% of its original native wetland areas. Wetland conservation is essential in order to maintain the ecological balance of nature, a clean water environment, and preserve biodiversity.

Awards won at the 2010 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2010 - EV035
AN INNOVATIVE METHOD TO EVALUATE THE EFFECTS OF THE AQUATIC ENVIRONMENT ON THE CHEMOTAXIS OF THE AMPHIBIAN PATHOGEN BATRACHOCHYTRIUM DENDROBATIDIS
Scott Paul Boisvert
Basha High School, Chandler, AZ

Chytridiomycosis, a disease caused by the fungus Batrachochytrium dendrobatidis, is diminishing amphibian populations worldwide; with 32.4% of species known to be threatened or extinct. Because B. dendrobatidis must penetrate into an amphibian's dermis to cause infection, chemotaxis is a vital factor contributing to its propensity to infect a host. This research evaluates how an amphibian's aquatic environment influences the chemotaxis of B. dendrobatidis. Water samples collected from amphibian habitats throughout Arizona represent diverse geographic conditions which impact the water chemistry of a site. Chemical analyses including Ion Chromatography (IC), Ion-Coupled Plasma Spectrometry (ICP) and Dissolved Organic Carbon/Non-purgable Organic Carbon (DOC/NPOC) documented the water chemistry for each habitat. A novel method was developed for the cultivation of B. dendrobatidis using customized agars that incorporate the water samples. An innovative assay was developed to measure chemotaxis as a function of the percentage of zoospores that traveled through a separation membrane toward a chemical attractant in a specified time. Results documented that the chemotactic response of B. dendrobatidis varied dependant upon the water chemistry of a site ($p < 0.05$), and geographic trends were observed. A stepwise multiple regression analysis isolated the factors of water chemistry significant to chemotaxis ($R^2 = 97.57$), identifying specific elements as inhibitors or facilitators. This study enhances the understanding of B. dendrobatidis, and benefits both ex situ and in situ conservation programs through interpretation of how a habitat's water chemistry may protect or predispose amphibians to infection by influencing the pathogen's chemotaxis.

Awards won at the 2010 ISEF
Second Award of \$1,500 - Environmental Sciences - Presented by Intel
Tuition Scholarship Award in the amount of \$8,000 - Office of Naval Research on behalf of the United States Navy and Marine Corps

2010 - EV036
TILE LINE TRAUMA
Brian Allan Buss
Southeastern High School, Augusta, IL

The purpose of the experiment was to determine the amount of nitrate-nitrite that is leaching from agricultural fields and determine whether the amounts that are being leached are environmentally safe. Tile lines are the best method of testing the contamination produced by agricultural uses that could contaminate drinking water sources. First, three fields must be found that will fit the crop rotation requirements of the project, and that have been tiled. Collections must be taken in sterilized containers before the testing period, 12, 24, and 48 hours after the beginning of a rainfall, and after the testing period. The samples must then be stored in a dark place at 4 degrees Celsius until the testing period is complete. Then, the samples must be tested for nitrate-nitrite concentration. The testing for this project was done by an Automated Hydrazine Reduction Method, and measured colorimetrically. Field 1, the bean field, had the lowest nitrate-nitrite concentration at a rate of 4.3 mg/L. Field 3, the corn planted after corn field, had the highest nitrate-nitrite concentration at a rate of 16.4 mg/L. But, field 3 exceeded the 10.0 mg/L concentration of nitrate-nitrite that is acceptable by state and federal laws for consumption. This could potentially cause several catastrophic diseases, particularly methemoglobinemia. The results from this test show that crop rotation is an economical and environmental choice. If a single crop is planted repetitively, the soil is depleted; eventually to the point of sterilization and can cause elevated levels of pollution as well.

2010 - EV037
ENVIRONMENTAL EFFECTS OF CARBON NANOTUBES AS SHOWN VIA THE INDICATOR ORGANISM TRIOPS LONGICAUDATUS
Gabriel Scott Stephens
East Noble High School, Kendallville, IN

Carbon nanotubes are extremely strong materials that have applications in engineering and medicine. They are projected to be used ubiquitously in the near future.

 But are they safe for the environment? There is a lack of research into their effects on ecosystems. This project dealt specifically with aquatic organisms found at the lower end of the food chain. If nanotubes damage these organisms, it could have negative cascading effect up the food chain.

 Daphnia magna, Triops longicaudatus, and Lumbriculus variegatus were exposed to exponentially increasing levels of multi-walled carbon nanotubes. It was hypothesized that cardiovascular rates, movement, growth, and reproductive capacity would decrease (types of measurement varied by organism).

 It was found that in Daphnia magna, at all concentrations, heart rate decreased by a statistically significant level. All decreasing p-values were less than .001. The same went for mortality, with death increasing by 61%, 53%, and 40%, with raising concentration.

 In Triops, movement decreased at extremely significant levels in all concentrations, with p-values less than .001. Carapace length for growth also decreased at extremely significant levels, less than .001 when compared to the control.

 In Lumbriculus, the decrease for movement was extremely significant with p-values less than .001 across the board. The decrease for viability was 27%, 20%, and 14% with increasing concentration.

 It can be concluded that nanotubes may have a detrimental effect on local ecosystems. More research into this subject could be done by creating an artificial food chain and introducing increasing concentrations of nanotubes to multiple generations.

Awards won at the 2010 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2010 - EV038

FINDING THE OPTIMAL CONDITIONS FOR ALGAE GROWTH UNDER THE PRESENCE OF CARBON DIOXIDE

Lauren Cushman Ransohoff
Lexington High School, Lexington, MA

The purpose was to study the effect of carbon dioxide and pH on algae growth, considering carbon dioxide sequestration using algae and biofuel creation from algae. To provide the carbon dioxide, a generator was created using yeast, sugar, and water. The amount of carbon dioxide, three different algae species and pH levels were tested to find the best growing conditions. Continuous exposure to carbon dioxide and pH level 7 were hypothesized to produce the greatest growth, and it was hypothesized that one species would grow best.

 Three different sets of conditions (with no, intermittent, and continuous carbon dioxide) were tested to determine which provided the best growth for Chlamydomonas. The amount of carbon dioxide was tested using a KH standard. The species, Chlamydomonas, Chlorella, and Pandorina, were tested with and without carbon dioxide. The pH level was tested in two experiments: the effect of acidic and basic pH levels on the growth of Chlorella with carbon dioxide. Experiments were conducted for seven days with cell counts taken daily.

 Cell counts exhibited logistic growth curves, revealing that Chlorella under continuous carbon dioxide with a pH of 8 grew best. Carbon dioxide is essential for algae growth and photosynthesis. Adding continuous carbon dioxide sped up the growth with Chlorella growing best. These results supported the hypotheses, but the pH level 8 did not.

 This research can be applied in the reduction of greenhouse gases and the development of alternate fuels. Algae can be used to sequester carbon dioxide and produce biodiesel.

2010 - EV039

THE EFFECT OF TURBIDITY ON LIGHT SCATTERING: A STUDY OF REFRACTED LIGHT THROUGH A CLOUDY MEDIUM

Holly Elizabeth Peterson
Sherando High School, Stephens City, VA

Turbidity is a principal physical characteristic of water and is an expression of the optical property that causes light to be scattered and absorbed by particles and molecules rather than transmitted in straight lines through a water sample. There are many causes of turbidity. Sediment from erosion, plant growth, and waste discharge to name a few.

This study proposed to answer the question "Does the level of turbidity effect the amount of scattered light?" If there is a strong correlation, then this cause and effect could be used to quantify turbidity levels thus providing important data concerning our environment.

The measured variables were the relative amount of scattered light and turbidity of the sample solution. I created turbidity in the sample solution by adding fat free milk. It is therefore the concentration of fat free milk in a water solution that was the independent variable. The relative amount of scattered light was the dependent variable. The hypothesis was that the level of refracted light would increase with the level of turbidity.

A photocell is used to measure the relative level of scattered light perpendicular to a light source. The photocell is connected to an electronic circuit that amplifies the voltage output of the photocell. The voltage output of the amplifier is measured with a digital voltmeter.

The concentration of the solution is controlled by measuring the volumes of fat free milk and distilled water using a graduated cylinder.

2010 - EV040

THE GENOTOXICITY OF ENVIRONMENTAL CONTAMINANT ON HEPG2 CELLS

Deepa M. Manjanatha
Little Rock Central High School, Little Rock, AR

The purpose of the experiment was to test the hypothesis that the environmental contaminant, Acrylamide (AA) is genotoxic to HepG2 cells (human liver cells).The null hypothesis stated that there would be no significant difference in genotoxicity between AA and the untreated control. To test this hypothesis, AA, along with two positive mutagens, ethylnitroso urea (ENU) and methylmethane sulphonate (MMS) were used in the Comet or Single cell gel electrophoresis assay. The Comet assay is a simple screening assay which can test at the cellular level if a chemical is DNA damaging or not. HepG2 cells were cultured overnight and then were exposed to 0 and 200 µg/ml each chemical in growth media for 2 hours. The Comet assay involved five steps: embedding the treated HepG2 cells; lysis of the cells; electrophoresis for 30 min; staining with SyberGold II stain; visualization and scoring of the Comets using Perceptive IV microscope and the Comet assay protocol. Approximately 100 cells per slide were scored for each chemical and the DNA damage was recorded as % DNA in tail of the Comets. The results showed that AA produced a significantly higher DNA damage in HepG2 cells compared to the untreated control (P<0.0001) and

therefore the proposed hypothesis was tested positive and the null hypothesis was rejected. Also, both the positive controls produced higher DNA damage than the AA. But, because of AA's presence in foods consumed by humans daily, the results were suggestive of the fact that AA's effect on the DNA of HepG2 cells could be a model for its effect on DNA in the human body, constituting a possible risk for liver cancer in those who consume high amounts of AA found naturally in foods produced by high temperature cooking.

Awards won at the 2010 ISEF

Second Award of \$1,500 - Air Force Research Laboratory on behalf of the United States Air Force

2010 - EV041

PSEUDOMONAS: ITS POSSIBLE USE IN REDUCTION OF FERRIC IONS IN WATER

Jayu Pramudya

Sekolah Menengah Atas Negeri 1 Surakarta, Surakarta, Central Java, INDONESIA

Water pollution is considered as one of the main problems in our life. It is suggested that water pollution can be the leading worldwide cause of deaths and diseases. This condition stimulates us to conduct research on water treatment. In this study, the influence of *Pseudomonas aeruginosa* toward the concentration of ferric ion (Fe3+) in water was investigated. Ferric ion (Fe3+) concentration was determined by spectroscopy. *Pseudomonas aeruginosa* was inoculated in five different volumes (5, 10, 15, 20, and 25 ml). The initial concentrations of ferric ion (Fe3+) were 5 and 7.5 ppm. The *Pseudomonas aeruginosa* density used in this experiment was 2 ose. Samples were run in triplicate. Data was analyzed using T-test analysis. The results show that, in all samples, the concentration of ferric ion decreased in the presence of the bacteria. In detail, the reduction of ferric ion (Fe3+) concentration in 5, 10, 15, 20, and 25 ml mixtures were, as much as, 81.84±5.05%, 87.44±1.28%, 87.05±1.11%, 89.09±1.05%, and 89.81±0.95%, respectively, with the highest reduction in 25 ml volume sample. This study indicates that the amount of reduction of ferric ion (Fe3+) concentration by *Pseudomonas aeruginosa* is linear and volume dependent. Overall, the result of this study may be applied in the treatment of water pollution especially in the case of ferric ion polluted water.

2010 - EV042

NEW NATURAL FERTILIZER

Martina Panfilo

Santa Elena, Lagomar, Canelones, URUGUAY

In the beginning of my project I decided to look for species of aquatic plants. I found three particular species that attracted my attention: water lentil (*Lemna gibba*, Gibbous duckweed), another one was a specie of water lentil with a smaller size (*Lemna minuta*, Least duckweed) and the other one was a water fern (*Azolla filiculoides*). I wanted to show that these aquatic plants could be used as natural fertilizers. I built a large scale pool where duckweeds, *Lemna gibba*, could reproduce freely until they had formed a layer of six centimeters thick. Two types of natural fertilizers were developed. One based on two species of duckweeds and another one based on a water fern (*Azolla*). The best result was achieved with the small water fern (*Azolla filiculoides*), both in reproduction and fertilization assays. That is, it turned to be the plant which reproduced faster and the one which made seeds planted with fertilizer based on it, grow faster. At room temperature (12° C mean) the two duckweed species (*Lemna gibba* and *Lemna minuta*) reproduced fast, doubling their population in 20 days, whereas the water fern (*Azolla filiculoides*) doubled its population every 15 days. Seeds germinated with fertilizer made from previously crushed water ferns (*Azolla filiculoides*), grew 7 cm. in 10 days, whereas seeds germinated on non fertilized soil only grew 4 cm.

2010 - EV043

DESTROYING MORE THAN ICE: THE EFFECTS OF ROAD DEICERS ON LUMBRICULUS VARIEGATUS

Paul Joseph Styslinger

The Altamont School, Birmingham, AL

The purpose of this experiment was to determine which common road deicing salt was the deadliest to *Lumbriculus variegatus*. The salts tested were Calcium chloride, Sodium chloride, and Calcium magnesium acetate. The worms were tested in 10,000 mg/L, 5,000 mg/L, 2,500 mg/L, 1,000 mg/L, and 100 mg/L concentrations of each chemical, and were placed in the solutions for time periods of 1 hour, 2 hours, 5 hours, and 24 hours. At the end of each time period, the number of dead worms per concentration was recorded. After the testing, it was concluded that the Calcium magnesium acetate solutions were the deadliest to the worms, with the Calcium chloride being the second-most deadly and the Sodium chloride solutions yielding the lowest death rate.

2010 - EV044

DECREASING THE ACIDITY OF ULTISOLS THROUGH SEQUESTERED CARBON SOIL AMENDMENTS

Megan Delilah Walsh

Kauai High School, Lihue, HI

The experiment I conducted looked at the ability of biochar to improve the acidity of Kauai's acidic soil (Ultisols) and the reasoning behind its ability to increase pH levels. Biochar is biomass that has undergone pyrolysis, the chemical decomposition of condensed organic substances by heating that occurs spontaneously at high enough temperatures (a process similar to making charcoal). The ability of biochar to decrease soil pH is contributed by two factors: the carbon content that creates a soil carbon-negative pool that withdraws atmospheric carbon dioxide and stores it in highly recalcitrant soil carbon stocks and the "ash" content (elements that remain after pyrolysis) that acts as a liming agent. To determine which factor contributed the most, or at all out of the two, I compared the pH of the acidic soil amended with biochar and soil amended with activated carbon (pure carbon). Since the only difference between the biochar

and the activated carbon is the ash content, it can be assumed that if the pH is the same between the two treatments, then the ash content has no significant effect on soil pH. Next, I tested if the concentration of the soil amendments would make a difference to the amount the soil's acidity decreased. To find the answer to these questions I compared a total of five treatments: control (soil without any amendment), 5% biochar, 10% biochar, 5% activated carbon and 10% activated carbon. After measuring out 100 grams of soil for each trial of each treatment, I moistened the soil with 50 ml of water (This is needed in order for the soil pH meter to make a reading). Next, I inserted a pH meter about 10cm into the soil sample and recorded each pH. I then statistically analyzed my data using the analysis of variance statistical test setting my alpha level to 0.05. After statistically analyzing the data, I was able to reject my null hypothesis: $F = 63.60$, $P = 5.91 \times 10^{-31}$. The results showed that biochar had a higher decrease in soil acidity than the activated carbon; indicating that the ash content contributed significantly to the increase in soil pH. I was not able to reject my null hypothesis stating that the high concentration of biochar/activated carbon decreased the soil acidity more than the lower concentration. The results showed that low concentration of biochar/activated carbon increased the pH just as much, if not more, than the higher concentrations of biochar/activated carbon.

2010 - EV045

THE QUANTITY AND QUALITY OF SPRING WATERS: FOR EMERGENCY HOME LAND SECURITY CRISIS

Tiffany Tu
Cookeville High School, Cookeville, TN

The purpose of this study is to investigate the quantity and quality of the spring waters in Putnam County for emergency response during the crisis of homeland security. I collected samples from Putnam County spring water streams on Billbrey road, Spring Creek road, Macedonia Cemetery road, Green Mountain road, Poplar Grove road, and Paron road. Then, I tested turbidity, total suspended solid, bacteria, chloride, nitrite, nitrate, sulfate, pH, alkalinity, and chlorine in the water and compared. I also calculated the flow rates of each spring water and the amount of water we need in Putnam County per day. The results show that there are plenty of good quality spring waters for us to supply water use during emergency crisis caused by terrorist attacks. This study will benefit the local government in many ways.

2010 - EV046

SOIL MEDIUMS WHICH ABSORB THE MOST POLLUTANTS

Jonathan L. Lin
White Station High School, Memphis, TN

Recently, the EPA added new provisions to the Clean Water Act which required states to reduce the amount of N, P, and K to enter sewage systems which were directly linked to rivers. N, P, K, and oil are the key products in lawn fertilizers. When I heard this news, I wondered how many states were going to adhere to these new regulations. This was how the idea for this project was born. There are two different ways to reduce the pollutant levels. First you can leech the pollutants off of the rainwater when it is entering the drainage system. Secondly, you can add strong chemicals or bacteria which may counteract with the pollutants and neutralize them. Since the second method involved possibly adding more pollutants into the sewage system, I opted with the first option. For the regional science fair, I determined what type of soil medium best absorbed the pollutants and the result was grass. However, grasses have to be planted in soil so for the second half of my project, I wanted to determine what component in soil best absorbed the pollutants.

2010 - EV047

ENGINEERING A PATH TO CLEANER WATER: PHYTOREMEDIATION OF COAL BED METHANE PRODUCED WATER ON AN INDUSTRIAL SCALE

Casey Brian Campbell
La Veta High School, La Veta, CO

Purpose of this study is to filter coal bed methane produced water using the macro algae Chaetomorpha on a large scale. I hypothesize that the Chaetomorpha filtration system implemented on a large scale will have a measurable effect on the Coal Bed Methane Produced Water. Collect 15 Gallons of coal bed methane produced water from designated sample site. Insert 6 cups of diatomite each into 5 5 gallon buckets with 3 micron microfiber screen below each. Insert a fist sized container of Chaetomorpha into each bucket. Drill a hole into the bottom of each bucket about ¼ inches wide. Arrange the buckets in a stair-like formation. Run coal bed methane produced water until 3 liters has been collected. Repeat with different amounts of diatomite. After the water has been collected, test it for pH, TDS, Ammonia, SAR, Magnesium, Lead, Arsenic, and Conductivity, as well as testing untreated waters for the same parameters. For 8 days Record Daphnia magna survival in different amount of diatomite tested waters, and unfiltered coal bed methane produced water. The filtration system killed off the Daphnia Magna and did not affect many other test except SAR. In the SAR test, the filtered water was significantly lower in than the unfiltered. Based on these results, there might be some possibility of coal bed methane filtration, most likely with out diatomite.

2010 - EV048

GET THE LEAD OUT: THE REMOVAL OF LEAD FROM WATER USING COMMON SEASHELLS

Madeline Maley Landon
Friendswood High School, Friendswood, TX

Lead contamination has numerous negative effects on the body. The purpose of this experiment was to find an inexpensive, effective way to remove lead from water. The following questions were asked: Can seashells be used to remove lead from water? Can seashells remove enough lead from polluted water to meet the EPA drinking standard of 15 ppb lead? How does time affect the amount of lead removed from the water? To answer these questions, distilled water was contaminated with 150 ppb lead. 800 mL of this water was exposed to 200g of crushed seashells. The exposure time varied from 10 to 20 to 30 minutes. After the appropriate time, a sample was analyzed using a colorimeter. Data from fifteen trials indicated that seashells are effective in removing lead from

water. Lead was removed from the water through a double replacement reaction where lead replaced the calcium on the surface of the shells, transforming into a solid crystal. The shells extracted over 50% of the lead in each trial and over 90% in several. It was concluded that seashells have the capability of reducing the lead in contaminated water to meet EPA standards. The longer the water was exposed to the seashells, the lower the concentration of lead in the water to a point. The majority of the reaction took place within twenty minutes.

The concept of removing lead from water using shells could be investigated further as an inexpensive means of purifying water in developing nations.

Awards won at the 2010 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel
Second Award of \$150 - Patent and Trademark Office Society

2010 - EV049
MOLD IDENTIFICATION AND ANALYSIS OF ZEA MAYS

Preston J. Gilderhus
Maddock Public School, Maddock, ND

The purpose of this project was to find out what kind of mold was growing on my corn samples. Originally, I wanted to see the functional differences of sweet corn to field corn, but the growth of mold changed my plans. I hypothesized that Aspergillus was growing on the corn.

After measuring some Zea mays plants from each type of corn once/week, I picked 10 cobs from each type. I took the cobs to the science lab to measure the mass, length and circumference, and count the kernels. I shelled the kernels and measured the length and circumference again.

From statistical analysis, I found sweet corn 1, which did not contain mold, to have the most variance in values. Then, I started to perform mold identification tests. My first confirmation test was a serial dilution sample which was incubated on PDA plates, but there was no growth. I did the same procedure with the exception of a direct corn ear mold sample, but I received similar results. My final test, a theoretical test, was to cross-reference pictures which led me to believe that sweet corn 2 and field corn had Cladosporium and Diplodia mold.

I found my hypothesis to be wrong because of the theoretical test I conducted. After different trials for determination of mold samples, I found the mold to be Diplodia and Cladosporium.

2010 - EV050
AN INQUISITION INTO THE HYDRO-CONDITIONS OF TILE DRAINAGE RUNOFF

Patrick Charles Gulan
Hankinson High School, Hankinson, ND

PURPOSE: To analyze water from tile drainage runoff and the Wild Rice River for their overall water quality. Secondly, to compare the amounts of gram-negative and general coliform bacteria in the water samples. Finally, to determine the levels of potential contamination of river water from the runoff of farmland tile drainage.

PROCEDURES: WATER ANALYSIS: Collected weekly water samples from 6 different locations, three from tile drainage runoff and three from the Wild Rice River, for eight weeks, and determined the amounts of dissolved oxygen, carbon dioxide, ammonia, zinc, iron, nitrates, sulfates, phosphates, copper, lead, conductivity, and pH through various testing methods. BACTERIAL COLONIZATION: Impregnated EMB agar plates with the samples and observed the bacterial growth. COLISCAN: Identified the presence and number of coliform bacteria in the water through the use of Coliscan Easygel kits.

CONCLUSION: In the Water Quality Analysis, I found that Location #2, Tile Drainage-Runoff-Ditch, had the best water quality, while Location #6, Wild Rice-Downstream, had the worst quality. In the bacterial colonization, Location #6, Wild Rice-Downstream, had the least amount of bacteria colonies, while Location #3, Tile Drainage-Runoff-Field, had the most. In the Coliscan procedure, I found that Location #4, Wild Rice-Entry, had the least amount of colonies, while Location #1, Tile Drainage-Runoff, had the most. In conclusion, I found that the runoff from tile drainage had slightly better water quality than the Wild Rice River, but the downstream river location did have the poorest overall water quality. Overall, I feel that the tile drainage runoff does create a negative effect on some aspects of the water quality of the Wild Rice River.

2010 - EV051
IDENTIFYING SOURCES OF E.COLI POLLUTION IN LAKE LAVADA

Katherine Elizabeth Christopher
Patrician Academy, Butler, AL

The purpose of this research is to determine whether the source of Escherichia coli in Lake Lavada is from domestic animals, wild animals, or humans. The feces to be tested are duck, dog, deer, and human. This project will be beneficial to residents of the Lake Lavada community who use the lake for recreational purposes such as swimming and fishing. The hypothesis of this project is that the main source of Escherichia coli in Lake Lavada is from wild animals.

Samples of water from Lake Lavada, duck, dog, deer, and human feces were tested. Each sample was combined with Coliscan Easygel, poured into a petri dish, and placed in an incubator for 2 days. Individual colonies were isolated and 5 different antibiotics were placed in each petri dish. After 2 days, the inhibition zones were recorded.

The control had an average of 0 mm inhibition zone for all antibiotics. Duck had an average of 0 mm inhibition zone in the control, Ampicillin, Erythromycin, and Penicillin. Tetracycline had an average inhibition zone of 11. mm and Chloramphenicol had an average of 21.2 mm. Dog had an average of 0 mm in the control, Tetracycline, Erythromycin, and Penicillin. Ampicillin had an average inhibition zone of 4 mm and Chloramphenicol had an average of 21.5 mm. Deer had an average inhibition zone of 0 mm in the control, Tetracycline, Erythromycin, and Penicillin. Ampicillin had an average of 19.8 mm and Chloramphenicol had an average of 1.8 mm. Lake Lavada had an average inhibition zone of 0 mm in all of the antibiotics although some bacteria grew.

The hypothesis of this project was not supported. Lake Lavada did not contain Escherichia coli.

2010 - EV052

THE ROLE OF CORTICOSTERONE IN THE ENDOCRINE CHEMISTRY OF XENOPUS LAEVIS (AFRICAN CLAWED FROG)

Anita Vasudev Saraf
Alfred M. Barbe High School, Lake Charles, LA

I wanted to understand the role played by the endocrine chemistry of frog in controlling the Corticosterone levels. The endocrine chemistry of an African clawed frog starts at the hypothalamus. The hypothalamus sends CRF to the pituitary gland where it binds with receptors 1 and 2. This signals the release of ACTH to the blood stream which then arrives at the adrenal gland. The adrenal gland produces glucocorticoids, one of which is Corticosterone. After Corticosterone is made, it travels to different tissues, and decreases the amount of Insulin Receptor mRNA as we found last year.

 We initially tested the pancreas for Beta-Actin, but were unable to detect sufficient mRNA levels and were therefore unable to continue working with pancreas. However, tests for Beta-Actin in the brain were successful.

 In my study, I found that the Corticosterone lowered the ACTH level. This could be attributed to the negative feedback. It is known that the negative feedback senses the levels of Corticosterone and alerts the pituitary and the hypothalamic center. That is, as glucocorticoid levels rise, they shut off the endogenous expression.

On the other hand, I did not detect CRF or its receptors. This could have been due to small amounts of the message being made or because of a very short half-life of the message.

 This combined study was done to understand the mechanism with which chemical stressors affect the glucose metabolism in frogs. Clearly, some of my experimental techniques will need to be improved to fully explore this subject.

 We need to exercise caution when dealing with chemicals in our environment as demonstrated last year. Similar to the process that is conducted when chemicals are used as pharmaceuticals, we may want to ensure the chemicals are safe for the environment as herbicides or pesticides. We need to always keep the environmental impacts in mind.

2010 - EV301
EVALUATING PESTICIDE AND HERBICIDE CONTAMINATION OF BIG HORN RIVER SEDIMENTS USING GC/MS

Jessica Fay Hunt, Kyra LaDon Cundall,
Greybull High School, Greybull, WY

The purpose of this project was to determine the types and concentrations of pesticides that might accumulate in the sediments of the Bighorn River.

 Experimentation began with the collection of sediment samples from five points along the Bighorn River. These samples were dried and then ground into a powder before extraction. Extraction was done initially using methanol. A second set of extracts were prepared using hexane and chloroform, in addition to the methanol. The extracted solutions were analyzed at the University of Wyoming's Department of Analytical Chemistry using the gas chromatograph and mass spectrometer. Testing was conducted twice in order to validate results. After the second testing, no pesticides were found. The graphs show cyclopentacyloxane, a fragment released from the column coating of the gas chromatograph, and toluene, a contaminant found in 90% of the methanol extracts.

 It was hypothesized that there would be pesticide accumulation in the sediment, and that the highest amount would be found in samples from Worland. This is because Worland is one of the bigger agricultural towns in the Bighorn Basin, and samples were from a site which carried a great amount of agricultural runoff.

After experimentation and analysis we concluded that our testing showed no pesticides in the sediment. This may be because the compounds were degenerated by the chromatograph or there was such a small amount of pesticides in the samples they couldn't be isolated. Also, sample collection occurred after the height of agricultural activity so many pesticides may have washed away. It is also possible that no pesticides were present within the sediment and they have instead accumulated in the water. Additional testing will be required to complete this research.

2010 - EV302
CO2 HERE, CO2 THERE, CO2 EVERYWHERE: A TEST OF CARBON DIOXIDE ON VARIOUS SOURCES OF GASES

Elise Nicole Howard, Neeraja Balachandar,
Shepton High School, Plano, TX

Carbon dioxide emissions are one of the leading causes of global warming. According to the Environmental Protection Agency, global atmospheric concentrations of carbon dioxide were 35% higher in 2005, than they were before the Industrial Revolution. Which source of gas contains the least amount of carbon dioxide- ambient air, human exhaust, edger-motor exhaust burning various octane levels of gasoline- (87-octane, 93-octane, and 89-octane), or nearly pure carbon dioxide? To determine this, the various sources of gases were collected in balloons and then released into test tubes with a solution composed of 15 mL of water and 10 drops of bromthymol blue indicator solution. Six trials were done for each source of gas to increase validity of the results. The color change that then occurred and the number of drops of ammonia needed to return each solution to its original color was recorded. In comparison with the other sources of gas, ambient air contained the least amount of carbon dioxide and the nearly pure carbon dioxide contained the most. Over the span of six trials, the average number of drops of ammonia needed to return the solution to its original color, for the ambient air was 0 drops and for the nearly pure carbon dioxide it was 6.5 drops.

The data from this experiment has many applications outside of the science lab. It may be helpful in deciding which sources of carbon dioxide should be given priority to in terms of reduction and which ones would be the easiest to reduce.

2010 - EV303
GLOBAL CLIMATE CHANGE: THE INFLUENCE OF TEMPERATURE DIFFERENTIATION ON EMBRYO FEMALE-TO-MALE PHENOTYPIC AND GENOTYPIC SEX REVERSAL IN THE MEDAKA FISH, PHASE III

Bethany Judith Rosemore, Benedict Scheuer,
Cloquet Senior High School, Cloquet, MN

he onset of global climate change altering water temperatures (Korner et al., 2008), many animals could be affected. Consequently, similar to reptiles, the gender of Medaka fish could be affected phenotypically and genetically(Rhen et al., 1999). The question is, what influence does temperature differentiation have on embryonic female-to-male sex reversal in Medaka fish, Oryzias latipes. The hypothesis is, if Medaka embryos are exposed to temperature fluctuations, within normal range, then female-to-male sex reversal in Oryzias latipes will increase. To perform the experiment, four different temperatures of 26°, 28°, 30°, and 32°

Celsius were maintained in four setups. Eggs were then added to each tank. Once the fry hatched, they were raised in 28° C water until the genders could be determined using phenotype. While monitoring our fish we also recorded data about mortality rates, and the amount of fungus in each temperature, this data was then put into SPSS and Excel. These graphs showed that 28° C was the optimum temperature to raise Medaka fish because it had the lowest mortality rate and least amount of fungus infection in the embryos. Once sexed, the ratios of males vs. females was recorded and also put into graphs. It showed that as the temperatures increased so did the number of males. This sex reversal happens between 28° C and 30° C. This is important because it shows that Medaka are affected phenotypically by a raise in temperature. If global fluctuation in temperature continue, many species could be affected. Genotyping results pending.

2010 - EV304

THE NEEDS OF SEEDS

Morgan Elizabeth Petersen, Ali Thomas,
Nettleton Junior High School, Jonesboro, AR

Soil pollution occurs when products made by man contaminate or alter the soil from its natural state. Many of the things that make life better for people -- cars, motorcycles, airplanes -- actually pollute the soil. How much pollution does it take to affect the growth of plants? The purpose of this experiment is to determine how much of a pollutant in soil will affect plant germination. One hundred percent of the seeds will fail to germinate in a mere 3% gasoline polluted soil.

For this experiment, Wisconsin Fast Seeds, Brascia rapa, were planted in 250mL polluted soil with the following amounts of gasoline as the pollutant: 2mL, 4mL, 6mL, and 8mL. Each soil treatment was placed in 3 cells of a 20 cell flat and 4 seeds were planted in each cell. A second flat was used as a control and the soil received no gasoline. The number of seeds germinated was recorded in a chart and this data was used to compare the effects of the amount of pollutant on the seeds' germination, as well as to compare the germination of seeds in non-polluted soil.

The results of this experiment supported the hypothesis that 8 milliliters of gas in 250 milliliters of soil would affect seeds germination because 100% these seeds failed to sprout. All of the seeds planted in polluted soil were affected to some degree. As expected the soil treatment receiving 2mL of gasoline sprouted the most seeds.

2010 - EV305

THE PHYTOREMEDIATION OF PETROLEUM IN TYPHA LATIFOLIA

Amber Jean Erickson, Presley Morua,
Alden-Conger Public High School, Alden, MN

This project in its present form is the result of Typha Latifolia and its ability to extract petroleum out of the soil. The initial purpose was to expose Typha Latifolia to petroleum contaminated soil and test to see how much petroleum the Typha Latifolia will take in and clean up the soil. The process begins with separating off each of the Typha Latifolia and exposing them to percentage of petroleum contaminated soil. After the petroleum was added we recorded observations each day. At the end of our test period we calculated how much the Typha Latifolia took in. Part of our hypothesis that was formed proved to be a success upon completion of our tests. In our studies we found that Typha Latifolia does take in a small percentage of petroleum with an average of .483968% of oil left in the soil after four weeks. Some failure in our experiment was found when the stem of the Typha Latifolia started to turn a tint of yellow.

2010 - EV306

STUDY OF GOBIOCYPRIS RARUS, EVALUATING ENVIRONMENTAL HORMONE EFFECT: THE EFFECT OF 17BETA-ESTRADIOL AND 4-NONYL-PHENOL ON GOBIOCYPRIS RARUS FEMINIZATION

Bingjie Hu, Wang Peng, Zhang Youran
Wuhan No.2 Middle School, Wuhan, Hubei, CHINA

With more serious problems of environmental hormones, a series of animal toxicological experiments were performed to investigate toxicity and molecular mechanism of hormone. Here we chose 17BETA-estradiol(E2) and 4-nonyl-Phenol(4-NP) as the testing chemicals, and treated juvenile Gobiocypris rarus with different concentration until they sexual matured. The results of morphological observation and gene expression showed: 1) E2 and 4-NP in environmental dosage slowed down the development of germ cells and raised the percentage of the female; 2) the expression level of cytochrome P450 aromatase gene CYP19b was significantly up-regulated with increasing the hormone concentration. Based on above results, we inferred that E2 and 4-NP might lead to significant estrogen effect by inducing the abnormal expression of CYP19b, and suggested G. rarus had the potential to become a sensitive, effective experimental organism for the environmental hormone evaluation.

2010 - EV307

UTILIZING THE ISOTOPIC SIGNATURE OF MACROALGAE TO IDENTIFY SOURCES OF NITROGEN IN STREAMS AND RIVERS FLOWING INTO MONTEREY BAY, CALIFORNIA

Lara Victoria Tromba, Isabella Tromba,
Pacific Collegiate School, Santa Cruz, CA

In the US alone, anthropogenic sources of nitrogen to the environment have doubled over the last 50 years. Humans have been radically altering the amount of nitrogen in the environment and the way in which it is cycled through ecosystems. Even worse, nitrogen cycling and assimilation, particularly in streams and aquatic systems, is not fully understood. Runoffs of sewage and agricultural wastes introduce large quantities of nitrogen, which have been linked to harmful algal blooms and lead to hypoxia.

We hypothesize that stable isotope analysis of macroalgae in agricultural, urban, and semi-natural rivers is a useful tool in tracing the source of anthropogenic nitrogen inputs into lotic ecosystems.

Macroalgae samples were collected from 10 sites located throughout Santa Cruz and Monterey Counties. The study's sample sites range from the northernmost site Waddell Creek to the southernmost site, Big Sur River. The large geographical and seasonal range of data will provide a substantial span of information that will help us better understand the impacts of land use on the

nitrogen isotopic signature of macroalgae. Thus, helping further our understanding of nitrogen inputs into the environment.

In order to see land use trends, we split the sites into three dominant land use categories: agriculture, urban, and semi-natural. Agricultural sites had mean d15N values of +15.15‰ and spread +9.49‰ to +19.73‰. The semi-natural sites had mean d15N of +6.44‰ with values ranging between +1.09‰ and +14.34‰. The urban sites had mean d15N values of +7.97‰ and ranged from +4.81‰ to +10.15‰. Elkhorn Slough had average d15N of +10.47‰ and ranged from +7.20‰ to +12.33‰. Using an analysis of variance test (F-statistic 26.266, p<.0001) we found the mean d15N values when grouped by land coverage were not all the same, suggesting a strong correlation between land use and the d15N values of macroalgae.

2010 - EV308

NATURAL OIL BOOM

Nor Adibah binti Mohd Hadzir, Nuradiza binti Rani, Rohaizah binti Mohd Fajjan
Kolej Tunku Kurshiah, Seremban, Negeri Sembilan, MALAYSIA

Due to oil spill, animals' insulation abilities are reduced consequently lead to body temperature fluctuations and death. More than 3 million metric tons of oil contaminates water every year. Currently, two types of booms are being used; one is oil boom, which acts like a fence to keep the oil from spreading or floating away on water, and two, oil absorbent boom or pad, which is used to absorb oil which is only suitable for on-shore application. The current equipments used today only have one function and very costly as they are imported from overseas. Thus, our Natural Oil Boom made from the unutilized plant found widely in Malaysia is perhaps the best answer. Imperata cylindrica (a type of weed found in Malaysia, locally known as 'lalang') is responsible for the absorption of oil as it has 35.5 % amount of cellulose. This cellulose which is oleophilic and hydrophobic, it can absorb up to 13 times their weight in hydrocarbon liquids while repelling water. The amount of cellulose in Imperata cylindrica is determined by using hydrolysis process. This plant is definitely economically beneficial as it can be found in abundance everywhere. Natural Oil Boom is invented by using the concept of oil boom and oil absorbent boom which can contain and absorb oil. This product is prepared by drying, blending, screening and compressing Imperata cylindrica in the net in the form of cylindrical shape. As a conclusion, Natural Oil Boom is the best option for oil spill problem. It is also very cheap and affordable compared to the current consumer's products.

Awards won at the 2010 ISEF

Second Award of \$1,500 - United States Coast Guard

2010 - EV309

QUANTITATIVE ASSESSMENT OF WATER QUALITY AND THE STUDY OF RAIN VARIATION IN THE COULEE BATON MICROWATERSHED

Julie Rene Matte, Paul Greagoff,
Ovey Comeaux High School, Lafayette, LA

This research project was based on a quantitative and qualitative assessment of water quality and the study of rain variation in the Coulee Baton Microwatershed located in Kaplan, Louisiana. The watershed is 6,200 acres of both agricultural and residential areas. This study was based on the variation of rain fall, volumetric flow rate, and downstream flow of the watershed. Three grab samples were collected from 11 sites for 8 different rain events. The parameters tested were: fecal coliform, Escherichia coli, phosphates, nitrates, B.O.D., D.O., salinity, conductivity, T.S.S., T.D.S., volumetric flow rate, temperature (air and water), metals, and pH.

T-Tests were performed comparing site to site and collection to collection; p<0.05 were considered significant. Regressions were analyzed to find the correlation of determination against rainfall and volumetric flow rate. The researchers concluded that the parameters tested from each rain event varied from one another (in most cases varied significantly). Furthermore, the hypothesis was proven correct as water flowed downstream. There was an increase in fecal coliform, E. coli, phosphates, nitrates, and total suspended solids.

The collected data may be used to determine priority areas to implement best management practices that could reduce potentially hazardous threats present in the waterways. Land use changes that can be considered (but not limited to) are: moving fences further away from the watershed to reduce fecal coliform inputs from livestock, planting trees or bushes to absorb phosphate and nitrate runoff, or lining ditches that input to the watershed with gravel to promote bacteria growth that could potentially decrease nitrates and phosphates, and most importantly, informing the community.

2010 - EV310

THE EFFECTS OF VARIOUS ORGANIC SUBSTANCES ON STRAINS ON ENVIRONMENTAL BACTERIA

Heather Lynne Nielsen, Priya Singh,
The Villages Charter High School, The Villages, FL

The purpose of this experiment is the researchers wanted to test the effectiveness of 2 organic substances, Neem and Pepper Juice, on different strains of environmental bacteria and a standard of E.coli K12 DHSAAlpha.

 The procedure begins with swabbing each chosen location to gather bacteria and streaking the corresponding plate with the correct procedure for isolation. Do the same for the E.coli strain. Place plates in incubator and return next day to check for bacteria growth. When growth is seen, select 8 colonies and prepare slides for gram staining. Using original colonies, gather bacteria and place in liquid LB. Place all tubes in shaker and check OD levels periodically. Centrifuge both organic substances and filter them. Dilute antibiotics, Kanamycin and Carbenicillin. Place filter disks in wells containing each solution. Take 18 plates and spread 2 plates/colony. Using forceps, place 3 disks on each half of every plate. Leave out at room temp overnight. Record results next day. For results, overall the pepper juice had a greater zone of inhibition than other substances. The neem showed almost no ZOI while both the Kanamycin and Carbenicillin showed varying ZOIs.Round 2 used Ampicillin instead of Carbenicillin and the Neem was prepared differently.

 After carefully reviewing and analyzing all data and research, the researchers came to the conclusion that the organic substance pepper juice was as effective as and/or more effective than the antibiotics tested in its ability to inhibit the growth of various strains of environmental bacteria. Ampicillin was more effective than Kanamycin & Carbenicillin. When compared, Kanamycin was better than Carbenicillin. The 2nd organic substance Neem was proven to be virtually ineffective throughout all testing.

2010 - EV311

HEALTH EFFECTS OF METAL NANOPARTICLES: THE ROLE OF HYPOXIA INDUCIBLE FACTOR-1ALPHA IN MMP-2 AND MMP-9 PRODUCTION BY HUMAN MONOCYTES EXPOSED TO NICKEL NANOPARTICLES

Yixin Li, Yihua Li,
Ballard High School, Louisville, KY

Nickel is an important economic commodity, but it can cause skin sensitization and lung diseases. With the development of nanotechnology, Nano-Nickel and Nano-Titanium dioxide particles have been produced for many years with new formulations and surface properties to meet novel demands. Previous studies showed that Nano-Nickel instilled into lungs caused a greater inflammatory response as compared with standard-sized nickel (5 µm) at equivalent mass concentration. Recently, several studies have shown that nanoparticles can translocate from the lungs to the circulatory system. To evaluate the potential systemic effects of metal nanoparticles, we compared the effects of Nano-Nickel and Nano-Titanium dioxide on MMP-2 and MMP-9 gene expression by RT-PCR and MMP-2 and MMP-9 activity by gelatin zymography. Our results showed that the exposure of U937 cells to Nano-Nickel caused dose- and time-response increases in MMP-2 and MMP-9 mRNA expression and pro-MMP-2 and pro-MMP-9 activity, but Nano-Titanium dioxide did not. To determine the potential mechanisms involved, we measured the expression of Hypoxia Inducible Factor-1alpha (HIF-1alpha) in U937 cells exposed to Nano-Nickel and Nano-Titanium dioxide by western blot. Our results demonstrated that the exposure to Nano-Nickel caused HIF-1alpha accumulation. Further, pre-treatment of U937 cells with HIF-1alpha inhibitors, such as 17-AAG, prior to exposure to Nano-Nickel, significantly abolished Nano-Nickel-induced MMP-2, -9 mRNA expression and pro-MMP-2, pro-MMP-9 activity. Our results suggested that HIF-1alpha accumulation was involved in the MMP-2 and MMP-9 production in U937 cells exposed to Nano-Nickel. Our research provided further understanding and evaluation of the potential health effects of metal nanoparticle exposure.

Awards won at the 2010 ISEF

First Award of \$3,000 - Team Projects - Presented by Intel

2010 - EV312

BERNOLLI VINTORI SIDEWALK

Abdul Kareem Hassan Darwazeh, Yazeed S Abdel Fattah,
Al Ra'ed Al Arabi School, Amman, JORDAN

Our projects main goal is to suction the polluted air in the street's environment in a physical, natural and an inexpensive way using solar energy.

We designed a pipe on which we applied Bernoulli's principle and Vontori's phenomena to increase the suction efficiency along the pavement.

The gas suction leads to an increase in the oxygen's amount around the car's engine and so the engine approaches the state of complete combustion and that reduces the amount of polluted gas produced by the car's engine.

This is an accumulative process, meaning that the polluted gas in the street's environment is reduced continuously.

We also designed an activated carbon filter with a high adsorption surface to purify the gases the device suctions , this filter gives you the opportunity to easily change the charcoal (activated carbon) and it doesn't cost a lot.

2010 - EV313

COMPACT FLORESCENT: A BRIGHT IDEA?

Amanda Caitlyn Edington, Erick Chavez,
Deming High School, Deming, NM

The purpose of this project is to compare the effectiveness of incandescent lights(ILs) to compact florescent lights (CFLs) in reducing the growth of bread mold in a basement-like environment.

Slices of bread were cut and placed in Petri dishes. The Petri dishes were placed in buckets. The slices of bread were "seeded" with a BSL-1 mold. Each bucket was fitted with a closure with a light fixture attached. One light fixture had a compact florescent light bulb, another fixture had an incandescent light bulb, and the control remained unlit. Each bucket had 100 ml of water added to it. These buckets were kept in a dark room for a week.

The resulting data showed the average sample from the control environment had 72.42 cm² of mold and 48% water evaporation. The samples under the compact florescent lighting grew an average of 55.00 cm² of mold and 74% water evaporated. The samples under the incandescent lighting didn't grow any mold and 100% water evaporated.

The incandescent light environment demonstrated to be the most effective in reducing mold growth and removing water from the environment.

The application of this experiment is that the phasing out of incandescent light (IL) bulbs needs to be addressed. The use of incandescent lights in certain environments can be more practical and efficient than the use of compact florescent lights.

2010 - EV314

UMBILICUS RUPESTRIS- A SMALL STEP IN PHYTOEXTRACTION, BUT A BIG STEP IN EVOLUTION

Susana Brito Duarte Sousa, Diana Raquel Quaresma Duarte, Tania Isabel Oliveira Brandao
Escola Secundaria de Arouca, Arouca, PORTUGAL

During World War II, tungsten was explored in the Regoufe mines, a village in the region of Arouca, Portugal.

From this exploration resulted worthless economic materials, which have been deposited in soil heap, constituting an environmental problem, being the source of contamination by toxic metals. In the remediation of these places, the use of accumulating plants represents an alternative to the traditional methodologies.

The present work constitutes a contribution to the prospection of bio accumulating plants in the local flora.

From the studied species, only Umbilicus rupestris, presented the capability to accumulate Cr in higher levels, considered a potential hyper accumulating Cr plant. Despite the low availability of this metal in the soil heap (18 ppm), Cr dosing by atomic flame absorption spectrophotometry show that U. rupestris can concentrate a six times higher amount of Cr of that in the soil (110 ppm).

Results from experimental tests showed that this species is a rare example of adaptation to geochemical stress imposed by the Cr excess, tolerating concentrations higher than 1 000 ppm and that can accumulate an amount about 23 larger than that of the soil, inferring about this species potential to integrate

fitorremediation programs of polluted Cr environments.

2010 - EV315

CATCHING IR: CONTRIBUTING IN SOLVING GLOBAL WARMING BY FINDING THE MOST EFFICIENT SURFACE FOR REDUCING REFLECTION OF INFRARED LIGHT FROM THE SUN IN ORDER TO REDUCE THE CO2 ABSORPTION FOR THE RADIATION

Ahmad Omar Bayonis, Abdullah Mohammed Aldosari, Abdullah Alkanhal
Asrary Schools, Riyadh, SAUDI ARABIA

Over the past 100 years, the global average temperature has increased by approximately 0.8 Celsius and is projected to continue to rise at a rapid rate. In this research we are aiming to stop or at least reduce this increase of heat. We were able to determine what type of surfaces can absorb the largest amount of IR radiation to prevent it from being absorbed by Carbon Dioxide, which is the main reason for global warming.

By placing different surfaces that vary in color and material, installing an infrared measuring tool pointing at the surface and calculating measurements it appeared that the substance of the surface does not affect the amount of reflected radiation. However, the color was very effective according to its gray scaling. The darker it is the less amount of reflection occurs. It turned out that using a black surface reduced about 72% of the radiation, while using a grey surface reduced about 35%.

It is known that darker colors produce more heat. Using several thermometers we were able to measure the surrounding area of the surface and prove that true. We are now studying a way to solve that problem by either converting that heat into another form of energy or using it as a heating mechanism.

2010 - EV316

EFFECTS OF CARDENOLIDES IN MILKWEED ON MONARCH BUTTERFLY (DANAUS PLEXIPPUS) DEVELOPMENT

Kristina Louise Tester, Kara Marie Lillehaug,
Breck School, Minneapolis, MN

We determined how levels of cardenolides in two different types of milkweed, Asclepias syriaca and Asclepias curassavica, affect growth of monarch larvae and development of adult monarchs (Danaus plexippus). We looked specifically at how cardenolides in A. syriaca and A. curassavica, which grow in the Northern and Southern hemispheres respectively, affect growth and development of second- through fifth-instar monarch larvae. Results indicate that overall development time for larvae raised on A. curassavica was significantly shorter than development time of larvae raised on A. syriaca (p < 0.00). Monarchs raised on A. syriaca emerged with significantly greater mass and longer wingspans (p < .0003), which indicates that larvae raised on A. syriaca may be more successful in reproducing and migrating than those raised on A. curassavica, even though larvae raised on A. curassavica developed faster. Results also indicate that larvae in third-, fourth- and fifth-instar stages show a significant preference for A. curassavica over A. syriaca (p < 0.8828). These results suggest that larval preference for A. curassavica could present a problem if global climate change favors spread of A. curassavica to northern climates: ingestion and preference for A. curassavica could result in monarchs being less physically prepared for southern migration, and could negatively affect their reproductive cycle.

2010 - EV317

ARE ECO-TERGENTS TRULY "GENTS" ?

Ream Elbadri, Sara Abu Obaid,
North Park Collegiate Vocational School, Brantford, Ontario, CANADA

Water quality is a worldwide issue. Eco-friendly laundry detergents are marketed as being better for the environment than regular detergents. The purpose of this experiment was to test this claim utilizing the planktonic crustaceans Daphnia, as they are sensitive and often used to determine the health of a water environment. As well, being at both the top end of the algae food chain, yet near the bottom of the animal food chain, their health impact has broad implications for overall water ecosystems. Four different concentrations of two eco-friendly detergents and one non-eco-friendly detergent were tested to see if the ecosystems containing the eco-friendly detergents would have a less severe effect on the life of the daphnia since they contain biodegradable ingredients derived from natural materials. After the concentrations were prepared, five daphnia were added to each ecosystem. This procedure was repeated three times. The following factors were observed after 48 hours: the number of intact but not moving daphnia, the number of living daphnia, the number of skeletized daphnia, the number of baby daphnia born, the number of pregnant daphnia and the number of eggs inside them. Results showed that one of the eco-friendly detergents displayed the greatest success in preserving living organisms within the ecosystem. Even in the greatest concentration, this eco-friendly detergent had the largest proportion of daphnia living, as well as highest number of babies born and the highest number of still pregnant daphnia, unlike the non-eco-friendly and the other eco-friendly detergent.

2010 - EV318

DETERMINING SEA POLLUTION BY ANALYZING METALLOTHIONEINS IN MYTILUS GALLOPROVINCIALISIS

Enxhi Vrapj, Eni Kodra,
Turgut Ozal College, Tirane, Tirane, ALBANIA

The river deltas and some areas of the continental shelf, where generally the ocean's greatest diversity as well as some of the world's biggest cities are located, get polluted by the industrial and urban development (ex: synthetic organic components (pesticides), hydrocarbures (of petroleum), heavy metals (Cd, Hg, Pb, Cr, Zn, Mn, Fe) and radioactive materials).

The aims of this project are:

• Measurement of the level of pollutant substances in sea organisms we eat.

• Identification of sea regions with pollution levels slightly higher than the limit.

• Getting to know the actual levels of pollutant substances in sea organisms.

• Studying the change in the concentration of these pollutants in the organisms during a time period.

Mussels were collected in 4 different regions of Albania: Butrint, Durrës, Vlorë and Qeparo.

The mussels' tissues were studied. The accumulation of heavy

metals in the tissues is directly proportional to the amount of pollution on a region. We also tried to detect the methallothionein's concentration for further studies. Metallothioneins are a group of non enzymatic proteins with a relatively small molecular mass, which bind to some heavy metals and are often used to monitor the sea pollution.

The results taken from the different stations and the different ways of analyzing were compared with each other to get to a conclusion.

-> For all the heavy metals there is a slightly higher concentration of them in the digestive system of the organisms, compared to the tissue.

-> Spectrophotometric method used in the laboratory has good results, determining that the level of pollution is not very high.

2010 - EV319
FARM FEEDING PRACTICES: EXPLORING SOLUTIONS FOR ENVIRONMENTAL SUSTAINABILITY

Pearl Sawhney, Minna Mohammadi,
Maharishi School of the Age of Enlightenment, Fairfield, IA

erved strong stench when passing the local animal farms, the source of which is gas produced by animals and their waste excretion (manure). If this manure is polluting the air, could it also be polluting the water around these farms? Could the feed given to the farm animals be the source of this pollution? Logically, output depends on the input; therefore, feed type consumed by the animals should impact their waste excretion.

One of the primary nutrients washing into downstream water from animal farms and adding to contamination is Phosphorus. We wanted to examine if the implementation of nutrient and feed strategies can reduce the level of phosphorus in the animal waste excretion.

Therefore, we contacted three farms using different feeds and got sample of organic feed, non organic feed, CAFO feed (non-organic fortified feed); we also got low-phytate and high phytate feeds from the USDA. Samples of water were also collected upstream and downstream from the three farms. Tests were conducted using the recommended protocol and readings were recorded.

T-test supported our hypotheses that the level of unbound phosphorus available from CAFO feed is significantly less than the amount available from a non-organic and an organic feed. We also found that significantly higher levels of phosphorus and BOD were found in the downstream water from the CAFO farm as compared to non-organic and organic farm. We also found that there was no difference in the levels of phosphorus and BOD in the upstream water collected from different farms.

2010 - EV320
CAUTION: WATER UNDRINKABLE

Michele Pacheco, Tiffany Armstrong, Victoria Green
East Boston High School, East Boston, MA

Large plastic water jugs and small paper cups are visible throughout almost 50% of the school. Signs posted in the bathrooms say "WATER FROM SINKS WILL BE USED FOR WASHING ONLY." The problem studied is why the water is undrinkable and what can be done to make it drinkable. Not only are these large plastic jugs harming the environment, but the amount of money the city is spending on these water jugs results in lack of funding for other school expenses that would benefit educational goals.

It was hypothesized that the chlorine levels in the water would differ between the school and the homes in the surrounding area. It was further hypothesized that the pH levels would be vary only slightly between the two areas.

Tests were performed on the water from various locations in the school and from selected homes surrounding our school. Four different experiments were performed testing pH levels. Additional experiments testing for chlorine, copper, iron, hardness, lead, and nitrate were done. Standards for tap water according to the World Health Organization, the Environmental Protection Agency, the state water authority, and bottled spring water were researched. The results showed that the amount of chlorine was four times higher than it should be, and in one location the color of the water was yellow from what appears to be rust in the pipes.

The conclusions reached indicate that the water test kit tablets used may not be as accurate as the ones used by the local health commission, but provide data that vary within a close range. Further tests are in process that are similar to the tests used by the local health commission and more controls such as distilled water and the bottled spring water will be included.

2010 - EV321
THE EFFECTS OF MILLTOWN DAM REMOVAL ON MACRO INVERTEBRATE POPULATIONS IN THE CLARK FORK RIVER

Luke Alan VonLanken, Bryce Caye,
Sentinel High School, Missoula, MT

The purpose of this project is to collect and monitor aquatic macro-invertebrate populations and to compare standard chemistry data above and below the Milltown dam site in Missoula Montana. The dam was removed because of toxic sediment accumulation from upstream mining operations. This population monitoring and water chemistry can indicate the effect of removing the dam on the water quality of the river. If the removal of Milltown dam causes degradation in water quality because of the release of toxic sediments, then the population of macro-invertebrates below the dam should be adversely affected and standard chemistry data should also show a decrease in water quality. Collection methods involved using a standard kick net to collect macro-invertebrates, and a HACH chemical kit to obtain chemistry data. Our findings indicate that the entire Clark Fork River was negatively affected by the breaching of Milltown Dam. This data indicates that the release of harmful sediment did exist and did negatively affect water quality in our study section of the Clark Fork River. Analyzing our data we found that all testing scores fell into unhealthy levels.

2010 - EV322
ANALYZING WATER SAMPLES BY LIBS METHOD

Matej Veis, Juraj Hasik,
Spojena Skola Novohradaska, Bratislava, SLOVAKIA

In 21st century, worldwide availability of pure drinking water is compromised. More than one fifth on Earth's population is without access to clean water. To

better understand the problem and search for sources of clean water, quick and precise analysis technology is needed. Our aim was to find an innovative approach of analyzing the rate of contamination of some water source, which has to be fast, easy to use and with sufficient preciseness.

Examination of samples was done using the Laser-induced breakdown spectroscopy.

The pollution of water was studied by measuring content of secondary sources, because of their ability to filter the water. Initial idea is to use limescale as specimen, which should contain traces of harmful elements within his matrix. To further examine the detection limits, the deliberately polluted water samples were evaporated to form a limescale.

By observation of limescale samples, the traces of metals were found. In willingly polluted samples, the method successfully estimated the contamination.

By studying the pollution of water through secondary sources, the higher precision and rapidity of measurements has been achieved. Usage of laser-induced spectroscopy this way is effective method of determination of inorganic pollutants in water. Because of the advantages of such approach, this method can be used as initiatory indicator of pollution.

2010 - EV323

ALKALINE RAINFALL

Sol Paskvan, Lucas Matías Gille,
Colegio San Ignacio, Tandil, Buenos Aires, ARGENTINA

The aim: "To determine the values of pH in samples from rainfall events in Tandil, and to be informed about the origin of the formation of the clouds whose water fall in the area". This is related with rain water composition that could be determined with an ionic balance. According to the variables the hypothesis is elaborated: "The rain in Tandil is basic, it's origin is a complex phenomenon, in which prevails the origin of the formation of clouds in the mid-levels of the troposphere".

To measure the collected samples, a more accurate pH-meter was used, verifying the results by carbonate titration and sending samples to official organisms, coinciding with the results obtained. Simultaneously satellite images were followed and specialists consulted.

In the current year 139 samples were collected in 38 rain events and the obtained values in this period are: average 7,13, maximum 8,98 and minimum 5,640.

As a preliminary characterization of anions and cations content, three samples were analyzed. The pH of rainwater is generally affected by acidic and alkaline ions in the rainwater. The differences observed doing the ionic balance of the samples may be due to the lack of quantification of certain ions such as carbonate, bicarbonate and ammonium. The elevated Mg/Na, Ca/Na and SO4/Na ratios indicate the possible contribution of other components, probably the soil. Alkaline pH indicates neutralization of acids by windblown soil dust and ammonia.

Conclusion: the pH of the rain in Tandil, during the period studied, is basic. It is contaminated; its origin is a complex and heterogeneous phenomenon whose elements are interdefined. The majority of the clouds in the mid-levels of the troposphere (rain clouds) come from the west and their formation in drought areas with atmospheric dust transfer prevails above the dragging of the particles of the place where the rain falls. In the last period the decrease of pH registered correlates with the rains in the cloud formation areas, except in one event in which the clouds are originated in the Atlantic Ocean (marine salts) which registers a pH of 8,93 reaffirming the importance of the cloud formation.

Awards won at the 2010 ISEF

Honorable Mention Award - American Meteorological Society
Third Award of \$1,000 - Team Projects - Presented by Intel

2010 - EV324

STUDY OF THE EFFECT OF ORGANIC DECOMPOSER ON THE INCIDENCE OF STABLE FLIES (STOMOXYS CALCITRANS) (L.) IN PINEAPPLE STUBBLE (ANANAS COMOSUS) (L.) MERR.

Susana Beatriz Garita-Araya, Alexia Quiros Rojas,
Colegio Científico de Costa Rica-Sede San Carlos, Santa Clara de San Carlos, Alajuela, COSTA RICA

The stable fly (Stomoxys calcitrans) (L.), is a hematophagous insect (feeding on blood) that reproduces in decaying plant material. It causes a highly relevant environmental impact because it affects livestock economy, through a reduction in the production of milk and meat. It is also capable of provoking and transmitting several diseases such as: trypanosomiasis and HIV. Nowadays, its control is difficult due to its ability to reproduce rapidly in different types of substrates. This project was designed for those reasons in order to help control the incidence of stable flies.

The purpose of the experiment was to verify if the plague can be indirectly fought by attacking the substrate where the fly breeds. The use of a substrate decomposer element was proposed in order to achieve the aforementioned; and tests were conducted with three types of organic decomposers; each included three replicates with the application of a single dose. Climate aspects affecting the process of soil preparation, such as rainfall, were considered. Effectiveness was measured by counting the fly in its development stages compared to a blank treatment.

The use of organic decomposers decreases the egg, larvae and pupae count of the stable fly by 46 to 100%, 72 to 95% and 38 to 77%, respectively; overall,

there were differences in the products tested.

Awards won at the 2010 ISEF

Fourth Award of \$500 - Team Projects - Presented by Intel

2010 - EV325

HEAVY METALS IN MINES

Humoud Saleh Almutairi, Saud Dakhel Alharbi, Rakan Thareeb Almutairi
Alhakm Bin Hesham Public School, Mahd Althahab, SAUDI ARABIA

The object of this projects is to determine the concentration of heavy metals in Mahd Althahab city soil and the association between soil pollution and the proximity of a mining field. Mahd Althahab city, located in the Western province of Saudi Arabia has the largest and oldest mine. Heavy metal concentrations can have a drastic effect on the community, especially the health of the local population. Various samples were obtained from different distances from the mine.

All samples were digested using soil digestion tools so it can be read using a microwave according to the U.S. Environmental Protection Agency EPA3051

Heavy metals' concentration levels were determined by using an atomic analysis device. Results indicated high levels of heavy metals in Mahd Althahab city soil. Each location had different concentration levels of heavy metals. Moreover, concentration levels would increase with closer proximity to the mine. Zinc levels were eight times larger than the world average, Moreover lead was nine times, copper five times than the world average. Also Cadmium was 28 times the world average!.

Awards won at the 2010 ISEF

First Award of \$1,000 - American Geological Institute
Fourth Award of \$500 - Team Projects - Presented by Intel

2010 - EV326
BIOLOGICAL, PHYSICAL AND CHEMICAL INDICATORS OF UNGULATE GRAZING PRESSURE ON MONTANE STREAMS WITH A DESCRIPTION OF A PREVIOUSLY UNIDENTIFIED INVASIVE SPECIES IN THE VALLES CALDERA NATIONAL PRESERVE

*Nathaniel Reichert Clements, Joe Abeyta,
Los Alamos High School, Los Alamos, NM*

The primary purpose of this study was to determine if ungulate grazing was damaging montane riparian zones in the Jemez watershed on the Valles Caldera National Preserve in northern New Mexico.

 Sampling protocols were developed for crayfish collection, and then twenty-one stream and pond sites were surveyed. Three of the stream sites had fenced exclosures to prevent ungulates (elk or cattle) from grazing near the streams. Crayfish were identified based on their reproductive structures and were then used as biological indicators of riparian zone damage. Their abundance, weight, length and carapace length were recorded. Chemical tests (pH, nitrate, aluminum, total phosphorus and copper) were performed and physical measurements (temperature, flow rate, total dissolved solids, and turbidity) were taken to determine whether grazing affected water quality.

 The invasive Orconectes virilis was the only crayfish present. If grazing had damaged the riparian zones, we would have expected to see decreases in crayfish numbers, changes in crayfish morphometrics, and decreased water quality. However, no statistically significant differences were seen in any of these measurements inside or outside of ungulate exclosures or between sites with different grazing pressures.

 We conclude that ungulate grazing is not damaging Valles riparian zones. At current grazing levels, there are no negative effects on crayfish or water quality. However, monitoring of the previously unidentified O. virilis is now needed because they may begin to out-compete native species.

2010 - EV327
GLOBAL INFORMATION SYSTEM AND GLOBAL POSITIONING SYSTEM IN REDUCING ENDANGERMENT OF DERMOCHELYS CORIACEA (LEATHERBACK TURTLES) NESTING HABITATS IN ST. CROIX, VI

*Mendrell Symphorien, Jaleel Benjamin, Stephanie Rhoden
St. Croix Educational Complex, Kingshill, St. Croix, VIRGIN ISLANDS*

Endangered Dermochelys coriacea (Leatherback Sea Turtles) have been tracked and studied on St. Croix, Virgin Islands for over 26 years. Nesting is prevalent on two beaches on the island. As it is their nesting medium; sand grain size, vegetation and crest were studied as a possible factor affecting Leatherback nesting trends on St. Croix beaches. Leatherback turtles have been classified endangered since 1980 with a decline in the population from approximately 43,000 to 26,000 nesting females annually, compared to 115,000, (Federal Register, 1999).

This project investigated, using Geographic Information System (GIS) and Global Positioning the nesting habitats of Leatherback Sea Turtles in St. Croix, Virgin Islands. Using sieve analysis, sand samples were studied from vegetation lines, crests and water lines from over 49 beaches on St. Croix with 147 samples. Sand was collected; dried through high voltage heating and sifted using a sieve shaker measured in micro meters. Comparisons were made on sand quality from vegetation line, beach crest and water line on each of the 49 beaches studied. Results of this investigation indicated that Dermochelys coriacea (Leatherback Turtles) prefer certain sand quality for nesting. Determinations were based coarse grain size, color, texture, vegetation and water line. Using the GIS and the GPS systems, nesting areas can be predicted, marked and protected from elements that are commonly associated with nesting disturbances.

Further studies are needed to determine how area mapping can be used to increase the endangered population of the Leatherbacks (Dermochelys coriacea).

2010 - EV328
USE OF NATURAL FLOCCULANTS IN MITIGATING HARMFUL ALGAL BLOOMS (RED TIDES)

*Maria Clara Isabel De Los Reyes Sia, Jean Reni B. De Guzman, Marc A. Mapalo
Philippine Science High School - Eastern Visayas Campus, Palo, Leyte, Leyte, PHILIPPINES*

This study examined the application of natural flocculants for removal of Harmful Algal Blooms (HABs) or red tide using clay, chitosan from shrimp exoskeletons and pounded Moringa oleifera seeds.

 Each natural flocculant was suspended in distilled water at a concentration of 4g/L to produce the treatments. Five mL of treatment was added to 50 mL of sea water containing algal cells for each treatment; an additional 50 mL of untreated seawater was used as negative control. This procedure was replicated three times.

 Cell counts were performed before and after treatment (administered for 30 minutes) to determine the removal efficiencies of the treatment.

 Analysis of Variance and Duncan's Multiple Range Test (DMRT) showed that the highest average efficiencies for removal of three algal species (Pyrodinium bahamense var. compressum, Protoperidinium murray and Protoperidinium conicum) were exhibited by M. oleifera (100%, 97.9%, 96.3% respectively) and chitosan (94.6%, 93.1%, and 93.7 %). This may be attributed to chemical properties of both substances. Clay exhibited removal efficiencies (72.86%, 47.59%, and 54.68%), which were either significantly lower or not significantly different from those of negative control (82.95%, 57.75%, 67.76%). Although chitosan and Moringa oleifera seed treatments caused an increase (1-2ppm) of nitrate in water, water chemistry testing revealed that this increase did not meet the nutrient level requirement (10ppm) for P. bahamense or Protoperidinium bloom.

 Based on the results, chitosan and Moringa oleifera seeds are considered effective flocculant treatments for HAB mitigation.

Awards won at the 2010 ISEF

Fourth Award of \$500 - Team Projects - Presented by Intel

2010 - EV329

IS SOIL AND WATER CONSERVATION BECOMING A MAJOR GLOBAL CONCERN?

Nadia Banks Miller, Nevada Banks Miller,

Sherman High School, Seth, WV

The boundaries between soil and water are among the most rapidly changing parts of the Earth's surface. However, the importance of soil conservation is relatively less talked about as compared to the conservation of water and other natural resources. Therefore, this project investigates the quality of regional soil and water and the relationship between soil and a clean water supply. Soil types, healthy soil, water erosion, and a clean water supply are important factors affecting the natural balance of the survival rate of the human race. According to research, there is an impending water crisis based on the Global water outlook to 2025. According to a professor emeritus of Animal Ecology, Iowa State University, there is a potential for Global water wars in the 21st Century. The amount of available clean, fresh water per capita on each continent is at risk. However, the three river basins with the most potential for conflict are all in the Middle East. It is therefore important to begin reaching out to communities and schools to teach all people the value of natural resources, in particular, soil and water, and to encourage conservation efforts. It is very rewarding to know one is able to help society by looking out for the future and providing a better world - a world where the natural resources still have meaning (the connection between water, soil, a hamburger, and the farmer that produced it)!!

2010 - EV330

TO SWIM OR NOT TO SWIM...

Sophia Maria Jimenez, Valerie Lopez,

Loving High School, Loving, NM

The purpose of our experiment was to determine whether or not the Pecos River at Carlsbad is a safe and healthy place for the public to swim. To conduct this experiment, we first gathered our materials and discovered more information from two water specialists in Carlsbad. Next, we went to the Pecos River and tested the five locations for E.coli. After gathering the samples we transported them to the Waste Water Treatment Plant. At the lab, we added the Colilert reagent to the 100ml sample. Once the reagent settled, we ran it through the Quanti-Tray Sealer. Following the compression of the samples, we placed them in an incubator for 24 hours at 35.0 degrees Celsius. Finally, we ran them through the ultraviolet light and counted the number of E. coli present.

Through the course of this experiment, we discovered that the Pecos River is safe to swim in during certain periods depending on the weather. Location 5 contained the highest E.coli count with 51 MPNs (most probable number). Location 3 had the next highest count with 27 MPNs. Location 2 contained 9 MPNs, while Location 4 had only 8 MPNs. Location 1 contained the least with 3 MPNs. The E.coli count that day was very low and acceptable to the EPA since the recommended swimming water level is 235 MPN/ 100 milliliters. In conclusion, the public can swim in the Pecos without risking their health as long as it hasn't rained heavily a few days prior to their swim.

2010 - EV331

CORRELATION BETWEEN HYDROGEN ION CONCENTRATION AND MALIGNANT NEOPLASMS

Leena Samir El-Sadek, Madison Burchfield, Jessica Chu

Mississippi School for Mathematics and Science, Columbus, MS

Over the years, environmental research has been studied in order to correlate different variables to significant health effects that have caused vital decreases in the populations. In Mississippi, malignant neoplasms, or cancerous tumors, have been steadily increasing due to some unknown source. In order to test out a possible source for this unfortunate increase, we analyzed the pH levels of tap water samples in six various counties, Madison, Hinds, Lowndes, Winston, Washington, and Rankin, in Mississippi and compared it to the neoplasm ratio in each county. The water samples were collected from sources, such as home, restaurant, and grocery store faucets in the months of November- January. The health data was researched and collected from the Mississippi State Department of Health Vital Statistics. Once we analyzed and graphed the results, we discovered that Madison, MS, had the lowest pH, meaning more hydrogen ion concentration. Hinds County had the highest pH, meaning less hydrogen ion concentration. When correlated to the health data, we also discovered that Madison, MS, had the most cases of malignant neoplasm and Hinds County had the least cases of malignant neoplasm. Through the results, we determined that more hydrogen ion concentration lead to more malignant neoplasm cases. With this extensive research, one will be able to determine new filtration methods or other solutions that can prevent high hydrogen ion concentration in common water sources from affecting the health of Mississippi residents. This research also leads to the assumption that water pollution can, in fact, lead to severe health effects.

2011 - EV001

THE ASSESSMENT OF SILVER NANOPARTICLES IN THE ENVIRONMENT ON GENE EXPRESSION IN C. ELEGANS

Alexander Michael Cecil

E.E. Waddell High School, Charlotte, NC

As a direct result of the emergence of nanoscience, consumers have seen a great deal of products generated from this scale due to its highly regarded and differing chemical abilities. Silver nanoparticles in particular have been a great product of utility in athletic wear, band-aids, etc. This upsurge has resulted in several laboratory studies of potential toxicity of said particles, but limited investigations have been performed to assess their impact on gene expression or products (nature's biological nano-units) thereof. To evaluate this specific problem, a dose response assessment was performed on C. elegans at various arrested developmental stages (embryogenesis, morphogenesis, and adult) under the influence of varying silver nanoparticle concentrations of 0.00, 0.55,

0.65, 0.75, 0.85, and 0.95ml/L. The various samples were then prepared for vertical electrophoresis, run through 4-20% pre-cast gels and stained with coomassie blue. Our data suggests that silver nanoparticles above the concentration of .55ml/L upregulates gene expression by an overall average of 3.25% with individual fluctuations within specific developmental phases; embryogenesis-7%, morphogenesis-1%, and adult-3.25%. In conclusion, Silver Nanoparticles at environmental concentrations > 0.55ml/L increases the number of gene products expressed in C. elegans as it progresses through its life cycle.

Awards won at the 2011 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel
First Award of \$3,000 - Air Force Research Laboratory on behalf of the United States Air Force

2011 - EV002
USE OF SATELLITE IMAGERY TO STUDY THE EFFECT OF LAND COVER ON WATER QUALITY IN SPALDING COUNTY, GEORGIA
Jed Matthew Mercado Paz
Griffin High School, Griffin, GA

The main goals of this study were to investigate satellite imagery of land cover near water bodies in Spalding County, Georgia and examine the effect of land cover on water quality parameters. Satellite images obtained from Google Earth indicate that sampling point 1 (SP1) is a pond which is surrounded by disturbed areas as indicated by the presence of industrial buildings, parking lots, and cleared areas. SP2 is a predominantly wooded area and a relatively less disturbed area near a few residential homes. SP3 is bordered mainly by residential homes, while SP4 is adjacent to a quarry. Results of this study support the hypothesis that if satellite images show an increase in disturbed areas (e.g., residential homes, industrial buildings, quarry) near a water body, then potential pollutants carried by run-off from disturbed areas will decrease water quality. Turbidity and total suspended solids were highest in samples collected from SP4, and this could be attributed to sediments carried by runoff from the quarry adjacent to SP4. Water samples collected from SP1 and SP4 exhibited relatively lower dissolved oxygen levels, while total coliform concentration was highest in SP3. This study demonstrates the application of satellite imagery as a quick and cost-effective way to identify effects of disturbed areas on water quality. This approach will be beneficial in estimating water quality in remote areas. The correlation between land cover and water quality will provide valuable information in land use planning, as well as in regulating urban development.

2011 - EV003
THE USE OF SARCOCORNIA QUINQUEFLORA AS A BIOINDICATOR OF SOIL SALINITY IN WETLANDS
Tanvi Srinivasan
The Queensland Academy for Health Sciences, Gold Coast, AUSTRALIA

Rising soil salinity is a major environmental problem in Australian wetlands. The experiment evaluated the use of Sarcocornia quinqueflora (Beaded Glasswort) as a salinity bioindicator for wetlands, as summarised by the research question: What effect does the change in soil salinity levels have on the pigment produced by Sarcocornia quinqueflora? The results from the investigation were used to create a universal guide to convey information about the salinity level of an area containing these plants.

The results of the experiment showed that at low salinity levels, the Beaded Glasswort plants produced chlorophyll A and therefore were a light green colour. At normal salinity levels for the Murray-Darling Basin, the Beaded Glasswort plants produced chlorophyll A and chlorophyll B and therefore were a dark green colour. At high salinity levels, the Beaded Glasswort plants produced anthocyanin and were a bright red/purple colour.

The Beaded Glasswort plants growing in highly saline soils were watered with spring water to investigate the effects of a decreasing salinity level. The pigment anthocyanin disappeared as the salinity level decreased, and the plants turned back into a dark green colour.

To validate the results from the experiment, samples of Beaded Glasswort plants, which were growing naturally in the wild, were collected and soil salinity measurements were taken. The experimental results produced a practical field guide with a real world application. Beaded Glasswort could be used as a suitable soil salinity indicator.

Awards won at the 2011 ISEF
Second Award of \$150 - Patent and Trademark Office Society

2011 - EV004
THE EFFECT OF CARBARYL PESTICIDE ON FREE NITROGEN FIXATION LEVELS, YEAR TWO
John Mark Grundy
duPont Manual Magnet High School, Louisville, KY

Nitrogen fixation is the process by which plants and/or diazotrophic soil bacteria capture airborne nitrogen and convert it to new compounds that fertilize the soil. The process is completed by "free" fixing bacteria that function independently as well as "symbiotic" fixers that require a plant. Agriculturally nitrogen fixation is important because crops can either acquire nitrogen from no-cost nitrogen fixation or from synthetic fertilizers that are environmentally destructive. Farmers often inoculate crops with symbiotic fixers to increase fixation levels.

Recent studies indicate that pesticides prevent symbiotic fixation by disrupting plant-bacteria signaling. These results may explain a forty year trend toward stagnant crop yields despite record high pesticides and synthetic fertilizer use worldwide.

Previous experimentation investigated the effect of carbaryl pesticide on free fixation levels. Considering that pesticides disrupt symbiotic fixation by blocking plant-bacteria signaling, but free fixers do not require a plant, it was thought that free fixers would be immune to the negative effects of carbaryl. To the contrary, results indicated that carbaryl inhibits free-fixation.

The goal of experimentation was to investigate if carbaryl interferes with free-fixation by causing a decline in free-fixer population.

The free-fixing soil bacteria, Azotobacter vinelandi (AV), was grown in media containing different concentrations of carbaryl. AV populations were measured every 20 minutes for six hours with a spectronic-20 spectrophotometer on transmittance with a wavelength of 600nm. Results were charted to produce growth curves.

The minor differences between the control and test curves suggest that carbaryl does not have a significant effect on AV growth.

2011 - EV005

OXO-PLASTICS VS. HYDRO-PLASTICS: WHICH DEGRADE FASTER?

Kermell Ricardo Huertas

Colegio San Ignacio de Loyola, San Juan, PUERTO RICO

Plastics are a fundamental part of our everyday life. However, excessive garbage pollution has become a major problem. Switching to biodegradable plastic seems like a possible solution. The purpose of this experiment is to compare two very different biodegradable plastics: OXO-plastics & HYDRO-plastics. Which biodegradable plastic degrades faster? Plastic bags were used as samples of each type and will be left to decompose in two areas: an aerobic compost and anaerobic landfill, for a period of seven weeks. Conventional thermoplastic was used as a control group. The progress was monitored once a week by weighing the mass of each sample. The hypothesis is that oxo-plastic samples will decompose at a faster rate than hydro-plastic samples because of their unique composition and technology. The experiment took place in a backyard with two 3'x 5' areas held up by wooden frames. The aerobic compost had 15 samples lain in the sun without cover. The anaerobic landfill had 15 samples buried under soil. The data was graphed as a line graph of the samples' average weight vs. time in order to compare the progress of the plastics. The results, although sketchy due to error with soil & rain, showed that the oxo-plastics could degrade faster than the hydro-plastics. A regression analysis of the data forecasts 52 and 64 years to completely degrade the oxo-plastic and the hydro-plastic, respectively. The calculated average oxo-plastic sample's weight went from 96.75 to 96.50 grams and the hydro-plastic from 79.58 to 79.42 grams in seven weeks.

2011 - EV006

ENHANCED ADSORPTION OF ARSENIC ON AQUIFER SOLIDS: IMPACT OF OXIDATIVE TREATMENT OF AQUIFER SOLIDS

Jenna Reed Huling

Ada High School, Ada, OK

Arsenic (As) contamination in drinking water is an epidemic in many areas of the world, especially Eastern Asian countries. Developing affordable and efficient procedures to remove As from drinking water is critical to protect human health. The oxidation of aquifer materials potentially enhances As adsorption and removal of As from ground water. In this study, the oxidation of aquifer materials was performed utilizing two oxidants, permanganate (MnO4-) and hydrogen peroxide (H2O2). Subsequently, an As solution was amended to the oxidized aquifer solids. After 30 days storage in an anaerobic glove box to prevent air exposure (oxidation), the reactors were sampled and analyzed for As. The unoxidized control attenuated an average of 0.35 µg/g of As from the ground water samples, while the H2O2- and MnO4--amended reactors removed 1.05 µg/g (3x the control) and 2.45 µg/g (7x the control), respectively. The aquifer materials with lowest organic carbon exhibited the lowest removal of As. Organic matter, when oxidized, forms different reactive surfaces in which As species will react and adsorb. It was estimated that the treatment of 1 m3 of aquifer material using similar oxidation procedures could treat 31,500 L of As contaminated ground water (150 µg/L) and achieve the EPA drinking water standard for As (10 µg/L), and the cost was projected to be \$1.46 / 1000 L water. Results suggest that artificial oxidation of reduced aquifer materials containing background organics could be an effective method of reducing As concentrations in ground water and protecting human health world-wide.

Awards won at the 2011 ISEF

Certificate of Honorable Mention - Society of Exploration Geophysicists

2011 - EV007

EFFECTS OF DIOCTYL SODIUM SULFOSUCCINATE ON THE DEVELOPMENT OF ORYZIAS LATIPES

Willa Ma Wang

Veterans High School, Kathleen, GA

To clean up the 2010 BP oil spill, 1.8 million gallons of Nalco's Corexit 9500A was sprayed over the Gulf of Mexico. Corexit 9500A is primarily composed of dioctyl sodium sulfosuccinate (DSS). An experiment was designed to see the effects of DSS on Oryzias latipes embryos. The eggs treated in 250 mg/L did not develop and had several, noticeable abnormalities: the yolks were swollen, and the space in the chorion was reduced. DSS damaged the chorion which allowed the solution to enter the egg, and the imbalance of osmotic pressure hindered the eggs from further development. The eggs in the 250 mg/L began to degenerate after 48 hours. All the eggs in the control, 2.5 and 25 mg/L concentrations continued to develop with no apparent differences. The three developing sets formed hearts after 120 hours. Although the physical features seemed similar, a difference was observed among the heart rates (49±4.4, 54±1.8, 57±4.3, for Control, 2.5, and 25 mg/L, respectively); as the concentration of DSS increased, the heart rates increased. Single Factor ANOVA indicated the significance of DSS on heartbeats. Increased heart rates could be problematic and impact the fish later in life.

2011 - EV008

CAN YOU DRINK A RIVER? AN EVALUATION OF SOLAR DISINFECTION EFFICIENCY IN THE INACTIVATION OF E. COLI AND COLIFORM BACTERIA AT A NORTHERN LATITUDE

Kathryn R McClintic

Cedarcrest High School, Duvall, WA

This experiment evaluated solar disinfection's (SODIS) efficiency as a method of drinking water disinfection in a northern cooler climate with limited solar altitude as measured by the inactivation of E.coli and General Coliform Bacteria. It was hypothesized that if using SODIS during non-optimal conditions to disinfect water for drinking is effective, then E.coli and coliform bacterial counts in water would be reduced to undetectable levels after disinfection, because UV rays would interfere with metabolism, and alter the bacterium's DNA impeding its reproduction. River water was collected from the Snoqualmie River in Monroe,

WA. Water was bottled, and half of the bottles were set on a metal surface exposed to the sky, and the other half were a control group under a box in the dark. At different time intervals, bottles were sampled using the membrane filter method, testing for Coliform and E.coli. Weather conditions were not optimal- the temperature never exceeding 12.2°C with constant cloud cover and intervals of rain. Viable cell counts per 100 mL were made for each sample/time interval. The results showed the hypothesis was partially supported. There was complete inactivation of E.coli in water samples exposed to UV. Coliform bacteria levels decreased significantly but did not achieve complete inactivation. This experiment was conducted under poor weather conditions that may have influenced results. Although results show that partial disinfection was achieved, further studies are needed to determine if SODIS can be reliably used for complete disinfection in a northern climate during periods of low solar altitudes.

2011 - EV009

RICE STRAW BIOCHAR: A POTENTIAL NEW MATERIAL FOR REDUCING CH4 EMISSION FROM PADDY SOIL

Yimin Wu
Hangzhou No.2 High School of Zhejiang Province, Hangzhou, Zhejiang, CHINA

Paddy field is one of the largest global CH4 emission sources. Returning biochar pyrolyzed from biomass into soil might play an important role in reducing CH4 emission from paddy field. In this study, the effects of biochar on CH4 emissions from paddy soil with and without rice straw added as an additional carbon source were investigated in the laboratory. The biochars tested were prepared from the pyrolysis of rice straw or bamboo chips which yielded straw charcoal (SC) and bamboo charcoal (BC), respectively. Results showed that adding biochar could dramatically reduce CH4 emission from the paddy soil as compared with the direct returning of rice straw. SC was more effective than BC in reducing CH4 emissions from paddy soils. CH4 emissions from the paddy soil amended with BC and SC at high level were reduced by 51.1% and 91.2%, respectively, compared with those from the unamended soil. Methanogenic activity in the paddy soil decreased with increasing rates of biochar added; while, the methanogenic archaeal communities in the paddy soil amended with biochar remained unchanged at the final stage of the experiment. Our results indicated that the reduction of CH4 emissions from paddy soil with biochar amendment might result from the inhibition of methanogenic activity during the incubation period. Returning biochar pyrolyzed from rice straw into soil might be a potential new technology in mitigating CH4 emission from paddy soil.

2011 - EV010

THE EFFECT OF PESTICIDES AND DHA ON THE REGENERATION OF PLANARIA

Christina Yah-yun Lee
Sherando High School, Stephens City, VA

Planaria are flat worms that have sensitive chemoreceptors. With such sensitive chemoreceptors, this organism can serve as a sensitive marker of chemical impact on environment ecology. The pesticides used in the experiment are Bifenthrin, Gamma-cyhalothrin, and Carbaryl are pesticides which affect pests by over stimulating their nervous system and DHA is a supplement believed to help in the development of the eyes and nervous system of infants and fetuses. Two dilutions of the pesticides were used. During the regeneration period, planaria were checked for photosensitivity daily, and after regenerated they were tested for chemosensitivity. The hypothesis is "If planaria are exposed to pesticides while regenerating, then the regeneration time period will increase compared to planaria which regenerate in pond water or DHA". This is because all of the tested chemicals are known to be neurotoxic to fish and insects and DHA is believed to aid in the development of the eyes and nervous system. The results were that pesticides, even in low dilutions such as 1/25,000 or 1/100,000 can affect the regeneration of planaria negatively by increasing the length of regeneration period, increasing the length of time needed to develop photosensitive eyespots, and by permanently hindering their chemoreceptors. My hypothesis was supported; DHA and the control regenerated the fastest, regained photosensitivity the fastest, as well as had the most responsive chemoreceptors. My results prove that the common store brand insecticides store could be dangerous to aquatic life and not only instantaneously, but the rest of the organism's life.

2011 - EV011

EASY ON THE EC

Vishalakshi Lakshmanan
South Fork High School, Stuart, FL

urpose of this experiment was to identify which kind of soil (topsoil, potting mix, and sand) either fertilized or with no fertilization, had the greatest electrical conductivity. The results of this experiment could help gardeners and environmentalists by hinting at what the soil composition might be and if chemicals have been added to the soil. I became interested in this experiment when I learned how to measure electrical conductivity in soils. The hypothesis was that if different types of soil are tested for their electrical conductivity (EC), then the potting mix with fertilizer would have the greatest electrical conductivity because it has the most salts and minerals. To test this, two sets of 200 grams of dried potting soil, topsoil, and sand were measured out, and half of them were fertilized with 50mL of fertilizer. After waiting for 45 minutes, their EC was measured in mA. Alligator clamps were used attach copper wires to the terminals of a 9 volt battery. The other ends of the wires were attached to copper ground straps inserted into a sample of soil. Then the probes of a multi meter were touched to the copper ground straps. To ensure accuracy, this procedure was repeated two more times. The hypothesis was proved incorrect because the sand had the greatest EC, not the fertilized potting mix as predicted. In fact, none of the fertilized soils had the highest EC levels, implying that fertilizer does not immediately increase soil conductivity levels.

2011 - EV012

PRODUCTION OF AMMONIA NITRATE BY COMBUSTING CHICKEN LITTER WITH HOG FUEL

Joseph Phillips Meyer
Tillamook High School, Tillamook, OR

Chicken farms must continually deal with the issue of litter disposal. Marketing chicken litter as a soil additive for its high ammonia-nitrogen content is an excellent sustainable practice. However, chicken farms produce more litter than the fertilizer market can use. Excess chicken litter is land-filled.

Lumber mills produce copious volumes of wood chips, sawdust and bark that has no commercial value. Most lumber mills burn this material as hog fuel to run their boilers. Nitrous oxides are a product of this combustion.

Is it possible to create a mixture of chicken litter and hog fuel that, when combusted, would reduce emissions of ammonia and nitrous oxides by producing ammonium nitrate. Ammonium nitrate makes an excellent fertilizer that is in high demand.

This project attempts to answer that question by burning various combinations of chicken litter and hog fuel, collecting exhaust and analyzing it for ammonia, nitrous oxides and ammonium nitrate. Fresh litter and hog fuel as well as the resulting ash is also analyzed. Preliminary burns indicate that it is possible to reduce ammonia and nitrous oxide emissions by burning 50% mixtures of chicken litter and lumber mill hog fuel.

2011 - EV013
SEASONAL COMPARISON OF DETRITUS, LARGE WOODY DEBRIS, PLANKTON, AND PERIPHYTON PRODUCTION IN UPPER GREEN RIVER BASIN, KENTUCKY

Aimee Michelle Turner
Ballard High School, Louisville, KY

Purpose. Measure detritus, large woody debris, plankton and periphyton. Comparisons between four seasons to identify differences or similarities.

Procedures. Multiple timed trials for capture of detritus, counting and measuring large woody debris, collecting and centrifuging water samples to measure plankton and collecting and weighing periphyton multiple times from identical areas.

Results. Detritus either consumed by aquatic organisms in lake or trapped as sediments. High river levels and record flooding affected sampling, especially large woody debris. Seasonal leaf fall is most important contributor to detritus levels in river during autumn, while summer and spring saw greenery and plant buds as major source. Periphyton strongly influenced by temperature and daylight.

Conclusions. Data indicates that organic materials are being captured in lake. Detritus increases with distance from dam as does mussel population and number of species. Debris sampling was inconclusive except that flooding was observed to be very significant in adding large woody debris to river. Measurement of plankton production did not reveal any strong trends. Many samples had only a trace of organic material. Periphyton production was greatest in spring and summer.

2011 - EV014
THE AFFECT OF OSCILLATORIA OF AQUATIC INVERTEBRATES

Riley Patrick Buley
Loyola Catholic School, Mankato, MN

The purpose of this project was to determine if Oscillatoria would affect aquatic invertebrates. I became interested in this experiment after seeing the affects of cyanobacteria blooms on the Lakes in the Minnesota River Basin.

My procedure for my project was as follows:

I first filled 4 beakers with 60ml of water.

I added 25 organisms to each beaker.

I also added fertilizer, and Oscillatoria to each beaker in various amounts and combinations. These beakers were checked every 24 hours for 48 hours. A retest was performed. Chemical levels where tested in beakers every 24 for 48 hours also.

My data showed that the beakers containing fertilizer and Oscillatoria combined killed the greatest number of organisms. The beakers containing only Oscillatoria killed the second highest number of organisms. The beakers with the fertilizer only killed the least number of invertebrates. In Conclusion, I found that I proved my hypothesis correct. The increase in Oscillatoria population levels decreased the amount of aquatic invertebrates. My background research done this past summer supported the fact that the population of Oscillatoria increase during the summer months. After analyzing my data, the tests which included fertilizer and Oscillatoria combined had the greatest mortality rate of the invertebrates. To make sure that the fertilizer was not responsible for the death of the invertebrates, test three was conducted. The population did not change significantly with this test.

2011 - EV015
A CHEAPER ALTERNATIVE TO A CLEANER FUTURE II: A STUDY TO OPTIMIZE THE EFFICIENCIES OF DYE SENSITIZED SOLAR CELLS

Sirish Chandra Kamarajugadda
Plano East Senior High School, Plano, TX

The most abundant and cleanest source of energy is solar energy. However, current methods of converting solar energy into electrical energy remain expensive and are not feasible because of the difficulty of making silicon solar cells on an affordable commercial scale. Therefore, a cheaper method must be developed without compromising the efficiencies. Fortunately, the Dye-Sensitized Solar Cell, DSSC, has been developed which is quite effective and has proven to be a viable alternative to the silicon technology. However, this DSSC uses a platinum solution on the counter electrode which is expensive and rare. Therefore, the scientific question is whether there is a method to effectively increase the efficiency of the DSSC by using more abundant and effective materials. Dye-Sensitized Solar Cells were made using the multi-wall carbon nanotubes to see if they could be used to replace the platinum based counter-electrode. The titanium tandem devices were made because they should be able to produce twice the open circuit voltage of a normal cell resulting in twice the efficiency. Furthermore, with the use of the titanium sheet as the bottom electrode, the light can be reflected back into the two active areas resulting in even more light absorption and thus higher efficiencies. From the data gathered on the control group, the the DSSC with the platinum counter electrode, achieved efficiencies exceeding 10%. The tandem cells managed to produce 6% efficiencies because the currents from both active areas did not add, resulting in a sub-par efficiency. Nevertheless, the cells using the MWCNT managed to achieve 7% efficiencies. With further testing and alterations carbon nanotubes and titanium tandem devices will prove to be the future of harnessing solar energy.

Awards won at the 2011 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2011 - EV016

THE IMPACT OF NATURAL PROCESSES AND HUMAN ACTIVITIES ON THE WATER QUALITY OF VARIOUS LAKES

Abigail Yu Chen
York High School, Yorktown, VA

Nutrients occur naturally in the environment. However, excess concentrations can often result from human activities like the application of artificial fertilizers and improper disposal of livestock and pet wastes. In this research project, the nutrients in various lakes are monitored to study the impact of natural processes and human activities on water quality. Water samples are collected weekly from six lakes with different surrounding conditions and water quality parameters including phosphates and ammonia. The project's aim is to compare the nutrient variations of these lakes over time to determine if and how natural processes and human activities are impacting their water quality. Based on ten months of data, the following environmental impacts have been found: Rainfall and sprinkler systems cause varying amounts of nutrients such as phosphates from fertilizer to wash from surrounding soils into lakes through runoff. In contrast to the lakes with fewer houses nearby, the phosphate data show that sites with more surrounding development have spikes in concentration after rainfall during late summer and fall when fertilizer application is highest. Site WT has a few homes in its vicinity that aren't on the county's sewage system, and ammonia concentration is much higher than that of the background level. This indicates that the "point source" pollution has much more impact to our environment than "non-point source" pollution like runoff from yards. This research reveals the causes and patterns of nutrient imbalances in water sources and can provide methods of minimizing water pollution caused by human activities.

2011 - EV017

AN ALTERNATIVE PATHWAY FOR WASTE STREAMS: OPTIMIZATION OF THE SYNTHESIS OF BIOCHAR--AN EVALUATION OF ITS SOIL AMENDING CAPABILITIES AND BIOFUEL FEASIBILITY

Andrea Aleah Pugh
Saginaw High School/ Saginaw Arts And Sciences Academy, Saginaw, MI

The purpose of this project is to; produce biochar from what one would consider waste (Phragmites, Cherries, and Orange Peels), determine if the biochar produces a more environmentally friendly water runoff than fertilizer, determine if the plant fertilizer effects soil quality, determine if change in temperature during pyrolysis effects the Biochar's porosity and the Syngases produced. The elemental analysis of the samples with Biochar added shows that the soils were amended by the addition of the biochar. However, the fertilizer didn't amend the quality of the soils over time. For the most part all of the samples had a pH within the optimal range pH 5.8-7.0; however five samples had values below the optimal range (Clay/Fertilizer, Top Soil/Cherry Biochar, Sand/Cherry Biochar, Top Soil/Orange Biochar, and Top Soil/Fertilizer). It is known that fertilizer make soils acidic. The Boiling point of all of the Biofuels synthesized were above 208 oF. Biofuel of cherries (500oF) showed peaks at 240oC. The 900oF Phragmites showed peaks in the C14 hydrocarbon which has a retention time of approximately 8 minutes. Whereas the other Biofuels had an elution time of only two minutes. Also in some cases as temperature increased to 900oF peaks decreased. The highest amounts of Nitrate were found in Clay/Control, Clay/Orange Biochar, and Top Soil/Cherry Biochar. The lowest amounts of Nitrate were found in Clay/Phragmites Biochar which contained 1.034 mg/L. Cherries yielded the highest amount of organics among the 3 starting materials. Cherries at 900 oF contained approximately 31.4% of organics. The organic oil can be potentially recovered and can be used as renewable chemical feedstock or fuel.

2011 - EV018

POROUS ASPHALT VERSUS CONVENTIONAL ASPHALT

Devyn Alexandria Yates
Seckman Senior High School, Imperial, MO

The purpose of this experiment was to inform people about a type of asphalt that could help with reducing storm water overflow problems. Conventional asphalt is the most widely used pavement in the United States, but porous asphalt filters water, while conventional asphalt does not. Porous asphalt not only reduces storm water overflow but also reduces water pollution. Engineers and construction workers could use porous asphalt to reduce storm water in areas that have overflow problems. Porous asphalt could also be used to pave low traffic roads, alleys, parking lots, and some major roads or highways. This experiment is most beneficial to cities and landowners. The materials that were used in this experiment were: water, 3 pucks of porous asphalt, 3 pucks of conventional asphalt, 2 PVC pipes, silicone sealant, measuring cup, 2 bowls, and 2 wooden dowel rods. To test which asphalt filtered the most water, a puck of asphalt was placed in a PVC pipe. Then both pucks were sealed around the top and the bottom edges so water would not leak over the sides. After letting the sealant dry, the puck and the PVC pipe were placed on two bars to elevate the pipe above the bowl, so water could filter thorough the asphalt. Then 250mL of water was poured on the puck. As soon as the water hit the puck the water filtered through the puck for 10 seconds. After the 10 seconds the water that was filtered through the puck and into the bowl was measured. Each puck was tested 5 times. The porous asphalt filtered more water than the conventional asphalt. The overall average for the porous pucks was 235.7mL. The overall average for the conventional pucks was 27.3mL. These results show that porous asphalt filtered the most water.

2011 - EV019

DIE-HARD DAPHNIA

K. McKlane Ganowsky
Dixie Middle School, Saint George, UT

urpose of this project was to determine which pesticide used by the city/county for tamarisk control and mosquito abatement was the safest. Which esticide, Pathfinder II or Malathion in varying concentrations will decrease the survival rate of Daphnia magna? My hypothesis was if the pesticides have labels

warning of toxic effects then both pesticides in any concentration will be unsafe, having a destructive effect on *Daphnia magna*; presumably, the higher the concentration of pesticide the faster the *Daphnia magna* will die.

The procedure was to expose *Daphnia magna* to test samples of varying concentrations of each pesticide for a 6 hour toxicity test. A control was kept for each. All Test Chambers and Control Chambers were observed every 20 minutes for 6 hrs. Visual and microscopic data was recorded. Toxicity was measured in terms of a decrease in activity and mobility. Population numbers of living versus dead *Daphnia* were then recorded.

Results indicated my hypothesis was correct. It was concluded that both pesticides decreased the survival rate of *Daphnia magna*, Malathion being the most toxic. Test results indicated Malathion should not be used for mosquito abatement if there is any chance it can get into the water system. Pathfinder II for tamarisk control is safe only in dilute concentrations of 6.25% or less applied only to stumps that are not near the river, open water, or where the aquatic ecosystem would be compromised. *Daphnia magna* are an important part of the food chain and are a vital aquatic indicator species.

2011 - EV020
CWADIS (CONTINUAL WATER DISINFECTION SYSTEM)

Batool Ahmed Al-Wahdani
King Hussein Foundation. The Jubilee School, Amman, JORDAN

According to WHO, half of humanity has diseases associated with unsafe water. Therefore; many people are daily exposed to dangerous diseases such as diarrhoea. CWADIS explored whether a combination of UV light irradiation, TiO₂ catalyst, PET and renewable energy resources could work as an effective water disinfection system continuously. Previous methods for disinfecting drinking water, including boiling and chlorination are time consuming, expensive and significantly alter the taste. Many water disinfection systems depend mainly on electricity to work. There is no doubt that wasting energy from LED irradiation offers a potential purification system for drinking water without known health impacts. CWADIS worked by turning on the LEDs -which take their energy from the solar cells and the wind turbine- until water temperature was around 55°C. Meanwhile; the glass beads which were coated by TiO₂ catalyst increased the efficiency of UV in decreasing bacteria and organic compounds. The water pump was then turned on to take water from the plastic container into a Filter where it got rid of water impurities. The results showed that CWADIS allowed (99%) reduction for bacteria. The turbidity of water was decreased to drinkable levels (< 30 NTU) and the pH of water reached allowable level (7 – 7.5). Moreover, the process was most effective by using the catalyst (TiO₂) which was converted into nanoparticles that increased its surface area and therefore the efficiency of UV. CWADIS also was able to work continuously, taking its electrical energy from the solar cells (daytime) and the wind turbine (night time). This feasibility research seems to indicate that CWADIS is simple low cost technology and effective in killing pathogens and micro-organisms that cause hazardous diseases which lead for big population death.

Key Words: LED: Light Emitting Diodes
TiO₂: Titanium Dioxide
PET: Polyethylene Terephthalate

2011 - EV021
EMBRACE AIR WITH ALGAE REPAIR

Chloe Anassis
The Study School, Westmount, Quebec, CANADA

Global warming remains a threat to the welfare of the earth's inhabitants. As the concentration of CO₂ in the atmosphere increases due to industrialization and the burning of fossil fuels; a safe, sustainable and biological method of capturing CO₂ needs to be created and implemented. Past research has shown that algae are potential candidates to assess that problem because of their accessibility and their ability to do photosynthesis. It was hypothesized that *Chlamydomonas reinhardtii*, a single-celled alga; can be genetically modified to improve its CO₂ fixation rate. Before making modifications within *C. reinhardtii*, an accurate system was designed and built to identify a base-line value for *C. reinhardtii*'s CO₂ fixation. This novel system was tested by emplacing a mutant called Dim 1 (chloroplast knockout), to observe if the mutant would not process CO₂ and if the system would detect this. The system demonstrated its effectiveness and readiness to assess the efficiency of unmodified *C. reinhardtii*. After numerous trials, 47.1% was captured by *C. reinhardtii* after twenty minutes of exposure. As a result, a base-line value for *C. reinhardtii*'s CO₂ fixation was created. Alternative modifications can be made, tested, and related back to this base-line value in order to detect a negative or positive difference in CO₂ fixations. This system has the potential to be used in studies concerning modified strains of various algae.

Awards won at the 2011 ISEF
Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2011 - EV022
THE ENVIRONMENTAL IMPACT OF PLASTICS IN A STRUCTURAL MATERIAL

Harold Blake Whitford, Jr.
Box Elder Public High School, Box Elder, MT

This study examined the effects of plastic in structural building materials on aquatic ecosystems using CO₂ and O₂ rates, gas chromatography/mass spectrometry (EPA 525 method) and algae population analysis.

Plastic bottles were cut into small squares and added to the building material cement. The plastic was added into the cement in different concentrations: 0 grams, 25 grams, 75 grams, and 100 grams. The cement with plastic was shaped into rectangular bricks and water was continuously circulated over the bricks into a tub for two weeks.

The green algae, *Selenastrum capricornutum*, was cultured in Bristol medium. Water from the tubs was used to prepare the medium.

Phthalate concentrations were measure by GCMS. Results of the GCMS show there was not any type of observable relationship between the amounts of plastic added and the concentration of phthalate. It was difficult to obtain an accurate measurement with the GCMS as the extraction proved extremely difficult.

Originally, algae concentrations were measured by percent absorbance with a colorimeter. This proved to be ineffective because algae settles to the bottom of the cuvette. Population size was then determined using a graduated cylinder as a percentage of the entire solution.

CO₂ and O₂ analysis was performed for three 24 hour tests. CO₂ and O₂ tests

were inconclusive, as an inversely proportional relationship was expected, where higher concentrations of plastic would lower the photosynthetic rates of the algae. This expectation was not observed with the test results.

2011 - EV023

A PHYSICAL, CHEMICAL AND BIOLOGICAL ASSESSMENT OF THE UPPER TRIBUTARIES OF THE ALPLAUS KILL

Ethan Churchill Strayer
Niskayuna High School, Niskayuna, NY

This study investigated the health of three sites on the Alplaus Kill, located in the counties of Saratoga and Schenectady in the State of New York, USA. Two test sites were chosen to enable comparisons with previous New York State Department of Environmental Conservation (NYSDEC) surveys conducted in 2005. The third site was located between the two NYSDEC sites. The purpose of this stream study was to determine if the Alplaus Kill meets the requirement of a class B(T) trout stream and to evaluate if the stream's water quality was impacted by residential development since the 2005 survey. At each site a physical survey, a chemical water test and a macro-invertebrate collection were conducted. The physical testing was based on guidelines set forth by the Hudson Basin River Watch, whereas chemical testing was completed using a LaMotte test kit. Biological testing utilized both the NYSDEC kick method and the Hudson Basin River Watch's rock-rubbing method to collect samples. The results were analyzed in accordance to the guidelines recommended by the NYSDEC and Hudson Basin River Watch. Survey results indicate that the Alplaus is a healthy stream, which has been only slightly impacted by humans and is suitable for trout restocking. These tests also developed a physical and chemical baseline for future testing to be conducted in the Alplaus Kill.

2011 - EV024

GROUND AND STAND LEVEL FACTORS IN A NORTHEAST NORTH AMERICAN FOREST WITH BEECH BARK DISEASE

Zachary Taylor Wood
Burnt Hills - Ballston Lake Senior High School, Burnt Hills, NY

Tree pests and diseases pose a major problem regarding forest ecology and conservation. One example is beech bark disease (BBD), a two-part syndrome consisting of beech scale, *Cryptococcus fagisuga*, and *Nectria* fungi. It only affects American beech, *Fagus grandifolia*, in North America, it causes a wide variety of damage to beech trees, and currently there is little evidence of heritable resistance or treatment. In this two year study, forest plots were delineated and observed in a mixed hardwood forest of eastern NY. Stands were characterized using basal areas, tree sizes, disease severity using a disease severity index (DSI), soil properties, and leaf litter decomposition rates. Plots with higher DSI levels had loamy soils and higher rates of leaf litter mass loss (based on losses compared using a paired t-test [$p=.005$]). These results suggest that a more rapid rate of nutrient cycling was occurring in the more diseased plots, providing more nutrients to the trees and therefore the BBD pathogens. The nutrients allowed the BBD to thrive more in these plots, thus increasing the DSI levels. This study may allow for forecasting of forest level succession in BBD affected plots, and increases understanding of spatial variability within disease affected forests.

Awards won at the 2011 ISEF

Award of three \$1,000 U.S. Savings Bonds, a certificate of achievement and a gold medallion. - United States Army

2011 - EV025

ENVIRONMENTAL EFFECTS OF SOLUBILIZED CARBON NANOTUBES ON DAPHNIA MAGNA AND LUMBRICULUS VARIEGATUS

Gabriel Scott Stephens
East Noble High School, Kendallville, IN

In phase I, it was established that at higher dosages, hydroxylated carbon nanotubes have a detrimental effect on *Daphnia magna* and *Lumbriculus variegatus*. Phase II's goal was to determine further these effects at dosages many orders of magnitude lower. Also, these nanotubes were tested with different functional groups (which affect bioavailability) to see the effects of this new, increased solubility. In addition to this, the mechanism of damage was hypothesized to be an oxidative stress-induced reaction which would be indicated by increased levels of superoxide dismutase. Overall, for phase II, it was hypothesized that if *Daphnia magna* ($n=20$) and *Lumbriculus variegatus* ($n=20$) are exposed to increasing concentrations of either non-functionalized, carboxylated, or hydroxylated multi-walled carbon nanotubes, then, in relation to that increase, cardiovascular pulse and viability will decrease while oxidative stress will increase. It was found that viability decreased in relation to dosage increase in both *Daphnia* and *Lumbriculus* in all scenarios without regard to solubility. However, contrary to the hypothesis, the organisms' oxidative stress was not affected quantifiably by either an increase or a decrease in dosage of any solubility of nanotubes. To accompany this, the vascular pulse of the *Daphnia* increased as dose decreased without regard to solubility – the opposite of what was expected. In the *Lumbriculus*, there was a decrease in pulse, with lower pulses corresponding higher solubilities and lower doses, corroborating the hypothesis. A very important distinction to make from these data is that the higher doses (more agglomerative) caused mortality, but the lower doses (less agglomerative) caused an increase in vascular pulse.

2011 - EV026

MACROINVERTEBRATE RESPONSE IN LEMKIN CREEK TO WETLAND TREATED WATER

David Johnathan Blount
Okeechobee High School, Okeechobee, FL

The purpose of my study is to determine if a project to reduce phosphorus levels to Lake Okeechobee through Lemkin Creek HWT improved habitat

conditions and water quality, resulting in increased abundance and diversity of aquatic macroinvertebrates in Lemkin Creek. Three sweep net samples were taken at each of the three sample sites. The sweep net has a mouth opening of 18 x 13 inches and is constructed of 500 micron Nitex® plastic netting. A sweep net sample was taken by forcefully moving the net through the vegetation for a distance of approximately 0.5 meters. Sweep net samples were field washed in a 13 liter bucket with a wire mesh bottom fitted with 300 micron Nitex® plastic netting, dumped into a white picking-pan, and transferred into 1000-ml Nalgene® plastic jars. All samples were field preserved in a 10% ethanol solution. Water quality parameters measured were water temperature, dissolved oxygen concentration, dissolved oxygen % saturation, specific conductivity, turbidity, and pH. Flow rate was determined with digital flow meter. The mean number of invertebrate taxa was highest, and equal, at the HWT outflow and downstream locations, and lowest at the upstream location; however, these differences were not statistically significant (ANOVA, $p = 0.956$). Data analysis indicates differences in abundance for the dominant taxa were not statistically significant ($p > 0.05$) between sampling locations. Dominant taxa collected were Dytisidae, Arachnids, Helisoma, Physa, Gerridae, Noteridae, and Palaemonetes. Statistically significant variations in macroinvertebrate abundance, overall and for dominant taxa, were not observed between sampling locations.

2011 - EV027

DETERMINING THE TRUE MUSSEL MAN: A COMPARISON OF THE FILTRATION EFFICIENCY OF LAMPSILIS TERES, VILLOSA IRIS, AND LAMPSILIS FASCIOLA

Rachel Michelle England
Demopolis High School, Demopolis, AL

ining the True Mussel Man: A Comparison of the Filtration Efficiency of
Lampsilis teres, Villosa iris, and Lampsilis fasciola
Freshwater musse
ls feed on microalgae, detritus, and other microorganisms; thereby naturally purifying water. This proves useful in many aquatic environments that are home to organisms that cannot flourish with an excess amount of algae. Alabama is home to the most diverse fauna of freshwater mussels in all of North America, with 180 different species. This experiment is a comparison of the filtration efficiency in three of these species. The three Alabama native species tested yellow sandshell (Lampsilis teres), rainbow (Villosa iris), and wavy-rayed lampmussel (Lampsilis fasciola), were all two-year old species that were cleaned and weighed prior to placement in individually labeled two-gallon buckets filled with 3 liters of well water. Each bucket was connected to an aerator hose to simulate the effects of rushing water. The mussels had an initial acclimation period of 24 hours in 75° F (24° C) water. Following the acclimation period, three tests were conducted which included the following contaminants: sediment, collected from a local dry pond; algae, which was instant marine microalgae concentration (shellfish food); and Miracle-Gro liquid feed fertilizer. At the conclusion of each test, each of the contaminants was measured by using a spectrophotometer.
According to the data collected in each of the tests, the filtration system in the wavy-rayed lampmussel (Lampsilis fasciola) proved to be the most efficient, as it filtered the most contaminates.

2011 - EV028

EFFECTS OF DI-BUTYL PHTHALATE (DBP) ON DEVELOPING MEDAKA EMBRYOS

Yunqian Tang
North Carolina School of Science and Mathematics, Durham, NC

Plasticizers are a group of chemicals commonly used to enhance the flexibility of plastic products. They are ubiquitous environmental contaminants because the plasticizers leak out over time because they are not chemically bonded to the plastic. Plasticizers have been shown to be present in river and lake waters, river sediments, and event in farming soil (Vitali et al, 1997). Specifically, plasticizers have been detected in relatively high concentrations in waste water treatment effluents (Vitali et al, 1997). The present study aimed to investigate the effects of di-butyl phthalate (DBP) on developing Medaka (Oryzias latipes) embryos. Groups of 10 eggs were placed into jars containing the following solutions: Embryo rearing medium (ERM) as negative control, 2.5% ethanol as positive control, 5 micrograms/L DBP, 25 micrograms/L DBP, and 45 micrograms/L DBP. Five jars containing 10 eggs each were used in each treatment group for the first trial. Both the positive control and the DBP groups showed dose-dependent morphological abnormalities; asymmetrical eyes and missing eyes were observed in DBP groups. In addition, dose-dependent mortality and dose-dependent developmental delays were observed. The percentage of nonviable embryos after 5 days of exposure ranged from 35% to 100 %. DBP increases deaths, induces deformities, and delays development, indicating that DBP poses an environmental hazard to developing fish.

Awards won at the 2011 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2011 - EV029

THE EFFECT OF SEICHE ACTIVITY AND NUTRIENT LOADING ON CARBON CYCLING IN GREAT LAKES COASTAL WETLANDS

Karl Gregory Koch
Marian High School, Mishawaka, IN

The effect of nutrient loading and seiche activity on Great Lakes coastal wetlands remains unknown to this day. Nutrient loading refers to the addition of nutrients, chiefly nitrogen and phosphorus, in aquatic environments, usually via agricultural runoff. A seiche is a low energy wave caused by persistent wind or differences in air pressure which cause water levels to differ between opposite shorelines. Seiches cyclically expose and re-inundate large areas of substrate, creating a unique environment for biological processes, such as decomposition of vegetation, to occur. In this experiment, a mesocosm system of tanks was built to simulate seiche activity by water level fluctuation using pumps, and nutrient loading by adding nitrogen and phosphorus in the water, with four treatments: seiche only, nutrients only, seiche and nutrients, and no seiche or nutrients as controls. Vegetation, sediment, and Lake Michigan water were placed in the tanks to run for six weeks. Decomposition of plant matter, dissolved organic carbon production, and microbial respiration were measured. Seiche activity did not have a significant effect on any measurements, but nutrient loading yielded a significant increase in plant matter decomposition and water

column respiration. This result provides insight on the key functioning of the extremely important, yet endangered, coastal wetlands of the Great Lakes.

2011 - EV030

REMOVAL OF HEAVY METALS FROM WASTE WATER USING CRUSTACEAN & MOLLUSCAN SHELLS

Brandon Pow Anak Brownie

Batu Lintang Government Secondary School, Kuching, Sarawak, MALAYSIA

This study aims to investigate the effectiveness of using crustacean and molluscan shells to remove heavy metals from chemistry laboratory waste water. To compare the effectiveness of heavy metal absorption, crushed crab, prawn, mussel and sea scallop shells were added into stimulated waste water containing 0.01 mole of iron(II) ions, nickel(II) ions, copper(II) ions and sulphate ions. The water was left overnight and filtered through a column filter containing sand and pebbles. The filtrate was analyzed and compared for pH value, iron(II) ion, copper(II) ion, nickel(II) ion and sulphate ion content. In another experiment, the optimum concentration of heavy metals absorption in crab shells were tested by multiple rounds of immersion into stimulated waste water. Lastly, a device was innovated to remove heavy metals disposed from school chemistry laboratories. The results showed that filtration using a column of sand and pebbles only removed 3% of iron, 19% of copper and 26% of nickel, whereas treatment with crab shells followed by filtration removed more than 90% of iron, copper and nickel content. Treatment with both molluscan shells also reduced iron and copper content by more than 90% but exhibited an increase in nickel content. The treatment with crab and molluscan shells increased the pH level from 3.2 to 6.8 and 7.5 respectively. The crab shells also displayed an increased tolerance to iron and nickel with each round of immersion. The designed sediment filter was user friendly and cost-effective. Therefore, I concluded that crustacean shells like crab shells are more effective in neutralising acidic waste water from school chemistry laboratories and reducing heavy metal content to safety levels, thereby reducing water pollution.

2011 - EV031

GREEN BASED CONDUCTIVE POLYMER SENSOR

Zawin Najah Binti Zulkefli

Tuanku Syed Putra Secondary Science School, Kangar, MALAYSIA

The detection and monitoring of gases using conducting polymer based sensor has become a well establish practice in various aspects of human lives especially in food industry, detecting hazardous gases and explosive. The specific need for 'eco-friendly' based sensor has been in search for quite some times. This research attempts to develop a multi-purpose conducting polymer based sensor using polyaniline/carbon black composite and this sensor can be tuned to certain application depending on doping agents such as silicon dioxide, eggshells or 'tyre dust'. Previous studies show that recycled bottles and glasses can be used as well as one of the doping agent to detect the presence of ethanol and aromatic volatile compounds. For this project, eggshell was selected for detection of ammonia gases. Eggshell compound contains with high content of oxides (Mn, Si, Al, Fe, Cr, Cu, and Ca) and organic substances. These components of eggshells are then combined with polyaniline form a better composite with higher conductivity and increased porosity. The surface morphology of the composite shows that agglomeration has occurred; completed the connection of the conductive path; and thus improving the sensitivity. Sensors with slightly large eggshell content are found to be more sensitive. This is due to the enhanced absorption/desorption rate as a result of higher porosity and changed in surface morphology of the polyaniline/eggshell composite.

Awards won at the 2011 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2011 - EV032

A NOVEL METHOD FOR COMPARING HUMIC SUBSTANCES BY UV-VISIBLE SPECTROSCOPY

Kiara Wenhan Cui

Cookeville High School, Cookeville, TN

Humic substances are organic macromolecules classified as natural organic matter. Their importance stems from the numerous biological and ecological benefits that they lend to soils and aquatic systems. However, humic substances are unidentified and complex mixtures. This imposes restrictions on their study. Therefore, this project aims to: (a) develop a single numerical value as an index to identify and compare humic matter using UV-Visible (UV-Vis) spectroscopy, (b) determine the numerical index values for a variety of samples from different sources, and (c) examine the usefulness of this index in identifying and comparing humic substances. Humic matter samples derived from a variety of soil, water, and commercial sources were prepared using 0.1 M NaOH, centrifugated, and examined. The samples were scanned in the spectrophotometer at 200 - 800 nm in successive half-dilutions. The UV-Visible spectra data obtained were used to generate a UV-Vis index. The UV-Vis index is an intrinsic quality that is independent of initial or unknown concentrations of the humic substances tested. The results show that: (a) the UV-Vis index can reflect variations in humic substances, (b) the index values for soil and water samples were similar, but combined, they were higher than those of the commercial samples, and (c) no strong correlation was found between values for the extracts of the air-dried and fresh samples. Therefore, this study indicates that the UV-Vis Index is sensitive to differences in humic substances, and it can provide a useful and convenient way to characterize and compare various humic substances.

2011 - EV034

REMEDIATION OF TOXIC METAL CONTAMINATED SOIL LONGTERM EFFECTIVENESS OF FISHBONE APATITE AMENDMENT

Kenneth Magwood

Syracuse Academy of Science Charter School, Syracuse, NY

Bioavailability of toxic metals in contaminated soil (untreated (U)), in contaminated soil treated with biogenic fish bone apatite, Apatite IITM, (treated (T)), and in uncontaminated garden soil (control C) was examined in this research. The soil from the Palmerton Zinc Pile Superfund site collected four years after the amendment was studied. The purpose of this research was to demonstrate the effectiveness of this amendment for remediation of Palmerton Superfund soil. To accomplish this task, changes in physicochemical properties of soil samples and concentrations of metals in leaves of plants grown in the amended, contaminated, and control soils were examined. Results show that the properties of the amended soil have improved over time: the amended soil is able to sustain the growth of a variety of plants, including a tree species and concentrations of toxic metals in leaves of these plants are significantly lower for some toxic metals than those in leaves of a plant grown in contaminated soil. An additional amendment may be needed for complete restoration of this highly contaminated superfund soil, but the proposed remediation method is very effective.

2011 - EV035
NITRATE RETENTION CHEMISTRY - DEVELOPMENT OF AN ENVIRONMENTALLY-FRIENDLY MANURE
Adam Joseph Dando
Franklin Regional Senior High School, Murrysville, PA

Nitrate (NO₃⁻) is a colorless, odorless, and tasteless compound that is most often applied to soil as a water soluble nitrogen-based component of fertilizers and manures. Nitrate nitrogen (NO₃-N) is an essential component for plant growth that is often applied to crop plants in large quantities to sustain high yields. NO₃-N is also considered a potential pollutant by the Environmental Protection Agency (EPA). The nitrate adsorption performance of used wall board (gypsum), clay soil, sand, carbon, iron filings, wheat litter, wood litter, coffee grounds, bauxite residue and vermiculite were comparatively evaluated using a nitrate ion selective electrode. Measurement interferences were effectively eliminated using commercially available nitrate interference suppressor solution. Of the ten nitrate retention candidates, only activated carbon exhibited a significant capacity for adsorbing nitrate. A linear adsorption isotherm was observed (r² = 0.975) over the dosing range 0.77-6.1 mg NO₃-N/g carbon using nitrate standards. The ideal nitrate adsorption capacity of activated carbon observed using neat standards was 0.69 mg NO₃-N/g carbon. The actual end-use performance of activated carbon for adsorbing nitrate under simulated runoff conditions was evaluated for 10, 20, 30, 40 and 50 weight % mixtures of activated carbon with cow manure. The nitrate adsorption capacity observed for mixtures of activated carbon and cow manure was 0.47 mg NO₃-N/g carbon, which is 68% of the ideal adsorption capacity observed using neat standards. This project proves that activated carbon could be added to cow manure to significantly reduce NO₃-N loss to water supplies, creating an environmentally friendly manure-based fertilizer.

Awards won at the 2011 ISEF
Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2011 - EV036
THE EFFECTS OF CALCIUM CARBONATE ON OCEAN ACIDIFICATION
Noah Alexander Betzen
Unalaska High School, Unalaska, AK

Ocean acidification is the process of the oceans becoming more acidic because of increased carbon dioxide in the atmosphere. The goal of this project was to explore the effects of calcium carbonate, a known buffer, on ocean acidification and the shells of important primary producing calcifying organisms. This was done by measuring the correlation between calcium carbonate and pH of seawater samples and their effects on calciferous shell mass. Specifically, several shells were placed in beakers of seawater. Different amounts of calcium carbonate were added to each beaker, save the control. Then a constant amount and concentration of acid was added to each beaker. The mass of each shell was measured before and after this buffer-acid treatment, and the data was recorded. According to the data, there is an inverse relationship between the amount of calcium carbonate added to seawater and the loss in mass. The results of this experiment demonstrated that a decrease in pH of seawater has a deteriorating effect on the mass of the shells and that calcium carbonate, when used as a buffer, was effective in reducing this decrease in mass.

2011 - EV037
USING AQUATIC PLANTS TO REMOVE WATER CONTAMINANTS
Mikayla Lynn Messing
Lakeview High School, Columbus, NE

Cyanobacteria (blue-green algae, henceforth algae) and Lemna minor (duckweed) were used to remove nitrate and copper ions from water. Phase One compared the duckweed and the algae's ability to remove ions from water, with both showing an average 50% reduction. Algae was selected for the remaining phases of the experiments because of its greater surface area and known ability to remove copper ions. Phase Two involved designing a filtering device using algae in a way that the algal cells would be immobile. A holding tank, wire filtration system, plastic eggs, and bubble wrap were tried. In Phase Three, algae were injected into commercial bubble wrap, and holes were placed on both sides of the plastic. Solutions of nitrate and copper ions were flowed through the algae injected in bubble wrap. This device had 6.6% reduction in nitrate levels and 7.8% reduction in copper levels for each time the solution was run through. The algae had an overall 33% reduction of nitrate ions and 39% reduction of the copper ions after five consecutive run-throughs. Algae placed in the bubble wrap remained viable even after three weeks without being immersed in water and were still able to reduce ion concentrations when used again. Also, when inside the bubble wrap, the algae did not leak out into the water. The bubble wrapped algae could be moved easily to various sites, and is an inexpensive solution to mitigate storm water runoff pollution or single event catastrophes.

Awards won at the 2011 ISEF
Second Award of \$1,500 - Air Force Research Laboratory on behalf of the United States Air Force

2011 - EV038

LONG-WAVELENGTH LIGHT AS A CATALYST FOR MS2 PHOTOINACTIVATION BY CATIONIC PORPHYRINS

Marc Herman Webb

Josephine Dobbs Clement Early College High School, Durham, NC

Cationic porphyrins have been shown to inactivate non-enveloped viruses in aqueous media. Prior research did not address the realistic possible of treating media that are not easily penetrated by light. The goal of this research was to determine if a novel series of cationic porphyrins were able to effectively inactivate non-enveloped viruses when exposed to light wavelengths longer than that of their maximum absorbance to simulate long-wavelength light penetration. This is practical for using porphyrins to treat aqueous media that require a deeper penetration of light such as turbid waters. An underlying objective was to determine the effect of pyridinium, cation charge, location on the photoinactivation of MS2. The 4 cationic porphyrins differed in pyridinium location and carbon chain length: Meso-tetrakis (3-[N-pyridiniumyl] propyl) porphyrin (C3PyP), Meso-tetrakis (4-[N-butyl] pyridiniumyl) porphyrin (TBuPyP), Meso-tetrakis (3-[N- propyl] pyridiniumyl) porphyrin (TProPyP), and Meso-tetrakis (4-[N-pyridiniumyl] butyl) porphyrin (C4PyP). A yellow light filter was used to block wavelengths less than 500nm. Porphyrins were made to 1µM concentrations, irradiated with a light dose of 4.8mW/cm2 light intensity for 5 minutes, and plated with model pathogen MS2, a bacteriophage, and host bacteria E. coli F Amp. The irradiated porphyrins resulted in 2.8 log10 to 3.9 log10 inactivation in Phosphate Buffer Saline (PBS). Flexible cation charges, longer carbon chains, and native state toxicities were advantageous to the inactivation of MS2. Longer periods of irradiation were necessary. Increased irradiation time could present problems with porphyrin degradation. Studying porphyrin degradation is the next logical step in the research.

Awards won at the 2011 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel
Tuition Scholarship Award of \$4,000 for original research in an important Naval-relevant scientific area. Trip to attend the London International Youth Forum - Office of Naval Research on behalf of the United States Navy and Marine Corps

2011 - EV039

RED TIDE SENSITIVITY TO OCEAN ACIDIFICATION

Matthew Philip Goldklang

San Diego Jewish Academy, San Diego, CA

Oceans absorb one third of the carbon dioxide (CO2) in the atmosphere. When absorbed by the ocean, CO2 exists in equilibrium with carbonic acid. This process is known as ocean acidification. Lingulodinium polyedra (L. polyedra) is a red tide dinoflagellate that has an unknown response to ocean acidification. The species is specifically known for the creation of hypoxia, deoxygenation of seawater under bloom conditions. The purpose of this study was to investigate the effect of ocean acidification on L. polyedra.

 A model was developed that electronically controlled gas composition in sea water. L. polyedra was then cultured in seawater, with and without F/2- silicate media under constant illumination. Its growth curve was characterized and its sensitivity to acidification was measured by incubating the algae under varying concentrations of CO2 (387 ambient, 763 and 1453 ppm CO2). Cell density was measured with a hemocytometer and pictures were taken with a photomicroscope.

 At higher CO2 levels (763 and 1453 ppm), growth rates increased, primary production increased by 32% (1453 ppm only; p<0.05), size increased by 10-30 µm (1453 ppm only; p<0.05), and cell structure changed. The cells became more spherical and lost definition of their thecal plates. All morphology changes were irreversible after two months of re-incubation in 387 ppm CO2. The increase in size and growth rates indicates the potential for a higher bloom incidence and therefore a greater incidence of hypoxia. The structure and size changes may disrupt the food chain by impacting species who consume L. polyedra.

Awards won at the 2011 ISEF

Third Award of \$250 - American Geological Institute
Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2011 - EV040

ALTERNATIVE WAY TO OBTAIN FRESHWATER FROM SEAWATER

Eric Omar Pabon

Radians High School, Cayey, PUERTO RICO

The objective of the study was to prove if freezing seawater or a survival method can be used as an alternative way to obtain fresh water from seawater. The survival method is used to separate a mixture. The seawater is heated by the sun's rays, the water condenses and the salt particles are left behind. The parameter ppt (parts per thousand) is the measurement of the amount of dissolved salts in a determined body of water. This research consisted of two methods: 1) leave the water outdoors in a plastic container to condense and then be collected in a cup in the middle; 2) to freeze and re-freeze the seawater. When the waters are collected compare to regular tap water. The results were that tap water had a salinity count of 0.1 ppt and seawater that was used 38 ppt. Compared to tap water and seawater, the survival method reduce the salinity from 38 ppt to 3 ppt. The freezing method only reduced 2 ppt, from 38 ppt to 36 ppt. By the survival method the water had lost significant amounts of salinity count and can be used as an alternative way to obtain clean and drinkable water. The freezing method's salinity count didn't change and its not an alternative way.

2011 - EV041

NIAGARA REGIONS ENVIRONMENTAL IMPACT ON WATER QUALITY OF LAKE ONTARIO

Alexandria Nicole Penny

Grimsby Secondary School, Grimsby, Ontario, CANADA

Water is a vital natural resource that humans and all other living things depend on for survival. Improving our understanding of how humans impact water systems is critical to developing better policies and guidelines to protect this valuable resource. This study reviews the surface water quality of three sources from Grimsby to Niagara-on-the-Lake, all of which ultimately flow into Lake Ontario. These sources include: creeks, sewage treatment plant effluents, and storm water runoff from the highways and surrounding areas. Effluent data for 2010 was provided by the Niagara Region for four sewage treatment plants and the Niagara Peninsula Conservation Authority provided data for ten creeks. In addition, samples of storm water runoff were collected at eleven locations along a major highway on four occasions and analyzed with a portable pH/conductivity meter and a HACH DR2800 Spectrophotometer which was used to measure nutrient contamination. Several of the parameters that were reviewed during this study include phosphorous, nitrate, ammonia, E.coli, conductivity, chloride, pH, lead, zinc, and copper. The water characteristics of all three sources were then compared with the Provincial and National Water Quality Guidelines. Phosphorous exceeded the objectives in all sources, while chloride, free ammonia, and E.coli exceeded the objectives on average at one or two of the sources. Further studies of all three sources are required to identify the primary source of each contaminant and policy creators need to use this data to re-evaluate regulations and strategies to better manage these pollutants in the future.

2011 - EV042

THE EFFECT OF DOMESTIC DISCHARGES ON THE CORAL ACROPORA CERVICORNIS (STAGHORN CORAL)

Frank L. Torres Torres

Jose Rojas Cortes High School, Orocovis, PUERTO RICO

In the coast of La Parguera in Lajas, Puerto Rico, there are some houses that discharge their domestic wastes to the marine water. These discharges affect many important species of fauna in that place, including the corals, because it is the most important habitat for many marine species.

 The purpose of this investigation is to demonstrate that domestic discharges produce the death of the coral Acropora cervicornis. The established hypothesis suggests that domestic discharges produce eutrophication, which provokes the death of the coral Acropora cervicornis.

 The experiment consists on placing a group of three wire cages, each with a coral sample that were exposed to water with domestic discharges (group A-experimental group) and another group of three cages, each with a coral sample that were placed in transparent and non contaminated water (group B-control group). Both groups were observed for a total of ten weeks. Also, there were salinity, temperature, chemistry, physical and microbiological tests made to both the experimental group and the control group.

 After the ten weeks, corals in group A developed a necrotic tissue along with bleaching under the cloudy and contaminated water, a consequence of the eutrophication. Group A, along with its physical deterioration, developed red and green algae, small sponges and an animal called Ascidia negri. Group B however, in its translucent waters, did not suffer any change whatsoever during the experiment. All this suggests that domestic discharges cause the death of the coral Acropora cervicornis, so the hypothesis was accepted.

2011 - EV043

ENTOMOPHILOUS STEPPE PLANTS OF THE VILLAGE KARABATYR

Yelena Aleksandrovna Galaton

High-School OZAT, Kostanai, KAZAKHSTAN

Research aim - the study of flora entomophilous steppe of the village Karabatyry will help to determine the species composition of insect-pollinators, as well as the dynamics of daily activity patterns of insect-pollinators, depending on the environmental factors.

 Hypothesis - if to study the entomophilous steppe flora of the village Karabatyry, one can determine the species composition of insect-pollinators of the area.

 Method of research: empirical.

 Novelty of this work is to study representatives of entomophilous steppe plants of the village Karabatyry that will help to determine the species composition of these plants and to expand knowledge on the ecology of the spreading of certain types of Northern Kazakhstan.

 Work results:

 - Entomophilous flora is plentiful, interesting, but still poorly explored;

 - On the investigated territory the representatives of 10 families (20 species) were marked out: Rosaceae, Fabaceae, Asteraceae, Poppy, Solanaceae, Euphorbiaceae, Burachnikovye, Rubiaceae, Umbrella, Figwort, the most numerous members of which the representatives of the family Asteraceae (Asteraceae);

 - The most actively visited plants: raznolistny Thistle (Cirsium heterophyllum), espartsetny astragalus (Astragalus onobrychis), bedstraw present (Galium verum), Russian knapweed (Centaurea ruthenica), omnezhnik (Oenanthe)

2011 - EV044

THE BIOCIDAL ATTRIBUTES OF THE FAMILY LAMIACEAE

Dre Erik Howard Steinwehr

Hankinson High School, Hankinson, ND

Purpose: To see the growth promoting and plant defense boosting aspects of herb solutions on Spinacia oleracea cultivars. Secondly, to determine the nutritional advancing components on the spinach. Next, to examine the antibacterial features of the herbs on Escherichia coli. Finally, to analyze the growth enhancing attributes on a surrogate plant.

Procedure: Collected three herbs (Rosemary, Oregano, and Thyme). Prepared an herb solutions consisting of 10 grams of an herb with 100 mLs distilled water (Creating a 10:1 dilution).

Test Plot: The test plot was performed to determine the impact that the herb solutions have on the growth of spinach, as compared to the control solution. Plant Defense Test: The plant defense test was performed on the spinach from the test plot. After a 20 day growing period, the plants were swabbed for their bacteria levels to set a baseline before the herbs were applied. Upon harvest, the plants were then swabbed again to calculate a percent decrease of bacterial colonies on the spinach. Nutrient Analysis: The nutrient analysis was run to determine if the herb solutions had any effect on the nutrient levels in the spinach from the test plot. Biomass: Biomass was completed to determine the anti-bacterial properties of the solutions against pure cultures of Escherichia coli in a broth growth medium. Surrogate Plant Method: The surrogate plant method was run to see the solutions effectiveness on an alternative host plant, such as soybeans.

Conclusion: Throughout the testing, I found that

Rosemary was the most effective product. Overall, I feel that Rosemary would be a great alternative to chemical bactericides, plus providing beneficial aspects to the plants defense system and nutrient content.

2011 - EV045

CACTI MUCILAGE AND REVERSE OSMOSIS MEMBRANES: A SOLUTION FOR FLORIDA WATER'S PHOSPHATE PROBLEM

Kirstie Rae Tandberg

Lake Region High School, Eagle Lake, FL

In this experiment, cacti mucilage and reverse osmosis membranes were used to create an effective addition to wastewater treatment plants to remove phosphate. the expected outcome was that pretreating the water with cacti mucilage, then filtering it, would remove the most phosphate from the water.

Three filters were made using reverse osmosis membranes. Two of the membranes were unaltered, but one was infused with cacti mucilage. 250mL of 1000ppb, or parts per billion, phosphate water was poured into one of the two unaltered membrane filters. This was the control. 250mL of 1000ppb phosphate water was poured into the cacti mucilage infused embrane. Then, 250mL of 1000ppb phosphate water was pretreated with 10mg of cacti mucilage and poured into the second unaltered membrane. The water was tested andthe phosphate levels were recorded. The data showed that the hypothesis wasproven correct. Pretreating the water with cacti mucilage then filtering it through the reverse osmosis membrane filter removed the most phosphate.

In conclusion, this technology is very effective at removing phosphate and may be an effective addition to wastewater treatment plants. The group that was pretreated then filtered removed 85% of the phosphate from the water compared to 40% removed by primary and secondary wastewater treatment plants.

2011 - EV046

ATMOSPHERIC CO2 SCRUBBING: ENGINEERING A GREENER TOMORROW

Tyler Miguel Knapton

Grants High School, Grants, NM

The purpose of this project is to see if it is possible to actively scrub CO2 from the atmosphere. The hypothesis is that it is possible scrub CO2 from the atmosphere utilizing readily available chemical reactants.

Experiments 1-3 were conducted on two ion exchange resins (IERS). Amberlite was a strong basic IER and duolite which was a weak basic IER. CO2 is slightly acidic, especially in water. The basic IER's were chosen to evaluate their reactivity and ability to scrub acid solutions. Amberlite proved to better at raising the PH of the acidic solutions.

Lithium hydroxide (LiOH) and potassium hydroxide (KOH) were tested to show their behavior in reacting with CO2. These compounds reacted chemically with the CO2, creating compounds that were more benign and easily removed from the system. KOH was able to consistently remove more CO2 than LiOH and amberlite.

All the reactants were able to remove CO2 from the air making them all candidates for widespread CO2 scrubbing. The experiments showed that man has the ability to scrub CO2 from the atmosphere.

Future evaluation must be completed to prove the economical feasibility of the process and to also ensure that the chemical process do not prove harmful in other areas of the environment.

Physical scrubbing of CO2 from the atmosphere can be combined with other CO2 reduction efforts such as carbon sequestration, green plant respiration, oceanic absorption,and green technologies to reduce CO2 gases in the atmosphere.

2011 - EV047

SALINITY TOLERANCE OF SEASHORE GASTROPODS FOUND IN PALA LAGOON, AMERICAN SAMOA

Marymargaretose Cheung-fuk

Tafuna High School, Tafuna, AMERICAN SAMOA

Gastropods are important marine organisms that thrive in certain salt levels appropriate for their species richness. With the increase in global warming, environmental and human-caused changes, the original habitat of Pala Lagoon has undergone alterations. This experiment was thus designed to test and study the salinity tolerance of seashore gastropods found in the Pala Lagoon, American Samoa. Gastropods and salt water utilized in this study were collected from the Pala Lagoon, and once collected; the gastropods were stored in the laboratory for 96 hours to ensure their survival under lab conditions. The gastropods were then assayed for salinity changes in different sea water dilutions of 50%, 35%, 25%, 17.5%, 12.5%, 6.25%, 3.13%, 1.56% and 100% sea water (control). Three replications of each percentage dilution were utilized in this study. The gastropods mortality rates were recorded after a period of 24 hours over a total of 96 hours. Observations were made and data collected from each salt water level was compared with sea water. This study indicates that the gastropods are tolerant to the different sea water dilutions and a higher level of salinity tolerance was observed. More efforts to conserve the natural biota of the Pala Lagoon should be initiated to keep the species richness.

2011 - EV048

BIO INDICATORS SPECIES ANALYSIS IN THE MITIGATION AREA AT LAS CUCHARILLAS MARSH, CATANO PUERTO RICO

Christian A. Eaton-Ocasio

Francisco Oller, Catano, PUERTO RICO

This research was made in the mitigation site at the old Bayamon Delta River in Catano, Puerto Rico, which is part of Las Cucharillas Marsh Reserve, one of the biggest herbaceous wetland in the San Juan Metropolitan Area. During decades, human activities have caused negative impact to this ecosystem such as habitat fragmentation, soil and water contamination and wetland lost and degradation. The hypothesis under study was that if there are bio indicator species in the mitigation site of Las Cucharillas Marsh, then this wetland has been impacted by contamination as a consequence of human activities around the ecosystem. The researchers tried to determine the presence of bio indicator species for water quality in the twelve (12) acres of mitigation site which was divided in two (2) parcels. Parcel A is named reforested area, and parcel B non reforested area. Both parcels were divided into three (3) lineal transects of fifty (50) feet long each. Three sample sites were marked using a GPS in all transects. In both parcels the snails *Marisa cornuarietis* and *Pomacea bridgesis* were

identified. Those snails species are bio indicators of poor water quality in the mitigation site. The water that floods the mitigation site comes from the Aguas Fria creek, which collects the industrial and household dischargers of the zone. These results lead to conclude that there are bio indicator species, such as the snails, in the mitigation site of Las Cucharillas Marsh. Both species are indicators of water quality. The hypothesis was confirmed.

2011 - EV049

THE EFFECTS OF CARBON DIOXIDE PRESSURE AND NITROGEN, PHOSPHORUS, POTASSIUM MASS CONCENTRATION ON THE BIOFUEL SYNTHESIS OF GREEN ALGAE

Rajet Vatsa
Brophy College Preparatory, Phoenix, AZ

The primary objective of this study was to determine the effects of carbon dioxide, nitrogen, phosphorus, and potassium availability on the biofuel synthesis of four species of desert-acclimated green microalgae: *Nannochloropsis oculata*, *Chlamydomonas reinhardtii*, *Dunaliella salina*, and *Haematococcus pluvialis*.

It was hypothesized that increased levels of all four nutrients would expedite biosynthesis rates. Furthermore, the doubling time of each specie would thereby determine the order of aggregate dry mass production, but not the specie's lipid content.

A closed photobioreactor was constructed, which held twenty-four experimental algal culture mediums. The algae were acclimated to the environment for one week and then exposed to experimental pressures of carbon dioxide and concentrations of nitrogen, phosphorus, and potassium for two days to determine biosynthesis rates.

After three trials of experimentation, it was concluded that algae exposed to fifteen megapascals of CO2 flow produced greater quantities of biofuel than algae exposed to ten megapascals and five megapascals of CO2 flow respectively. In addition, as for the N.P.K. test, the algae samples cultured in the highest experimental N.P.K. concentration generally synthesized more biofuel than those cultured in the first experimental group and the control. Moreover, doubling time did have an effect on the gross dry mass production for each specie.

Finally, it was concluded that potassium did benefit the biofuel production in all four species of algae. In comparison with the CO2 test controls, the potassium controls rendered greater results, a factor which will be critical in sustaining biofuel output in response to recent trends in essential algal nutrient (phosphorus) depletion.

2011 - EV050

WHAT ENVIRONMENTALLY SAFE DETERGENT IS MOST EFFECTIVE IN CLEANING BIRDS INVOLVED IN AN OIL SPILL?

Caroline Nikolaidis
Huron High School, Ann Arbor, MI

When an oil spill occurs, the lives of thousands of animals are put into danger. Birds are especially vulnerable to oil for many reasons – the water resistance in their feathers is reduced, and they are more subject to hypothermia and being eaten by predators. In this project, the goal was to find the detergent - out of the five most commonly used to clean birds in an oil spill – that would clean the birds the most efficiently and effectively. Using the image processing features from a software program, I was able to establish how well each detergent preformed, based on its cleaning index, the coefficient of variation, and the cleaning index normalized with time. I was able to determine all of this information using the image processing program. After dipping twenty feathers for each detergent in dirty motor oil, they were assigned a number from 0-250, 0 being the darkest black and 250 being the lightest white. After cleaning them with the detergent, I scanned them once more to determine their improvement and determined the factors I listed above.

I concluded that the brand that was most used did not perform to what I expected it to; it was outshined by the others that I tested. Out of the five I tested, one brand turned out the best, winning the two out of three ways that I analyzed my data. To save more birds, it is important to adapt a cleaner to fit their needs, and one that will work faster and more efficiently.

2011 - EV301

THE AFFECT OF DISSOLVED OXYGEN PRODUCTIVITY IN AN AQUATIC ECOSYSTEM

Fady Hani Ibrahim, Ramy Ibrahim,
E. E. Waddell High School, Charlotte, NC

Pharmaceuticals and Personal Care Products (PPCPs) are a variety of bioactive chemical entities that have been found as a growing health and environmental concern around the world due to their accumulation in the environment. And while scientists have assessed and confirmed the presence of these drugs and their specific concentrations in influent and effluent waters, they have just begun to research and test the impact of these drugs individually on various types of marine life. This investigation attempted to assess the influence of effluent PPCPs concentrations on the overall health of aquatic ecosystems via dissolved oxygen (DO) productivity. To evaluate this, three of the most heavily quantified classes of pharmaceuticals identified in effluent waters (antibiotics, Sulfamethoxazole; analgesics, Naproxen; and beta-blocker, Metoprolol) were introduced to simulated aquatic ecosystems separately and collectively at their most recently documented concentrations of 0.115ug/L, 1.89ug/L, and 0.338ug/L respectively and assessed daily for DO levels for a 4 day span. Individual PPCP levels were maintained daily by half-life analysis and distribution. Our results revealed consistent daily fluctuations in DO levels cross categorically, but exposed diverse productivity trends individually. On average, individual drug exposure to similar systems yielded a net DO productivity disparity compared to that of the control (Sulfamethoxazole 12.25%, Naproxen 22% and Metoprolol 21%). Collectively, there was an average disparity percentage of 5.75%. In conclusion, the perpetual influx of PPCPs detected in effluent waters of aquatic ecosystems created daily fluctuating disparities at a maximum of 7% decrease and a maximum of 8% increase.

2011 - EV302

DEGRADATION OF ENVIRONMENTAL POLLUTANTS WITH NANOCOMPOSITES

Mehwish Ghafoor, Ambreen Bibi,
Federal Government College for Women G 10/4, Islamabad, Capital, PAKISTAN

The polluted water effects whole ecosystem and causes numerous diseases in human. The present research was aimed to synthesize new bimetallic nanocomposites (cerium oxide- manganese oxide coupled semiconductor particle systems) and investigate its photocatalytic activity for degradation of organic pollutant of waste water under visible light irradiation, which are comparatively less expensive.

Cerium oxide- manganese oxide bimetallic nanocomposites were synthesized by treating the prepared solutions of cerium sulphate and manganese nitrate with 1 M solution of NaOH which was added drop wise at room temperature with the addition of water soluble surfactant (SDS) to control pH and particle size respectively with constant stirring. The final slurry was washed several times with deionized water to remove any traces of sulphates and nitrates. The washed powder was dried overnight at 100 degree centigrade and calcined at 400 degree centigrade for 6 hours. The synthesized sample was characterized by XRD and SEM to study the surface morphology, phase, particles and metal-metal interaction.

Photocatalytic activity of cerium oxide- manganese oxide nanocomposite was investigated for the liquid-phase photocatalytic degradation of waste water of industrial area under visible light irradiation. High photocatalytic activity of nanocomposite for the degradation of organic wastes present in polluted water was observed by colour change from yellow to transparent. SEM showed that fresh material has pores structure with uniform distribution. This research has resulted in the development of cheap nano composites and process for underprivileged people who can use this technology to make impure water drinkable.

Key Words: photocatalyst, irradiation, degradation

Awards won at the 2011 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2011 - EV303

ENVIRONMENTAL NOISE POLLUTION WITHIN URBAN STRUCTURES WITH HIGH DENSITY POPULATION

*Amanda Marie Acosta-Ruiz, Carlos R. Martínez-Licha, Rey Díaz
Academia del Perpetuo Socorro, San Juan, PUERTO RICO*

Urban expansion caused a great impact on public health. The population of urban areas is limited to confined spaces that contribute to high noise levels, an increasingly worrisome and hazardous pollutant. A study was conducted to describe a historic structure's sound activity and identify cost-effective changes to lower high noise levels and improve environmental sustainability. A sonometer was used to measure the noise levels in six intervals of 30 minutes distributed throughout a typical school day for ten days with a frequency of fifteen seconds per data record, providing 120input/30minutes for n=6,240. According to the results, the noise fluctuated between an average minimum and maximum of 49.2dB and 92.7dB, over the 45dB limit established by the EPA. The equation for relative sound intensity level indicated the levels of specific noise contamination's minimum (60.6dB) and maximum (69.4dB). There was a statistical difference between internal and external noise levels (p-value 0.0001). A linear regression between the indoor noise sources and the noise levels was established for the second ($r^2 = 0.94$) and third floor ($r^2 = 0.72$). High noise levels in the first floor were attributed to the external noise sources from the urban environment ($r^2 = 0.13$). Noise contamination, a proven health hazard, is strengthened by the confined spaces from urban expansion.

The sustainability required by global development can be achieved through the incorporated proposal to rehabilitate the internal and external structure that will restore low noise levels and make way for progress.

2011 - EV304

RESEARCH ON EFFECT OF URBAN RAINFALL RUNOFF POLLUTION ON WATER ENVIRONMENT AND AMOUNT ACCOUNTING

*Yixin Zhang, Yumeng Li, Anqi Wang
Anhui Bengbu No. 2 High School, Bengbu, Anhui, CHINA*

This research aimed to reduce the effect of rainfall runoff pollution on surface water environment and decrease the emission of pollutant in water environment.

Single factor water quality index for evaluating water quality of rivers was supposed to be applied into the valuation of urban rainfall runoff pollution; and water quality pollution concentration value dimensions were uniformed in the premise of not considering the functional area dividing element. The research provided the calculation mode of Bengbu rainfall runoff pollution amount based on the monitoring data to investigate the hazard degree of the rainfall runoff pollution.

The single factor water quality index was applied to the Chemical Oxygen Demand and Biochemical Oxygen Demand after Five Days correlation analysis of rainfall runoff pollution. It was proved that the single factor water quality index well valuated water pollution degree in the same sort and satisfied with the national standard sort qualitative evaluation. By calculating and analyzing the annual rainfall runoff pollution amount, it was concluded that the waterfall runoff pollution was main pollution source along with the improvement of urban point source control; as the pollution ratio of the rainfall runoff pollution got higher and higher, the rainfall runoff pollution became main pollution source which made pollution emission reduction amount get higher and higher.

Awards won at the 2011 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2011 - EV305

THE TOXICITY OF BIOREMEDIATION AGENTS

*Andrea Elise Green, Catherine Mitchell,
H. B. Woodlawn, Arlington, VA*

On April 20th, 2010, the Deepwater Horizon explosion caused an estimated 200 million gallons of crude oil to gush into the Gulf of Mexico. The effects of the agents used to clean up this oil spill, as well as other spills, are largely unknown. This experiment was designed to test the toxicity of bioremediation agents currently being used to clean up oil spills. Artemia salina (brine shrimp) were used to test the toxicity of three different bioremediation agents: Oil Spill Eater II (OSE-II), Micro-Blaze, and S-200. Two controls were also used, one with crude oil and one without. There were four trials for each testing variable. On days one, three, and four of testing, the number of Artemia salina living and dead was determined for each trial. All of the Artemia salina were dead on the fourth day of testing, with and without oil, for OSE-II and S-200. Without oil, Micro-Blaze averaged a 60.5% survival rate of Artemia salina on the fourth day of the testing

period. With oil, Micro-Blaze averaged a 16.8% survival rate of Artemia salina on the fourth day of the testing period. Comparatively, the control without oil averaged a 78.5% survival rate of Artemia salina on the fourth day of the testing period. The control with oil averaged a 37.6% survival rate of Artemia salina on the fourth day of the testing period. Micro-Blaze was the least toxic bioremediation agent, while both OSE-II and S-200 were equally toxic. All data was statistically significant at $p=0.01$.

Awards won at the 2011 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2011 - EV306

BIO-DEGRADATION OF POLY(ETHYLENE TEREPHTHALATE)/POLY(LACTIC ACID) BLENDS

Yi-Ying Tsai, Kai-Li Hsieh,

National Taichung First Senior High School, Taichung, CHINESE TAIPEI

More than billions of non-degradable poly(ethylene terephthalate) (PET) bottles used in our daily life, which cause serious environmental issue. In this work, an interesting and easy concept is used to speed up the degradation rate of PET. Our approach is simply mixed one non-degradable polyester (PET) with the other biodegradable polyester (poly(lactic acid) (PLA)) using "physical blending" technique. The degradation experiment of PET/PLA was carried out in the environment with the presence of enzyme (Lipase from porcine pancreas, Type II(PPL)), which is particular selected to degrade PLA. Our results indicate the addition of certain amount of PLA into PET system can significantly increase the degradation rate of non-degradable PET. This study provides a new idea to make our earth more friendly.

2011 - EV307

HD CONVERTER

Doha Raaouf Sokarieh, Hayat Itani,

Canadian High School, Beirut, South, LEBANON

The HD Converter is a machine made up of dumped pepsi cans, containing a base of Naoh solution. This converter is put on the car exhausts to reduce the quantity of CO2 would react with the NAoh and will be converted to another material which is Na2CO3 Dissolved in water according to the reaction: "CO2+ NAoh --> Na2Co3 + H2O

This project aims to reduce global warming through reducing CO2 and reducing garbage at the same time by revising the cans dumped everywhere.

Awards won at the 2011 ISEF

Award of \$1,000 - National Collegiate Inventors and Innovators Alliance/The Lemelson Foundation

2011 - EV308

ALLELOPATHY: A POTENTIAL METHOD FOR INVASIVE PLANT SPECIES CONTROL

Elan Heller, Eric Rubin,

Long Beach High School, Lido Beach, NY

Allelopathy is a set of phenomena in which certain chemical compounds released by allelopathic plants inhibit or benefit the growth of other plants. In the walnut fruit, these chemicals exist as hydrojuglone until chemically stimulated by exposure to oxygen to form juglone. In order to inhibit the growth of certain plant species, juglone affects respiration by inhibiting certain chemical reactions which regulate plant growth. Research supports that a juglone-based herbicide will adequately inhibit the growth of soybeans through a method of spraying. Other allelopathic species are prevalent in the northeastern United States. These species include corn, lantana, and rhubarb. These species adversely affect the growth of plants in their immediate area by releasing allelochemicals into the soil. Soybeans were used as a test plant to determine which of these plants have the most significant allelopathic response, and were inter-planted with each species. Another group of soybeans was grown for three weeks, and then sprayed with a Juglone-based herbicide. The results of the Sprayed and inter-planted group were compared in order to determine the most effective method of allelopathic species control. After comparing the raw data (plant height and dry mass measurements) of the interplanted and walnut-exposed groups, it was determined that the walnut-based herbicide was much more effective in inhibiting the growth of the soybeans than the inter-planting method. Statistical analysis of the results from the walnut-exposed trial at $\alpha = 0.05$ display a p-value of <0.0001 . At a 95% level of confidence, the results of the walnut-exposed trial were highly significant. If applied in a commercial setting, a walnut-based herbicide would be effective in inhibiting unwanted vegetation growth.

2011 - EV309

MUSSELS, A NATURAL APPROACH TO SEWAGE TREATMENT: EVALUATING GEUKENSIA DEMISSA AS BIOFILTERS OF LOCAL BAY POLLUTION

Arianne Elizabeth Papa, Jane Elizabeth Smyth,

Long Beach High School, Lido Beach, NY

Sewage treatment methods currently in use are ineffective in eliminating the wide range of chemical pollutants draining into waterways. This project studies local channel water quality and the implementation of Geukensia demissa (ribbed mussels) to remediate this bay. Pharmaceutical, chlorine, nutrient, and turbidity levels were studied at various distances from a sewage treatment plant outflow in the channel. To determine their ability to reduce contamination, G. demissa were added to a microenvironment with treated wastewater. Turbidity and chlorine levels were tested over time. Also measured was the ability of G. demissa to filter DEET (N, n-diethyl-m-toluamide), a ubiquitous water pollutant and the active ingredient in insect repellants, since our previous research

indicates that *G. demissa* can filter DEET within 24 hours ($p<.0001$ ANOVA). Effluent was found to be the primary source of pollution in the channel with highly elevated chlorine (2.0 mg/L), turbidity (24.0 ntu) and various nutrient levels. A full spectrum analysis of sewage effluent using mass spectroscopy revealed detectable levels of household cleaning products present in this wastewater. In comparison to treated wastewater without intervention, wastewater with *G. demissa* showed reduced chlorine and DEET levels when tested for three consecutive days. *G. demissa* were able to decrease chlorine levels in bay water from 0.6 mg/L to 0.1 mg/L within four hours. Since *G. demissa* are known to be a hardy species with a rapid filtration rate, they could be applied as biofilters, preventing bioaccumulation and damage to aquatic ecosystems. This study provides promising evidence that *G. demissa* can be feasibly used in the future as industrial-scale biofilters as a novel approach to enhancing sewage treatment.

Awards won at the 2011 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel
First Award of \$5,000 - King Abdul-Aziz & his Companions Foundation for Giftedness and Creativity
First Award of \$2,500 - Sigma Xi, The Scientific Research Society

2011 - EV310
REMOVAL OF CRUDE OIL FROM DIFFERENT SUBSTRATES USING BIOSOLVENTS

Consuelo Esperanza Gatica, Valentina LLanca,
Windsor School, Valdivia, Region de los Rios, CHILE

This research is based on the use of synthesized biosolvents obtained from the esterification of natural fatty acids as cleaning agents of crude oil in different substrates. The hypothesis was that biosolvents can be utilized to clean crude oil from different substrates and its application immediate or posterior can affect the degree of cleaning. To test these hypothesis different substrates were contaminated with crude oil and then cleaned with biosolvents immediately after the contamination and a week later. The results indicate that the biosolvent is effective, due to the removal percentage in average was an 88% for the substrates cleaned immediately and a 73% after a week. These results proved that hypothesis that biosolvents can be used as cleaning agents in different substrates after being contaminated with crude oil, and its effectiveness is reduced when the cleaning is done a week later.

2011 - EV311
PHOTOAUTOTROPHIC FILTRATION: THE EFFECTS OF CHLORELLA PYRENOIDOSA ON THE REDUCTION OF CO2 EMISSIONS

Jed Donald Grow, Andrew Quinn Ross,
Clearfield High School, Clearfield, UT

A major issue debated throughout the world today is “going green” and whether the world, specifically the United States, has the technology and funding available to transition to green thereby making a substantial improvement in the global environment. A series of studies were conducted to examine the effects an algae, *Chlorella pyrenoidosa*, has on the reduction of CO2 emissions, a major factor contributing to climate change. To perform the experiment, carbon dioxide was pumped through three 1,000ml beakers of algae where the density of the algae continuously increased from day-to-day, which was quantified by measuring the turbidity. The CO2 ran from inside the beakers through a tube into an enclosed environment where a CO2 probe was able to measure how much carbon dioxide permeated the algae. Every day the algae thickened and became denser, providing a linear reduction in the amount of CO2 capable of permeating the algae. It is estimated that at any given time, 50-70% of all CO2 emissions were completely and thoroughly scrubbed (reduced) when compared with control samples of 1000ml beakers of distilled water. More than fifty (50) tests validate the claim that *Chlorella pyrenoidosa* serves as an optimal candidate in the scrubbing and reduction of carbon dioxide emissions. Photoautotrophic filtration, using *Chlorella pyrenoidosa*, could be useful in offering factories and large producers of greenhouse gases a means of reducing the output of CO2 emissions and potentially improving the global environment.

Awards won at the 2011 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2011 - EV312
ACTIVATION OF THE HEXOSE AND AMINO ACID TRANSPORT SYSTEMS IN CHLORELLA PROTOTHECOIDES (VULGARIS) FOR ENHANCED BIOMASS PRODUCTION VIA AMPHITROPIC (MIXOTROPHIC) REACTION USING ALTERNATIVE ORGANIC CARBON SOURCES

Andrew Michael Howington, Michael James Hulick,
Morristown-Hamblen High School East, Morristown, TN

Research on increasing the efficiency of biomass production in *Chlorella* microalgae has focused primarily on either the photosynthetic or the heterotrophic mechanisms. The separate approaches are based upon an assumption that these mechanisms function independently of each other. This investigation examined the efficiency of *Chlorella protothecoides* biomass production under conditions within a mixotrophic reaction designed to incorporate both mechanisms.

Optimizing the growth environment for the unique properties of *Chlorella protothecoides* addressed the following conditions limiting efficiency:

A)carbon uptake/utilization,

B)lag phase in photosynthetic growth following naturally occurring dark cycles, and

C)protein synthesis deficiency associated with heterotrophic growth.

Diffusion of CO2 into the culture at reported maximum of approximately 70% (diffusion) is known to decrease efficiency in autotrophically grown cultures. Organic carbon sources can diffuse more easily into the medium (e.g. acetate) are preferable for increased efficiency. Adding glucose initiated active transport of hexoses and amino acids leading to higher rates of protein synthesis. A photo bioreactor was designed and built to support any combination of these growth methods. The timing of light/dark cycles was adjusted to reach the systemic equilibrium necessary for maximal yields. Over a 48 hour period, the biomass growth was tested using acetic acid and brewery waste water as alternative carbon sources while simultaneously balancing oxygen levels. This combination produced successful mixotrophic reactions with increase in yield nearly twice that of autotrophy alone.

Awards won at the 2011 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2011 - EV313

A.W.S.S. (AUTONOMUS WATER SANITIZATION SYSTEM)

Jorge David Varlotta, Ruth Maurente Jaime, Elisa Bustamante

Escuela Tecnica N012 "Libertador General Jose de San Martin", Ciudad Autonoma de Buenos Aires, Buenos Aires, ARGENTINA

ORIGIN: This project (A.W.S.S.) emerges of the need to obtain distilled water for the operation of a hidroponic system that we built for a frontier school in Jujuy State (Argentine Republic).

PROBLEM: The water currently in use for this hidroponic system is brought by the National Gendarmerie in tanker trucks because the underground water there is highly contaminated with arsenic and cianide, a result of the open sky minery, so they have to purify their water supply.

AIM: To design and to build a device that takes the contaminated water of the underground supply, purify it and then be connected with the hidroponic farm.

PRODUCT: a.w.s.s. is an autonomic water sanitation system that takes contaminated water from the underground supply and takes three steps to purify it:

i) Adds chlorine in the begining of the process to get rid of germ contamination and to oxidize the arsenic.

ii) Makes a distillation and a double condensation taking out metaloids and mineral salts.

iii) Executes a biotechnological treatment with a fern (PTERIS VITTATA) that absorbs the remaining arsenic that is present after the destillation process.

RESULTS: Because of the obtained results the device can be used to get rid of the arsenic and cianide present in the undergroug water supply in Jujuy.

REPERCUSSIONS: After we received many calls for help from several places we get to know that our system is also useful to treat boron contamination, excessive salts and bacteria contamination. That is the reason why we call for help to build a real size one and give the help that we are asked for.

Awards won at the 2011 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2011 - EV314

PESTICIDES, A LATENT THREAT?

Nahuel Gaillard, Karen Daniela Itati Mogni,

Escuela Secundaria Numero 18, Colonia San Cipriano, Entre Rios, ARGENTINA

The progressive advancement of agriculture and need for higher yields, as well as the needs to more intensive checking against all types of weeds ands pest that may affect crops, have been possible through the use of agrochemicals to achieve their purposes.

However, the use of these products brings about the disadvantage of polluting soil, air, water and living things, to a greater a lesser degree. This is caused due to the lack of information regarding this matter and the nonexistent control on the part of the State.

Therefore, this paper is aimed to analyze the consequences caused by the use of pesticides in Colonia San Cipriano's fields.

 Nowadays, not only people are becoming aware of the importance of this problem, but also national and international legal protections for the environment are being discussed.

Due to the current state of rural areas, scientific research is being carried out to observe the levels of pollution at present.

All in all, the massive application of those chemicals causes a high degree of pollution in the environment reducing and avoiding the development of the flora and fauna of the region. This is capable of altering human being's health and causing different diseases. The inefficiency of controls exacerbates this situation.

2011 - EV315

SEASONAL SUCCESSION OF PHYTOPLANKTON SPECIES IN QUARTERMASTER HARBOR AND AS PRECURSORS TO ALEXANDRIUM CATENELLA BLOOMS

Elizabeth Anne Meucci, Alyssa Ylescupidiez,

Bellarmino Preparatory School, Tacoma

Phytoplankton are crucial to the marine ecosystem. They produce 50% of the world's oxygen through photosynthesis and are the foundation of the marine food chain. Some phytoplankton, however, can be toxic, such as Alexandrium catenella, which causes Red Tide blooms and Paralytic Shellfish Poisoning (PSP). The purpose of this research was to determine phytoplankton concentrations and successions in Quatermaster Harbor and how this data correlated with the appearance of Alexandrium catenella blooms. From February through October, weekly water samples of phytoplankton were collected from Quatermaster Harbor, Washington. In the laboratory, concentrations and successions of twenty-eight different species of phytoplankton were recorded. Two blooms of Alexandrium catenella were observed in July and September. High concentrations of Alexandrium catenella were recorded during periods of decreased diatom populations. The data indicated a strong relationship between Alexandrium catenella blooms and diatom concentrations.

2011 - EV316

THE EFFECTS OF ENGINEERED NANOPARTICLES ON THE CHEMOATTRACTION OF A STRAIN OF THE CILIATED PROTOZOAN, TETRAHYMENA

Laura Gunderson, Joseph Black,

Cookeville High School, Cookeville, TN

Applications of nanoparticles include use in the semiconductor industry, cell imaging, and in LEDs. However, increased production and use of such particles also increases the chance for environmental effects. Currently there is an interest in the impact of nanoparticles on organisms in the environment. The present study aims to determine effects of nanogold particles (NGPs) and quantum dots (QDs) on Tetrahymena, a common ciliated protozoan important in food chains, nutrient cycling, and wastewater processes. To determine lethal effects, ciliates were exposed to NGPs and QDs in sterile pond water for 24 and 48 hours, after

which the ciliates were enumerated. The sublethal effect of inhibition of chemoattraction was studied by testing exposed ciliates for their ability to enter microcapillaries containing an attractant, 0.15% yeast extract. Numbers of exposed ciliates that reached the attractant were compared with number control ciliates (not exposed to NGPs or QDs). Experiments were run in triplicate, and data were analyzed by a t-test. Results showed no mortality over 48 hours; chemoattraction was significantly inhibited ($p < 0.05$) at 24 h but not at 48 h. Ciliates were observed via confocal microscopy to accumulate QDs and release them in pellets. NGPs also appeared to be released in pellets. Such results show that under certain conditions nanoparticles may have a temporary sublethal effect on ciliates, but this may important because these ciliates are part of a healthy ecosystem, and even temporary sublethal effects could have consequences for the environment.

2011 - EV317

THE IMPACT OF ELECTROMAGNETIC POLLUTION ON A FOREST

Pedro Julio Hernandez Rodriguez, Elliot Ramos Chevere,
Adela Rolon Fuentes, Toa Alta, PUERTO RICO

This research was done to determine if there is electromagnetic pollution and the effect of it in the Santa Ana forest flora. The problem was that flora of the forest contains electromagnetic contamination from outside sources. The hypothesis was that there is electromagnetic pollution from external sources in the Santa Ana forest and that the trees are affected by it. A specific area of the forest was selected and measurements were done in ten sectors separated by a distance of 30 meters. Soil temperature, pH levels and soil nutrients were measured. A portable weather station was used to measure soil temperature, humidity and wind speed. A multimeter was used to measure voltage, electrical conductivity and electrical resistance of the soil and trees' trunks. An electromagnetic field meter was used to measure the electric field intensity, the magnetic field intensity and the potential density. The analysis of the different results evidenced the presence of external electromagnetic sources in the selected areas of the forest. The highest intensity of the electromagnetic field and electric potential was at the top of the forest, suggesting that electromagnetic waves that are received by the leaves induce the flow of electric particles that go into the soil. The soil's organic materials are destroyed and the reticular hair of the roots are lost. This reduces water and sap movement in the trees and that's why their top branches are dry and twisted. Then trees die from top to the bottom. The hypothesis was accepted.

2011 - EV318

THE EFFECT OF COAL ASHES IN THE HUMAN BODY

Irmarie Gonzalez - Valentin, Emily Bernardeau Rivera,
Natividad Rodriguez Gonzalez, Arroyo, PUERTO RICO

-producing plants cause 20% - 30% of pollution. They produce ashes containing radioactive isotopes, ionizing radiation and high levels of heavy metals that attack the body's nervous system. Problem: Do the expositions to coal ashes affect human beings' health? The hypothesis was: human beings that live adjacent to areas that have been filled with coal ashes will suffer lung, stomach, and liver diseases. Literature investigation and disease statistics were done. Two communities adjacent to areas filled with coal ashes were studied. Community (A) had nine years of exposure and (B) had two years. Twenty two persons were surveyed in (A) and 38 in (B).

Research evidenced that 55% of the persons often felt headache and nasal allergies, sore throat (53%), tears (48%), sinusitis (45%), cold (32%), and stomach disorders, bronchitis and heart disease (20% each). The conditions that worsened after filling the soil with ash were colds, sinusitis, bronchitis, asthma and stomach disorders. The symptoms and diseases suffered by the respondents have a direct relationship with the following heavy metals: beryllium, aluminum, nickel, copper, zinc, molybdenum, cobalt, vanadium, lead, arsenic and chromium.

The respondents presented symptoms and conditions which proved that the hypothesis was true, since 42% of the respondents presented conditions related to the respiratory system and 20% to upset stomach. However no person knew if their liver was affected. Community (A) presented more respiratory and stomach conditions. It is planned to analyze particles in air and water of the surveyed communities to confirm the presence of heavy metals.

2011 - EV319

CONTRASTING REPRODUCTIVE SUCCESS OF FEMALE STREAM FISHES IN TWO DRAINAGES IN NORTHWESTERN FLORIDA: A LIFE HISTORY STUDY OF EASTERN MOSQUITOFISH, GAMBUSIA HOLBROOKI

Marjana Chowdhury, Maryama Diaw,
The Young Women's Leadership School, New York, NY

Okaloosa darters (Etheostoma okaloosae) are endangered because of limited geographic distribution, declining population size, and loss of habitat. This small fish occupies streams draining into Rocky and Boggy Bayous in northwestern Florida. Boggy supports about twice as many Okaloosa darters per meter of stream as Rocky, which may be due to differences in reproductive success between drainages. The Okaloosa darters could not be euthanized because they are endangered, so a surrogate species was used to test differential reproductive success between drainages. Eastern mosquitofish (Gambusia holbrooki) were used because they are abundant and have well-described reproductive traits. A total of 268 adult female mosquitofish were collected from six creeks within each of the drainages using seines and dip nets. Standard length and mass of each female was measured and counted, and determined the developmental stage of eggs and embryos in her clutch. Average fish length (31 mm) and clutch mass (20 mg) were the same between drainages at a 95% confidence level, but females in Rocky had more eggs in each clutch and therefore produced larger numbers of smaller eggs. Females in Boggy contained larger eggs and more mature embryos. Reproductive success may, therefore, be better in Boggy because larger offspring tend to have higher survival rates than smaller offspring in stream fishes. Differences in reproductive traits between drainages likely reflect differences in environmental factors. These results may help biologists understand variation in abundance of endangered Okaloosa darters and suggest ways to increase abundance in sites that are being restored.

2011 - EV320

ALTERNATIVE METHODS OF OPTIMIZING FOOD PRODUCTION IN "RED-LINED" AND URBAN FOOD DESERTS USING AQUAPONICS AND HYDROPONICS VS. CONVENTIONAL GROWING METHODS

Quantavious Yorel Griggs, Nouhayla Houssaini,
Benjamin E. Mays High School, Atlanta, GA

In the past years, world hunger has dramatically increased in third world countries, urban and redlined areas. Food Deserts is a new term that describes areas that lack access to affordable fruits, vegetables, whole grains, low-fat milk, and other foods that make up the full range of a healthy diet. These "Food Deserts" are predominately low-income families who do not have the transportation to get to the superstores located afar. Lower income families have better access to fast food than they do fresh food because grocery stores are starting to only appear in areas where people can afford them and that is contributing to the high obesity rate of low income Americans. According to a study done by the U.S.D.A. (United States Department of Agriculture) a small percentage of American consumers are limited in their ability to obtain affordable, nutritious food because they live far from a supermarket of large grocery store. Fresh food has become so difficult to obtain for low-income families that they must create their own food sources. Some urban and low-income areas are not suitable for traditional growing methods, so families must find alternative methods of producing their own food. Two productive solutions to this problem are aquaponics and hydroponics. Aquaponics is the soil-less, simultaneous cultivation of fish and crops in a symbiotic relationship. Aquaponics is also a combination of aquaculture (the cultivation of fish) and hydroponics. Hydroponics is the cultivation of crop in water enhanced with a nutrient solution. With aquaponics and hydroponics we intend to provide two of the most productive methods of producing plants without soil. Research has supported these facts; aquaponics and hydroponics saves ninety percent of the water used for in-ground growing, it grows vegetables and fruits faster, there's no need to water because the water is continuously circulated throughout the system, no need for pesticides, fertilizers, herbicides or fungicides because the unit naturally balances the system and these systems can be used year-round. In our experiment we have proved that the research was indeed correct. As a conclusion to the results from our experiment, aquaponics has proven to be more successful than hydroponics, but both methods were more productive than geaponics. In our future we intend to manufacture miniature systems that can be installed in urban living spaces and inside the homes of low income families.

Awards won at the 2011 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2011 - EV321

THE EFFECT OF POLLUTANTS ON EISENIA HORTENSIS (EARTHWORM) AND IT'S POTENTIAL AS AN INDICATOR SPECIES

Gillian Claire Gundersen, Brenda Perez,
Herndon High School, Herndon, VA

Pollutants carried in runoff affect an environment and its organisms in many ways. Indicator species, such as Eisenia hortensis (earthworm), may indicate the types of pollutants in an area and their impact on the biota. In this experiment, populations of earthworms were exposed to solutions of fertilizer, sodium chlorite, bisphenol-A (BPA), and motor oil over a period of five weeks; first at 100 times the EPA recommended maximum amount of pollutant in drinking level standard and then at 500 times the EPA standard. Periodic mortality counts were taken along with dissections, blood smears, and observations of behavior. Each pollutant had different effects. Motor oil was visibly absorbed by some worms causing bloating and secretion of oil. Eisenia hortensis could, therefore, be used to indicate the presence significant motor oil in an area. Worms exposed to fertilizer showed clear, thin digestive tracts, visibly disintegrating bodies, and they tried to escape the polluted bedding. Over fertilizing, then, would cause high fatality in the worm population or migration from otherwise suitable environments. In the sodium chlorite exposed worms, eggs were abnormally clear and the worms systematically moved the paper litter that had absorbed the pollutant to the top of the container. Similar behavior in a natural environment might result in polluted litter found in concentration at the surface. Dissections of worms exposed to BPA showed abnormal, perhaps mutated, reproductive organs and they had lysed eggs. BPA is known to affect reproduction in some organisms and may also affect the fetal development of the worms; it appears worms may be used as an indicator of this pollutant.

Awards won at the 2011 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2011 - EV322

THE WAY OF CO2 STORAGE USING FORMATION OF CARBONATE MINERALS BY ABORIGINAL MICROBES

Doyeon Baek, WoongUi Hwang,
Cheonnam Science Highschool, Naju, Cheonnam, SOUTH KOREA

As the global warming is getting worse, we need to do something. Now, the method of disposal carbon dioxide is well researched and is now the process of can be waiting So, we get the idea of reducing the carbon dioxide which is the most worse factor that can accelerate global warming. In our research, we used the antioxide microorganism to make carbonate mineral. As using microbes to make carbonate mineral and storing carbon dioxide as carbonate mineral can be most efficient way to store carbonate mineral. Since, the carbonate mineral exist as solid, it won't be resolve back to air. We used akaganeite which is valance-3 iron, and manganese dioxide. We used glucose, and lactate as electorn acceptor. We used SEM, TEM, XRD to find out what minerals have made, and how much the mineral made. Akaganeite becomes siderite. Manganese dioxed becomes rhodochrosite. We finally got the conclusion that the electron acceptor does not give much to the result. To use electron donor may significantly related to the result of our research. We used 64 media to make sure that we made. It was most effecient to make carbonate mineral in the condition that the ejection time 2minuite. The existing CO2 treatment methods may damage the ecosystem since the captured CO2 can leak out due to crustal movements of the earth.

 Enhance the stability of microbes by analyzing the material balance for formation process of carbonate minerals and by understanding the biochemical mechanism clearly. In the future, study and analyze accurately the effect of the quantity of microbes on the amount of captured CO2 and the production of carbonate minerals, and understand accurately the efficiency of factors affecting inhibition of global warming. And then search for a plan to utilize this information.

Awards won at the 2011 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2011 - EV323

MIMICKING WETTING BEHAVIOR OF SPIDER SILK: STUDIES ON WATER-HARVESTING EFFICIENCY ACCORDING TO THE FABRICATION OF THE PATTERN OF WETTABILITY GRADIENT

Dongju Shin, Jinyoung Seo,

Korea Science Academy of KAIST, Busan, Busan, SOUTH KOREA

Among the attempts to relieve water shortage, intriguing but less studied one is fog harvesting, the method to harvest water from air. Fog harvesting can be an innovative solution to water shortage because it provides clean water ceaselessly without filtering process and power supply. However, because of its inefficiency, fog harvesting could not be used in many areas under water stress. Thus, the search for a new approach to improve its efficiency was desirable. In a wettability gradient surface, droplets spontaneously move toward hydrophilic region. Recently it was discovered that spider silk is composed of many nodes, and each node has a pattern of wettability gradient. Thus, the water droplets on the spider silk move towards the center of each node and coalesce into bigger ones. At the beginning, we supposed that spider silk's ability to directionally collect water would be able to improve fog harvesting. However, not only the method to mimic spider silk had not been studied, but also the effects of spider silk's directional droplet transportation on water-harvesting efficiency had not been verified. In order to mimic spider silk, we suggested a novel method using controlled vapor diffusion and self-assembled monolayer (SAM). A wettability gradient was generated by the method, and verified by surface chemical reaction and droplet movement analysis. Wetting behavior of spider silk was successfully mimicked on surface by this method. And, we figured out that water-harvesting efficiency of the surface mimicking spider silk was 7 times higher than current method. Furthermore, we designed an new concept of water-harvesting device inspired by spider silk. By this research, fog harvesting will be used widely, and thus save people under water shortage.

Awards won at the 2011 ISEF

Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by Intel

Second Award of \$3,000 - King Abdul-Aziz & his Companions Foundation for Giftedness and Creativity

The SIYSS is a multi-disciplinary seminar highlighting some of the most remarkable achievements by young scientists from around the world. The students have the opportunity to visit scientific institutes, attend the Nobel lectures and press conferences, learn more about Sweden and experience the extravagance of the Nobel festivities. Valid passport required for travel. - Dudley R. Herschbach SIYSS Award

2011 - EV324

EVALUATION OF THE CACHAZA IN THE IMPROVEMENT OF THE SOIL AND IN THE PHENOLOGY OF THE PLANT OF BEAN

Cesar Landeros, Hector David Ayala Beltran,

Unidad Academica Preparatoria Vladimir Ilich Lenin, Eldorado, SINALOA, MEXICO

chaza is a secondary product of the juice clarification process in the elaboration of raw sugar for its physical, chemical, phsicochemical, and microb iological properties. Diverse sources say that the cachaza is a good product for its kindness in the improvement of soil and development of crops. The purpos e of this investigation is to evaluate the effect of different concentration of cachaza on soil, in its physical, chemical and microbiological properties and the phenol ogical development of one variety of bean. An experiment was realized in pots using regional soil planted with bean and seven treatments where establ ished with different levels of cachaza, using revant methods, such as: phenology of the plant (height, dry, wet, weight root volume, root weight and force) physic al and physicochemical(bulk density, ph, porosity electrical conductivity, color and permeability), chemical(organic matter, major elements and trace elemen ts) and microbiological(cfu/g of soil microorganisms)of soil.The results indicate that the application of cachaza increased the dry weight and the force of the plant, as well as the porosity of soils and infiltration capacity; good levels of oraganic matters, nitrogen , phosphorus, sulfur, potassium, calcium, magnesium, minor elements, low levels of sodium and high capacity cationic exchange. The microbial population(bacterias, fungi and actinomycetes) demonstrated the highest level in all treatments, highlighting where the treatment was applied by itself, concludes that the cachaza alone or combined improves the properties of soils and positive effects emerge on the plants.

2011 - EV325

AN ECOLOGICAL INDICATOR: HARMFUL ALGAL BLOOMS AND MONITORING OF THEM BY MOLECULAR METHODS

Dilruba Reyyan Kilic, Berivan Karatas,

Private Fatih Science High School, Istanbul, Marmara, TURKEY

The excessive reproduction of micro-algae that is expressed as "Harmful Algal Blooms" (HAB) has a multifaceted effect on the ecosystem. Some micro-algae species try to eliminate the other species that they compete with through their toxic secretions. Zooplankton that consume micro-algae, which are also called phytoplankton, shelled sea creatures, fish and humans become exposed to and accumulate those toxic materials in the food chain.

The micro-algae that reproduce excessively in the ecosystem are observed carefully by taking all of the harmful effects into consideration. Those observations that are carried out for researches are usually done through conventional methods and morphological examinations.

In our research, we aim to determine the species and observe micro-algae species through molecular methods.

First, the determination of species of the micro-algae samples obtained in different periods of reproduction were made morphologically. The DNAs were amplified by using the taxon and primaries of those species, whose isolation and DNA concentration had been carried out, through PCR method.

The DNA data of the morphologically determined species belonging to the cultured forms were compared with the DNA data of our samples. Taxon and species determinations were made by using genetic data. In addition, analyses related to intraspecific genetic variation were carried out.

The molecular determination procedure related to Prorocentrum minimum and Skeletonema costatum species, which reproduced excessively in the Marmara Sea, were made by using the genetic data that were obtained.

2011 - EV326

THE EFFECTS OF ENVIRONMENTAL TOBACCO SMOKE (ETS) ON THE SEED GERMINATION, ROOT GROWTH AND ROOT TIP CELL MITOTIC DIVISIONS OF LENTIL (LENS CULINARIS) USING A NARGILEH MODEL

Zehra Fatmatuz Karakus, Beyza Akin,
Beylikduzu Azem Yukseloglu Anatolian Imam hatip High School, Istanbul, Istanbul, TURKEY

In this study, the effects of Environmental Tobacco Smoke (ETS), one of the most serious closed area pollutant, on Lentil (Lens culinaris) seed germination, root growth and mitotic division of root tip cells (Lens culinaris) are investigated. In the experiments, nargileh water required for 1, 2, 3, 4, 5, 6, 7 and 8 times of nargileh smoking was used. The nargileh which is a water pipe for is smoking tobacco and is a source of ETS was used as the model. In plant growth, however, when compared to the control group, a growth promoting result was recorded in the root growth of the group which received water required for 1, 2, 3, 4 and 5 times of nargileh smoking and a growth preventing result in the group which receive water required for 6, 7 and 8 times of nargileh smoking. It was determined that there was no particular difference in the seed germination when compared with the control group. However, germination was observed to be completed in a longer period of time in the group which received water required for 6, 7 and 8 times of nargileh smoking. The most important result is the difference in growth between Nargileh Water group for 8 smoking and the control group. While Nargileh Water groups for 8 smoking showed a growth of 0 mm, the control group showed a growth of 8.95 mm. While a growth increasing effect was determined in root growth of Nargileh Water for 1, 2, 3, 4 and 5 smoking, a growth preventing result was observed in Nargileh Water group for 6, 7 and 8 smoking. In the cell division mitotic index calculations in the groups that were irrigated with trial waters of ETS, 72% mitotic division was observed in the control group, while 68% and 36% mitotic division was observed in the groups which received water required for 6 and 8 times of nargileh smoking.

2012 - EV001

BLACK IS THE NEW GREEN, PHASE II: A FIELD TRIAL OF THE EFFECTS OF BIOCHAR ON SOIL NUTRIENTS, SOIL MICROORGANISMS, SOIL PH, AND THE GROWTH OF GLYCINE MAX

Abby Fitzgerald Anderson
Cloquet Senior High School, Cloquet, MN

Biochar is a soil additive produced by the pyrolysis of wood. Many of the benefits of biochar have been documented, but many additional questions remain including: What effect does biochar have on soil nutrients, soil pH, soil microorganisms, and the growth of Glycine max. The hypotheses tested were: If biochar has an effect on soil nutrients, soil pH, soil microorganisms, and the growth of Glycine max (soybeans), then soil with added biochar will: retain higher levels of nutrients; neutralize pH; produce more soil microorganisms; and produce soybean plants that germinate faster, grow taller, contain more chlorophyll, and have a greater mass of Rhizobium nodules than soil without added biochar.

To test the hypotheses, two 2m x 4m plots were created - one with biochar applied at the rate of 5kg/m2 and one without. Soil samples were taken from each to analyze the soil nutrients. Two hundred soybean seeds were planted in each plot and after 60 days of growth, final plant heights, chlorophyll concentrations, growth rates, germination rates, and nodule weights were recorded. Plant heights, chlorophyll concentrations, growth and germination rates were all significantly different with p values < .05. Nodule weights were not significantly different. Soil extractions were serially diluted and streaked onto nutrient agar plates and incubated at 37 C for 12 hours. The number of colony forming units was analyzed for statistical significance using an ANOVA test. There was not a significant difference in bacterial growth.

2012 - EV002

THE USE OF FLUORESCIN AND RHODAMINE DYES TO LOOK AT PHOTODEGRADATION IN STREAMS AND PHOTODEGRADATION RATES OF CAFFEINE, A POTENTIAL WASTEWATER MARKER

Bethany Judith Rosemore
Cloquet Senior High School, Cloquet, MN

Little is known on the amount of sunlight that affects a lotic system. By comparing the ratio of Fluorescein to Rhodamine WT dyes, this can be tracked and applied to other compounds such as caffeine, a potential wastewater marker. This project looks at the photodegradation in streams using Fluorescein and Rhodamine WT dyes, where caffeine could possibly exist and also looks at the photodegradation rates of caffeine. The hypothesis' are if fluorescein and rhodamine dyes are used then photodegradation in streams can be tracked. Also, if the photodegradation of caffeine is analyzed then there will be no degradation seen and thus able to be used as a potential wastewater marker. To determine the photodegradation occurring in streams, the ratio of two dyes, Fluorescein (photodegradable) and Rhodamine WT (photostable), was measured in a stream using a fluorometer. Samples were taken and irradiated with different band-pass filters (345, 360, 400, 420 nanometers (nm)). This was replicated for the 0.5 milligram per liter (mg/L) solution of caffeine. Thereafter, to observe the photodegradation of caffeine, 0.1, 0.25, and 0.5 mg/L were mixed and later irradiated in 500 ml quartz round-bottom flasks. Samples were taken during irradiation. T3. These samples taken were then later run through a HPLC column and then a UV-Vis. It was found that the dyes degraded on the sunny day with a low flow, but when irradiated there was no difference in the amount of degradation when comparing the different filters. Also, when irradiating caffeine, no degradation occurred.

Awards won at the 2012 ISEF

Second Award of \$350 - Society for Freshwater Science

2012 - EV003

"LEAF" PARTICLE BOARD BEHIND

Chandler David Holliman
Bartlesville High School - East Campus, Bartlesville, OK

My project is combining different leaf structures with Polylactide resin to form 4" square plaques. The goal of the project is to find a completely renewable alternative to particle board. The plaques are compression molded and then impact tested. Polylactide resin is corn based plastic that is completely renewable. I am using three different leaf structures including ground with a blender, shredded with a paper shredder, and mulched by hand. The leaves were in concentration of 40 and 80% by volume in the mixtures. My goal was to examine the different impact strengths of leaf structures and Polylactide resin, against traditional building materials like plywood, medium density fibreboard (MDF) and sheetrock. The 100% Polylactide resin had the most impact strength, but was brittle and unusable for the applications I sought to replicate. The 80% shredded leaf mixture performed the best out of any of the leaf mixtures from an impact standpoint but was brittle. There were two ductile failures in the group of leaf mixtures, and this made them stand out because they had potential for use with these applications. The 40 and 80% ground mixtures had the best impact ratings, while being ductile. This means that they were the best performers. The 40% ground mixture closely resembled the MDF and was also ductile, so I consider it the most closely related performer to any of the controls. Looking at the practical uses of the leaf-Polylactide resin mixture, MDF applications might be the best fit for the leaf mixtures.

2012 - EV004

CALCIUM: A POSSIBLE ACTIVE COMPONENT IN CACTI MUCILAGE FOR PHOSPHATE REMOVAL

Kirstie Rae Tandberg

Chain of Lakes Collegiate High School at Polk State College, Winter Haven, FL

In this experiment, a possible active component of mucilage in phosphate removal was investigated. Calcium, in the form of calcium chloride, was the assumed active component. The expected outcome was that phosphate reduction would increase as the amount of added calcium increased. Calcium was added to cacti mucilage so its effect on the mucilage's ability to reduce phosphate levels could be determined. Cacti mucilage containing 0% (for the control), 10%, 20%, and 30% added calcium was added to four different beakers filled with water containing one part per million phosphate. After 30 minutes, the phosphate levels of each breaker were tested and recorded.

The data showed that the hypothesis was proven correct. The group with 30% added calcium reduced 73.5% of the phosphate compared to the 40% removed by primary and secondary wastewater treatment plants. In conclusion, this treatment was very effective. By raising the calcium content of mucilage, phosphate reduction is increased.

2012 - EV005

BIOREMEDIATION OF OIL-CONTAMINATED WATER: IMPROVED DELIVERY MECHANISMS, SALINE IMPACTS AND SOIL INTERACTIONS

Jessica Fay Hunt

Greybull High School, Greybull, WY

This experimentation is a second year analysis which investigates utilizing a unique mesophilic species, collected from local geothermal hot springs, Thermopolis Wy, as a catalyst in oil degradation. Experimentation was conducted considering environmental factors such as salinity (freshwater vs salt water) and current. The addition of absorptive clays such as Zeolite and bentonite was also considered to increase effectiveness. Soil chemistry was also investigated for this year's analysis. In order to assess delivery mechanism improvements, spectrophotometry occurred at two different settings in order to compare oil breakdown and bacterial growth, and GC/MS was used to determine what compounds were created through oil decomposition. This continuing development may yield a more innovative technique for oil spill cleanup which would transcend the bioremediation methods of today.

It was hypothesized that the mesophilic bacteria collected from a local thermal feature; Thermopolis Hot Springs, would remain the most effective in the breakdown of oil and could be utilized as an alternate method for oil cleanup procedures; The effectiveness of breakdown would increase when adhered to the complex surface of clays; Mesophilic species would give off some form of combustible material through the breakdown process. In addition it was hypothesized that, over a period of time, the mesophilic species would break down oil within soil samples re-establishing requirements for plant growth.

Based on analysis of experimentation, mesophiles collected from Thermopolis can be considered highly effective in the bioremediation of oil as they held the average lowest percentage of transmission in the spectrophotometer. This means these cultures experienced more growth and breakdown, the byproducts of which would block more light from reaching the photometer of the spectrophotometer, resulting in lower transition levels. Increased growth is a sign of the bacteria thriving off of, and decomposing oil components. Analysis with GC/MS yielded many different hydrocarbons, which are potentially combustible under the proper conditions. There are still many other factors that need to, and will be considered in this experimentation.

Awards won at the 2012 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2012 - EV006

AN EXPERIMENTAL STUDY OF THE IMPACT OF TARGET VOLATILE ORGANIC COMPOUND (VOC) EMISSIONS ON LUNG HEALTH PLUS A NOVEL RISK ASSESSMENT MODEL TO PREDICT THEIR EFFECT ON THE PEAK EXPIRATORY FLOW RATE (PEFR); AND THE DEVELOPMENT OF A NEW VOC ADSORPTION FILTER

Naomi Chetan Shah

Sunset High School, Portland, OR

1.5 million deaths are attributable to indoor air pollution (IAP) annually (WHO, 2010). This three-phase study shows promise as a next generation cost-effective and sustainable solution for

targeted remediation and IAP filtration to improve environmental safety, mitigate lung disorders, reduce mortality and health-care costs.

After experimentation in the field and laboratory (Phase 1), a novel PEFR mathematical model (Phase 2) and a new filter to adsorb indoor VOCs were developed (Phase 3). The PEFR model utilizes over 4 million air quality readings from indoor environments and 112 air samples from test chambers to quantify the impact of each target VOC on the PEFR. Twenty eight test chambers, containing common building materials, were independently constructed and maintained in a

controlled environment. The model uniquely quantifies the effect of the most harmful VOCs identified

using gas chromatography and mass spectrometry, including Methylene Chloride, 1,2-Dichloroethane, Xylene, Styrene, and Ethyl Benzene, on PEFR.

The results are statistically significant. This project's original approach enables medical practitioners to utilize the PEFR model to attribute any degradation in lung health to pathophysiological and environmental factors. After deploying the novel VOC biofilter, which

incorporated pollutant-degrading microorganisms, the TVOC, Styrene, Toulene, and Xylene, levels declined by about 44%, 19%, 29% and 33% respectively.

Future work must focus on quantifying the effect of other harmful VOCs, optimizing the design of the VOC filter for cost and maintenance, and developing a smart thermostat that monitors both

HVAC functions and IAP levels in real time.

Awards won at the 2012 ISEF

- First Award of \$2,500 - Duquesne University Bayer School of Natural and Environmental Sciences
- Scholarship Award of \$15,000 per year, renewable annually - Florida Institute of Technology
- Trip to the EU Contest. - European Union Contest for Young Scientists
- Intel ISEF Best of Category Award of \$5,000 for Top First Place Winner - Environmental Sciences - Presented by Intel
- Third Award of \$1000 - National Aeronautics and Space Administration
- Award of three \$1,000 U.S. Savings Bonds, a certificate of achievement and a gold medallion. - United States Army

2012 - EV007

DESIGN AND FABRICATION OF FLUORESCENT SILICA NANOPARTICLE BASED PROBES FOR POTENTIAL DETECTION OF TOXIC HEAVY METAL IONS IN CONTAMINATED DRINKING WATER

Rikhav Shah
Lake Highland Preparatory School, Orlando, FL

The objective of this research is to design and fabricate nanotechnology-enabled optical based sensor probe for detecting toxic heavy metal contaminants (HMCs) in drinking water. If successful, this probe can reliably and rapidly detect HMCs in water, specifically disaster affected water bodies. One of the critical components of the sensor probe is the optical based signal transducer. In the present design, a metallorganic fluorescent dye, Tris(2,2'-bipyridyl)ruthenium(II) dichloride (RuBpy) embedded within a silica nanoparticle (~80 nm size) will serve as signal transducer. The idea is that fluorescence of RuBpy will be quenched when the RuBpy loaded silica nanoparticle (RuSiNP) will interact with heavy metal ions in water. This quenching mechanism is known as heavy-metal induced fluorescence quenching. Using a Stober sol-gel method, RuSiNPs were synthesized which involved base catalyzed hydrolysis and condensation reaction of tetraethylorthosilicate in ethanol-water mixture containing RuBpy dyes. The RuSiNPs were characterized by UV-Vis and fluorescence spectroscopic techniques. Preliminary results demonstrated that fluorescence intensity of RuSiNP was decreased linearly with the increase of copper ion concentration. We will present details of the RuSiNP synthesis and optical characterization data. Future studies would include (i) optimization of RuBPY dye loading within the silica nanoparticles, (ii) quantification of quenching efficiency against Cu ions and (iii) determination of quenching efficiency with other toxic heavy metal ions such as lead, mercury and arsenic ions.

Awards won at the 2012 ISEF

- Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2012 - EV008

FROSTY AIR: HOW AIR TEMPERATURE AFFECTS SOIL FROST DEPTH

Alisha Ruth Mosloff
Lincoln High School, Thief River Falls, MN

Information is needed about frost depth in order to accurately predict how much flooding will occur when spring melt occurs because water can not infiltrate frozen soils. However, without soil water infiltration, the water will become ground water and contribute to flooding.

The purpose of this experiment was to determine how air temperature affects soil frost depth. I hypothesized that as air temperature increased one degree, soil frost depth would increase by one half centimeter.

Frost tubes were set up in order to collect the data, remove the insulated cap, pull out the frost tube, and measure to where the green dye turns clear from the bottom of the hex nut in millimeters. Replace both the frost tube and insulation cap and repeat at the second site.

After collecting data everyday for two weeks and weekly for ten weeks I rejected my hypothesis. I found that while there was a correlation between the air temperature and the frost depth, it was not at the 1 degree to ½ centimeter ratio that I had predicted. I believe this could have been caused by different soil compositions in each site.

Awards won at the 2012 ISEF

- Certificate of Honorable Mention - American Meteorological Society

2012 - EV009

DETERMINATION OF RAYLEIGH SCATTERING MEASUREMENTS FOR GLOBAL WARMING COUNTERACTING ATMOSPHERIC AEROSOLS R-14, HFC-125, HFC-216, HFC-227EA AND HALOCARBON C-318

Serena Zadoo
L.C. Anderson High School, Austin, TX

Anthropogenic atmospheric aerosols, suspensions of minute particles, exhibit optical properties that can have direct (albedo) effects on the global radiation balance. An instrument that can quantify light-scattering is the nephelometer, which must be calibrated to certain gases for proper use. The incorporation of environmentally acceptable gases (low global warming potentials, non ozone-depleting substances & small atmospheric lifetimes) for the calibration of

integrating nephelometers is encouraged. In this investigation, the Rayleigh scattering coefficients (bRS, Mm-1), scattering cross sections (RS, cm2) & Rayleigh multipliers for tetrafluoromethane (R-14), sulfur hexafluoride, pentafluoroethane (HFC-125), hexafluoropropene (HFC-216), 1,1,1,2,3,3,3-heptafluoropropane (HFC-227ea) & octafluorocyclobutane (C-318) are reported from measurements made using a Radiance Research M903 integrating nephelometer operating at = 530 nm & calibration with gases of known scattering constants. Rayleigh multipliers (\pm 90% conf. int.) were found to be 2.6 ± 0.5 , 6.60 ± 0.07 , 7.5 ± 1 , 14.8 ± 0.9 , 15.6 ± 0.5 & 22.3 ± 0.8 times that of air, respectively. Experimental accuracy is supported through measurements of values for SF6 & HFC-227ea which agree to within 3% of previous literature reports. In addition to documenting fundamental Rayleigh scattering data for the first time for R-14, HFC-216, HFC-125 & C-318, the information presented will find use for calibration of optical scattering sensors such as integrating nephelometers. This data is practically useful for the calibration of nephelometers in urban locations since large aerosol scattering coefficients are encountered. Future investigations could examine more environmentally friendly calibration gases, such as HFEs or HFOs.

Awards won at the 2012 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel
Award of Merit of \$1,000 - Society of Exploration Geophysicists

2012 - EV010

MYCOREMEDIATION: USING PLEUROTUS OSTREATUS MYCELIUM TO REMOVE PETROLEUM HYDROCARBONS FROM FRESHWATER AND SALTWATER ENVIRONMENTS

Devon M. Enke

La Veta Junior-Senior High School, La Veta, CO

If forests are planet Earth's lungs, then water is certainly planet Earth's blood. Sadly, petroleum based pollutants are poisoning our planet's waters, our planet's life blood every day. Even small amounts of petroleum can harm aquatic life. The impact of regular petroleum pollution combined with oil spills is devastating. Current cleanup methods are generally ineffective and are often hazardous. This project was designed to determine if Pleurotus ostreatus mycelium could collect petroleum hydrocarbons from saltwater and freshwater environments.

Six tubs were filled with freshwater and motor oil, and six tubs were filled with saltwater and motor oil. These were divided into two groups, Pleurotus ostreatus (PO) and Control. A PO colonized strawblock was floated in each PO tub. An uncolonized strawblock was floated in each Control tub. Mycelial health, water and oil levels were monitored for 63 days. Water and mycelium samples were run through a mass-spectrometer for elemental data.

Strawblock Oil Uptake Results:

13% in Freshwater Control, 10% in Saltwater Control

73% in PO Freshwater, 83% in PO Saltwater

Water evaporated 3X faster in PO Group making a more hospitable underwater environment. The mycelium thrived. Mycelium produced fruiting bodies in the PO Saltwater Group. Elemental mass-spectrometer data is pending.

These results show that PO mycelium can collect petroleum hydrocarbons from saltwater and freshwater environments without causing further environmental harm. I believe Mycoremediation will help solve many environmental challenges. Being open to new, creative solutions can help us jump far ahead in restoring and maintaining the health of the planet.

Awards won at the 2012 ISEF

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2012 - EV011

A NOVEL STUDY OF THE EFFECTS OF CAFFEINE AND ESTRONE ON THE REPRODUCTION OF THE LYTECHINUS VARIEGATUS, SEA URCHIN

Michael Alexander Kaiser

St. Edwards' School, Vero Beach, FL

Associated with land development and increasing human populations, pharmaceuticals have become more abundant in our water supply. It is important to understand how these chemicals affect aquatic ecosystems. Few studies conducted have demonstrated the impact of these pollutants on the marine life in the waters off of South Florida. Inadequately treated sewage may enter marine habitats. Previous research has examined the occurrence and distribution of steroids, hormones, and pharmaceuticals off the coast of South Florida. Hormones, such as estrone and 17 Beta-estradiol, as well as the insect repellent DEET, have been shown to be prevalent. In addition to these substances, caffeine was observed in relatively high concentrations when compared with other compounds (Singh, et al, 2009). Whether the compounds have a significant impact on marine invertebrates is a question that has not been investigated.

In this novel study, the effects of caffeine and estrone on the fertilization and larval survivorship of the Lytechinus variegatus sea urchin were examined. Three concentrations of both caffeine (15, 30, 60ng/L) and estrone (1, 2.5, 5 ng/L) were tested individually on sea urchin fertilization and larval viability to determine the effects of these agents. After experimentation, each cross was compared to a control group. The results indicated estrone and caffeine had no significant effect on fertilization or larval survivorship. While several variables, such as polyspermy and incompatibility, could account for this, the underlying conclusion is that these two agents did not impact fertilization and larval survivorship.

2012 - EV013

NON-POINT VS. POINT-SOURCE POLLUTION: WATER QUALITY ASSESSMENT OF THE VERMILION RIVER WITH VARIOUS CLIMATE CONDITIONS

Gina Gabrielle Biddick

Ovey Comeaux High School, Lafayette, LA

The Vermilion River is one of the most polluted rivers in Louisiana. There are two types of pollution: point-source and non-point. Point-source is traceable, while non-point cannot be traced to a particular source. This study consists of 5 sites and 4 collections. Collections 1 and 4 were taken after a week of rain, and Collections 2 and 3 after a week of no rain. Sites 1 and 2 are before the water treatment plant, the plant is Site 3, and Sites 4 and 5 are downriver from the plant, each 0.5 miles apart measured by GPS. The purpose of the experiment is to discern the source of pollution. At the sites, the parameters of dissolved

oxygen, temperature, turbidity, salinity, TDS, pH, and salinity were measured. In the lab, the water was tested for nitrates, phosphates, TSS, coliform, and E. coli. The results showed correlation between the plant and levels of pH, turbidity, conductivity, salinity, TDS, nitrates, and phosphates. The results also considered the amount of rainfall. After a week of rain, the levels of pH and dissolved oxygen increased. It is concluded that a majority of the pollution factors measured were point source, although the E. coli, coliform, and TSS were non-point. In addition, the weather played a major role in both the amount of pollution in the water and the location of the pollution.

Awards won at the 2012 ISEF

Full tuition scholarship - Drexel University

2012 - EV014

POINT SOURCE OF POLLUTION FOR SUNDANCE CREEK

Antonio Joseph Morsette

Box Elder High School, Box Elder, MT

Sundance Creek was studied for the presence of E coli/coliform pollution. Five sites were studied for the concentration of nitrate (ppm) in water samples, dissolved oxygen (ppm) in water samples, water alkalinity, E coli/coliform presence, and E coli/coliform colony counts. It was hypothesized that the point of pollution for Sundance Creek is the business of local market's septic system, as the septic system is buried uphill from the stream. Results indicated that the local business cannot be definitively proven to be the sole point source of pollution for Sundance Creek. Results showed that downstream from the local business, E coli/ coliform counts were the highest of the five sites, indicating that the local business may have a part to play in polluting Sundance Creek. Further study is needed to identify other points of pollution to Sundance Creek, because E coli/coliform counts were found upstream from the local business, indicating that there is a second source of pollution.

2012 - EV015

EFFECTS OF MULTICELLULAR CHLOROPHYTA ON THE MICROCYSTIN

Xu Zhang

Sichuan Emei No.2 High School, Emeishan City, Sichuan Province, CHINA

The microcystin is a kind of hepatotoxins generated by cyanobacteria, with exceptional solubility, heat tolerance and potential carcinogenicity. The water bloom with the microcystin is the most harmful one in fresh water. On the basis of the reciprocal inhibition of algae and the characteristics and generation mechanism of the microcystin, the effects of multicellular chlorophyta on the microcystin and the significance of these effects were explored for the purpose of controlling the hazards of the microcystin. In the co-culture experiment of multicellular chlorophyta and cyanobacteria and the cyanobacteria culture experiment under chlorophyta extract, Spirogyra sp., Hydrodictyon sp. and Microcystis aeruginosa were used as the representative strains of multicellular chlorophyta and cyanobacteria. The results show that the concentration of the microcystin and the amount of cyanobacteria decreased evidently as a consequence of multicellular chlorophyta. The project conclude that: multicellular chlorophyta can wipe off the microcystin significantly, and the mechanism may be like that: 1) the multicellular chlorophyta can inhibit the growth and reproduction of cyanobacteria through nutrient competition, allelopathy and the effect of symbiotic microorganisms, especially the control over the sedimentation mechanism of cyanobacteria; 2) they can restrict the synthesis of the microcystin and facilitate the degradation of the microcystin. The research suggests that multicellular chlorophyta have some application prospects in the biological control over the microcystin.

2012 - EV016

MOLECULE SORTING AND HIGHLY SELECTIVE METHANE DETECTOR

Zhendong Lei

The High School Attached to Shanghai Normal University, Shanghai, CHINA

I could never forget when I was young, my mother and I were almost killed during an incident of gas poisoning. That's why I always keep an eye on gas safety. The detection and early warning of hazardous gases is an important research subject in environmental science and technology. Inspired by fruit sorting based on size distribution in fruit processing plants, this work proposes a new approach in molecule detection, which can selectively detect methane based on molecular size sorting. In an optimized design, tin tetrachloride is infiltrated into an alumina template with nano-sized channels and transformed into tin dioxide after heat treatment. The tin dioxide-impregnated template is then placed in a tubular furnace and heated in the presence of an acetylene stream. Acetylene is pyrolyzed in the nano-sized channels, formed carbon nanotubes enclosing the tin dioxide particles. The template is then immersed into sodium hydroxide solution to dissolve alumina and liberate tin dioxide-filled carbon nanotubes. Finally, the nanotubes are fabricated into gas sensors by regular thick film techniques and aged for several days to improve their stability. Sensors were manufactured by these procedures and tested for sensitivities to methane and various components of cooking smoke. Results indicated that the tin dioxide-carbon nanotubes composite sensing material enhanced the selectivity and sensitivity of methane detection. Compared with commercial sensors, the relative response of methane to dimethyl nitrosamine was from 1.4 up to 16.1, to methylnaphthalene was from 2.6 up to 12.1, and to benzopyrene was from 1.3 up to 18.0.

Awards won at the 2012 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2012 - EV017

THE EFFECT OF CYANIDE POLLUTION DUE TO SLIMES DAMS ON PLANT GROWTH

Ntuthuko Winston Mthabela
Harmony High school, Virginia, Free State, SOUTH AFRICA

Purpose

This project is a contextual study of the environmental deterrent posed by cyanide to plant growth in the Goldfields area of Virginia in the Free State of South Africa.

Procedure

Organised sampling of the soil (radially, at, specific distance interval) was used establish a model of cyanide contamination in the environment surrounding the slime dams. Plants (radish) were grown in soil samples and later chemically tested for cyanide.

Data

Fundamentally, data indicated trends on cyanide concentrations in soil (area around slimes dam) relative to the slimes dam and relevant variables. Tests using the Prussian blue test showed that cyanide concentration in the soil is inversely proportional to the distance from the slimes dam.

Conclusion

Analysis of plant growth rate in the area showed cyanide concentration blow-off, run-off and ground water are significant to the retardation of plant growth. The results of floristic survey and legislative study are also presented.

2012 - EV018
UBIQUITOUS ENVIRONMENTAL POLLUTANT ACROLEIN (C3H4O) ENHANCES THE ANTI-HIV THERAPY MEDIATED LIVER TOXICITY

Sanal Dinar Gupte
duPont Manual High School, Louisville, KY

PURPOSE: The project was aimed at examining the potential detrimental effects of the ubiquitous environmental pollutant, acrolein, on hepatotoxicity that could occur in response to HIV medication. The clinical asset of this project is the evaluation of the potential impact of a negative living environment (exposure to acrolein) on the hepatotoxic effects associated with HIV medication leading to significant liver injury and mortality.

HYPOTHESIS: The exposure of hepatocytes to the ubiquitous environmental pollutant acrolein will exacerbate the hepatotoxicity occurring in response to the anti-HIV therapeutic- azidothymidine (AZT).

PROCEDURE: To investigate the effects of acrolein and AZT on hepatocyte injury and cell death, we used a well characterized human hepatoma cell line (HepG2) model. HepG2 cells were treated with acrolein (12.5-50µM) and AZT (250-500µM) alone or in combination for 24hr. The hepatocyte injury and death was assessed using MTT assay, JC-1 staining, DNA fragmentation analysis, RT-PCR and Western Blot analysis.

RESULTS: Acrolein or AZT by itself had minimal to no effect on hepatocyte survival. However, combination of acrolein and AZT was observed to significantly induce hepatocyte injury and death as shown by the MTT assay and an increase in DNA fragmentation. Examination of the mechanisms demonstrated that cell death occurred due to induction of the apoptotic cascade as seen by increased mitochondrial depolarization (JC-1 staining). Additionally, the results also showed that acrolein and AZT up-regulated the gene expression of the key death/apoptosis inducing Fas ligand (FasL) and a critical inflammatory cytokine IL-8.

CONCLUSION: The data suggests that exposure to the ubiquitous environmental pollutant acrolein can potentially exacerbate the AZT induced hepatocyte injury/death leading to hepatotoxicity with detrimental effects on the treatment outcomes in HIV patients.

2012 - EV019
WHAT WILL GROW: MINING RECLAMATION-ESTABLISHING PLANT LIFE ON ABANDONED MINE SITE WASTE FIELDS, II

Serina Lee Pack
Cliff High School, Cliff, NM

PURPOSE: To determine possible native grasses that would grow on abandoned mine-waste fields in Grant County, NM, with the hypothesis being that potentially there are native grasses that could be successfully introduced, without having the costs associated with soil reconditioning. Long term goal is to restore lost rangeland in an economical manner with palatable, native vegetation while improving the watershed and functional condition of the land by improving the watershed's hydrological, biotic and ecological processes.

PROCEDURE:

--Thorough review of literature and interviews was conducted, followed by an extensive ecological site assessment and soil analysis completed on the abandoned Rio Grande Mine that has two prevalent tailings (yellow and gray)

--Over sixty native grasses evaluated on a "critical-factor weighted-scale model"

--Selected six native grasses, introduced at mine-site with sixty test plots

--Additional research involved creation of a "coir bio-friendly matt" assisting with hydrophobic soil

RESULTS:

--Greish soil successful at growing Curley Mesquite, Sand Love Grass, Prairie Wild Rye, and Side Oats Grama

--Yellowish soil produced favorable live root-plug results for Prairie Wild Rye, Curley Mesquite and Side Oats Grama

--The coir matt is a viable topical soil treatment to assist the yellow soil situation

CONCLUSIONS: Results produced prospective grasses that grew in both types of tailings, especially for live-plugs. This could provide palatable vegetation for animals, assist in erosion control and reclamation in order to reduce the negative impact of mining.

Awards won at the 2012 ISEF
First Award of \$3,000 - Environmental Sciences - Presented by Intel

2012 - EV020
MACROINVERTEBRATE AND NUTRIENT RESPONSE TO STREAM WATER QUALITY AFTER A WILDFIRE IN MEDANO CREEK, GREAT SAND DUNES NATIONAL PARK & PRESERVE

Taylor Ann Rocha
Monte Vista High School, Monte Vista, CO

This study evaluated water quality and macroinvertebrate population differences on two affected sites and one control in the Medano Creek drainage after a wildfire. Methods followed River Watch protocols for all samples collected, except turbidity which was measured using a turbidimeter at the Bureau of Reclamation. It was found that dissolved oxygen was higher on the control, and pH, alkalinity metals and turbidity was higher on both burn sites compared to the control. Chloride, sulfate and phosphateswere all higher on the burn sites for May and November samples. During the July macroinvertebratecontrol sample, mayflies composed 71% and weighed 768.5 mg, whereas caddis and stoneflies combined at ~5% and ~190 mg of the population. Combined mayflies, caddisflies, and stoneflies on both of the burned sites were less than 50% of the total macroinvertebrates. Caddisflies were more numerous, had longer lengths,

and a higher biomass on the lower burn site compared to both the middle burn and control sites. For the July sample, there was more species diversity and greater numbers at the control compared to burned sites. During September samples collected after a flood event, all population numbers were lower, but particularly on the burned sites, with the control sample at 339 insects, and the burned sites at 19 and 14 respectively. Because of all the data collected from April through November, it can be concluded that wildfire does have an impact on water quality and macroinvertebrate populations especially after flood events which was predicted in the hypothesis.

Awards won at the 2012 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel
First Award of \$600 - Society for Freshwater Science

2012 - EV021
BIG BUSINESS ENVIRONMENTAL IMPACT: THE EFFECTS OF CHLORINATED SUGAR IN WATER

Lauren D. Walker
Mid Buchanan RV, Faucett, MO

ount of chlorinated sugar in our water systems has shown issues with breaking up. In the human body, the sucralose does not properly digest. Instead, it goes through without any absorption. Amounts of the artificial sweeteners are accumulating throughout the water system in our atmosphere. Nothing has been found that can cause the molecule to break apart. According to research, the "Splenda® debate" is becoming a hot topic. The purpose of this study was to determine if the sucralose molecules in the water system have an effect on exposed bioindicators. The heart rate of *Daphnia magna* was tested and the regeneration of *Dugesia tigrina*. The organisms were divided into four different testing groups. The first group was a control group which contained zero parts per million concentration of sucralose. The other three testing groups had 1ppm, 3 ppm and 5 ppm of the sucralose brand, Splenda®. The hypothesis stated that the daphnia would have a more stable heart rate in the control environment as compared to those in the concentrations and the planarian would have a better regeneration rate in the controlled environment. The initial results gave no indication that the chlorinated sugar had any large effects on the bioindicators. Therefore, it was decided to modify the concentration levels of Splenda®. The testing groups selected were 100 ppm, 300 ppm, and 500 ppm. The results indicated that the chlorinated sugar may affect water organisms differently. An observation was made that the daphnia were all dead within twenty four hours in the 300 and 500 ppm concentrations. This indicates that there is a limiting concentration of survival between 100 and 300 ppm. Surprisingly, the planarian organisms were different. The planarian in the control and 100 ppm were dead within forty eight hours, while the 300 and 500 ppm remained living. The study can be useful in studying the safety of water systems and showing the effects that a sucralose trend could have on the environment, as well as the organisms exposed. The effects found in this study should make one question the long term effects that humans will be faced with in the future if continual bioaccumulation occurs.

Awards won at the 2012 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2012 - EV022
THE EFFECT OF AIR PRESSURE AND AIR FLOW ON INFILTRATION: A BOX MODEL STUDY

Stephen Yao
University High School, Tucson, AZ

Air entrapment and associated air back pressure has been known to stop or slow down the infiltration and sometimes cause the infiltration to be unstable and flow down in limited paths, resulting in finger flow. However, how the air flow and air pressure underneath a soil affect soil infiltration is not particularly understood. A box model study was utilized to study the effect of air pressure as well as air flow on the rate of infiltration. In addition to the box model, an air flow controller and a Mariotte bottle were used for the experimental setup to control air flow and water flow, respectively. Furthermore, a data logger and pressure transducer were used and programmed to collect a pressure response during the experiment. The experiment found that a higher air flow corresponded with a higher back pressure, which ultimately decreased the infiltration rate. With a high air flow rate, the infiltration rate could effectively be reduced to zero. The application of Darcy flow to this experiment under low air flow condition was verified but failed under high air flow conditions. This study has possible real-world applications such as minimizing the spread of toxic chemicals from mines and landfills due to a high water column infiltrating through soil. High air flow and back pressure have the potential to be used to minimize water infiltration. Advancing our understanding of this can assist in developing an effective strategy to prevent the toxic seepage of contaminated water, especially into water reservoirs and wells.

2012 - EV023
"LIGHTS OUT": THE USE OF VIBRIO FISCHERI TO DETERMINE WATER QUALITY

Maislinn Pheobe Helfer
Palmer High School, Colorado Springs, CO

Bioassay is increasingly being incorporated into environmental monitoring programs in several countries based on research that has shown the bacterium *Vibrio fischeri*'s bioluminescence decreases in the presence of many common water contaminants. This study explored the effectiveness of *V. fischeri* as a bioluminescent indicator for determining water quality in the Fountain Creek Water Shed. *V. fischeri* were cultured in complete darkness in liquid photobacterium broth for 24 hours, at room temperature, using a water bath shaker. Water samples collected from several locations in the Fountain Creek Water Shed were then added to the bacteria. After 30 minutes light intensity was measured by rapidly stirring each sample for 60 seconds with a vortex mixer and then visually comparing them to control samples. The average of multiple trials was used to determine the effect of potential contaminants on bioluminescence. To verify the effectiveness of *V. fischeri*, all collected water samples were also tested with commercial water quality tests. An analysis of data

showed that *V. fischeri* bioluminescent levels did vary when testing the water quality in the Fountain Creek Water Shed area, however there was a low correlation to commercial water quality tests making it ineffective in determining overall water quality. However, changes in light intensity did show some consistency to changes in pH, hardness, total nitrites/nitrates, and the presence of other bacteria. The development of efficient testing protocols to improve the performance of *V. fischeri* will be needed before it can effectively improve protection of human health and the environment.

2012 - EV024

"IRONING" OUT GLOBAL WARMING

Mariah Suzanne Rendeiro
Granbury High School, Granbury, TX

Iron fertilization is the idea that if iron were to be spread across the oceans, phytoplankton growth would increase which would in turn decrease the levels of carbon dioxide in the atmosphere. The type of iron that will have the best effect however, is questionable. So, if three iron compounds are tested with one mole of iron in each, then the iron nitrate will be the most effective at carbon sequestration because the nitrates in the compound will benefit the phytoplankton as well.

Four aquariums were used in two different trials using iron oxide, iron nitrate, and iron chloride along with a control aquarium. The carbon dioxide levels were monitored for 2 weeks in each trial.

The iron nitrate was the most effective compound, as hypothesized. Following was the iron chloride and then the iron oxide with the control tank in last.

The hypothesis was proven correct because the nitrates are a key component in eutrophication, so it resulted in increased growth. However, the other two compound tanks did decrease as well. This experiment is applicable to the real world because it gives scientists evidence of which type of iron has the most profound effect on phytoplankton in the ocean.

2012 - EV025

ADVERSE EFFECTS OF MALATHION ON BRINE SHRIMP

Sarthak Garg
Little Rock Central High School, Little Rock, AR

Malathion is the most widely used organophosphorus insecticide in the United States. Once introduced into the ecosystem by the farmer, it travels up the food chain, affecting humans. *Artemia salina* is a commonly used bioindicator. Due to its wide use, *A. salina* were used in this study to evaluate the effects of malathion on morphology and proteins of brine shrimp. The shrimp were exposed to 140 ppm of malathion for 2, 4, 6, 8 and 24 hours showing a time-dependent decrease in proteins. The total body protein levels decreased from 1287.9 µg/ml in control, to 815.0 µg/ml in 24 h. The proteins had decreased by 36.7%. The proteins were separated by SDS-PAGE. In control, proteins between 49 and 64 kDa were highly expressed. Proteins from 115 to 82 kDa were more prominent in 2 h, 4 h, and 6 h treated groups. SEM studies showed that malathion deformed *A. salina*. Some shrimp had ruptures in their skin while others had deformed secondary antennae. Malathion is made of mainly phosphorous and oxygen. In elemental analyses, there was a constant time dependent increase of these 2 elements suggesting that malathion was accumulating in the shrimp. A significant decrease was noted in the total protein levels of brine shrimp exposed at 25 ppm after 3 days of exposure compared to control. Day 3 controls had an average protein of 70.69 µg/ml compared to 47.40 µg/ml in the 3 day treated group. If the bottom of the food chain is taken out, then humans, will be wiped out. We must watch how much pesticide we use.

2012 - EV026

ENHANCED ADSORPTION OF ARSENIC ON AQUIFER SOLIDS AND SOIL, PHASE II: OXIDATIVE TREATMENT AND FEASIBILITY ASSESSMENT

Jenna Reed Huling
Ada High School, Ada, OK

Arsenic (As) contamination in drinking water is an epidemic in many areas of the world, especially Eastern Asian countries. Developing affordable and efficient procedures to remove As from drinking water is critical to protect human health. In phase I of this study in 2011, aquifer material was amended with two oxidants, sodium permanganate (NaMnO₄) and hydrogen peroxide. Results of that study indicated that the MnO₄⁻ had the greatest removal of As from groundwater. In this year's study (phase II), aquifer material was oxidized using different concentrations of NaMnO₄ (0-10 g/L) and subsequently amended with an As solution (620 micrograms/L). After 30, 60, and 90 days storage in an anaerobic glove box, aqueous samples were collected, filtered, frozen and analyzed for As. The results show that reactors (0, 1, 3, 5, 7, and 10 g/L) removed an average of 41%, 77%, 88%, 93%, 95%, and 97%, respectively; resulting in the removal of 1.7, 3.52, 3.79, 3.93, 3.97, 3.99 µg As/ g aquifer material. The efficiency of As removal decreased as MnO₄⁻ concentration increased; however, greater As removal, and lower As concentration was achieved at higher MnO₄⁻ concentration. Arsenite (As+3) was oxidized to arsenate (As+5), forming a multivalent anionic form of arsenic that adsorbed to the aquifer solids. Preliminary calculations indicate the oxidant should be pumped at a faster rate into the aquifer to achieve a greater radial influence, the MnO₄⁻ will rapidly react leaving no residual, and that treatment costs were estimated to be \$0.41, \$0.69, and \$1.41/1000 L for 3 g/L, 5 g/L, and 10 g/L MnO₄⁻, respectively. Artificial oxidation of reduced aquifer materials could be an effective method of removing As in ground water to protect human health world-wide.

Awards won at the 2012 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel
Tuition Scholarship Award in the amount of \$8,000 - Office of Naval Research on behalf of the United States Navy and Marine Corps

2012 - EV027

A STUDY ON THE USE OF LIPID PRODUCING ALGAE IN WASTEWATER TREATMENT

Kathleen Marie Seeley
Benjamin Logan High School, Bellefontaine, OH

This study focused on the use of the lipid-producing micro-algae *Chlorella vulgaris* and *Nannochloropsis salina* in the high nitrate and phosphate environment of artificial "waste water" that is the Proteose Medium (the control). The question was, "Will *Chlorella vulgaris* or *Nannochloropsis salina* produce the greatest amount of lipids when grown in Proteose Medium, a medium used to simulate waste water, and which of the two micro-algae has the greatest metabolic uptake of the phosphates and/or nitrates in Proteose Medium?" In response it was hypothesized that "*Chlorella vulgaris* will produce the greatest amount of lipids and have a greater metabolic uptake of phosphates than *Nannochloropsis salina*. *Nannochloropsis*, however, will have a greater metabolic uptake of nitrates." The basic procedure that was followed was to grow each micro-algae in Proteose Medium in four flasks for two weeks; then extract the lipids using the Bligh and Dyer method, and test the phosphate and nitrate levels using a HACH Water Test kit. It was found that the *Chlorella vulgaris* produced ~19.3% of the original mass as lipids, and that *Nannochloropsis salina* produced ~17.4% of the original mass as lipids. *Nannochloropsis* had a greater uptake of nitrates than *Chlorella*: less than six percent of the original nitrates in the *Nannochloropsis* flasks remained after two weeks of growth; 41% remained in the *Chlorella* flasks. After two weeks, the remaining phosphates in *Nannochloropsis* measured 46.6 mg/L, and 47.8 mg/L in *Chlorella*. In conclusion, the lipid production of *Nannochloropsis* was hindered significantly by high nitrate concentrations.

2012 - EV028
RECORD FLOOD IMPACTS ON BIODIVERSITY IN UPPER GREEN RIVER, KENTUCKY

Aimee Michelle Turner
Ballard High School, Louisville, KY

Purpose. Determine if the record flood of May 2010 impacted autumn detritus production above and below the dam as well as large woody debris based upon riverbank landslides and amount of trees per area of slide. These nutrients impact mussels and other rare animals, including some that are endangered, further downstream. Comparison of sampling sites should show the differences in detritus and large woody debris as a result of the flood and how it affects biodiversity.

Procedures. Multiple timed trials for sampling of detritus. Counting, measuring and identifying large woody debris, and locating and measuring landslides.

Results. Seasonal leaf fall is the most important contributor to detritus levels in the river during autumn. The flood of May 2010 did show an impact on detritus levels in affected areas and stayed consistent in areas that weren't affected by the flood. Large woody debris shows a significant increase after the record flood.

Conclusions. Changes in detritus levels in response to the flood will likely have short-term and long-term positive impacts on the biodiversity. Changes in large woody debris will likely have positive or beneficial impacts to biodiversity through increased variety in aquatic habitat and long-term release of nutrients from decaying wood including making additional carbon available for aquatic life. Landslides, besides making obvious physical changes in stream habitat and shape, are significant contributors of large woody debris.

Awards won at the 2012 ISEF
Full tuition scholarship - Drexel University
Scholarship Award of \$15,000 per year, renewable annually - Florida Institute of Technology
Third Award of \$1,000 - Environmental Sciences - Presented by Intel
Award of Merit of \$500 - Society of Exploration Geophysicists

2012 - EV029
DOES THE CLOSE PROXIMITY TO KAOLIN PROCESSING AFFECT WATER QUALITY?

Makayla Amithy-Cora Moon
Washington County High School, Sandersville, GA

pose my project is to use Macroinvertebrate water testing to identify the close proximity affects the quality of water in a certain are depending on the proximity around Kaolin Processing.When conducting my experiment I will use the Method of evenly the distrutind the debris.After i will use the Sheer Sheet which will allow water to flow through it, but simultaneously catching debris and macroinvertebrates.After each body of water has been tested I then would take each macroinvertebrate and place them in a white ice cube tray for an easier visual Once they have been transfeered to the ice cube tray I can then start the identification process.This includes the immune systems of each macroinvertebrate,the quality of water they are found in and the number of each that is found in a tested area.After each creek has labeled for their qualities i can use this to compare all of the areas.By using this technique I will be able to identify if Kaolin Processing really effects water quality.

2012 - EV030
EFFECT OF MAGNETIC FIELDS ON VIABILITY OF CELLULAR STRUCTURES

Andrew Wei Chen
Beaverton High School, Beaverton, OR

The lack of clean water supplies is an ever growing problem with the global population increase and presents itself as one of the greatest obstacles for a billion individuals to overcome worldwide. This study sought to explore the possibility of decreasing cellular viability through the use of magnetic fields. Due to moving ions being of importance in cellular biological functions, such as homeostasis and ATP production, it was postulated that a magnetic field could inhibit cellular growth by disruption ion movement. *E. coli* K-12 was used as an experimental unit because it provided a manipulable cellular system by which to make regulatory observations. After dilution, the *E. coli* was subjected to magnetic field strengths ranging from 0.14mT to 8.25mT for 24 hours. ImageJ was used to compute bacterial colony counts on which statistical analysis (correlation, r-squared, t-test, confidence interval) was conducted. There was found to be an extremely strong negative correlation between magnetic field strength and cellular growth as shown by the significant decrease in bacterial colonies. As a result, it was concluded that magnetic fields negatively affect cellular viability and the hypothesis was found to be true. The implications of this study are two-fold. First, the results detail the possible health hazards of prolonged magnetic field exposure. Second, magnetic fields can be used as a method of decontamination of water and in industry. Magnetic fields are more efficient, safe, and cost-effective than current methods of irradiation and chemical

application.

Awards won at the 2012 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2012 - EV031

DIG DEEPER: EFFECT OF CARBARYL, PYRETHRIN AND INSECTICIDAL SOAP APPLICATION ON CRICKET (GRYLLUS ASSIMILUS) AND EARTHWORM (LUMBRICUS TERRESTRIS) MORTALITY RATES, RADISH GROWTH (RAPHANUS SATIVUS) AND SOIL COMPOSITION

Eunice Linh You

Laval Liberty High School, Laval, Quebec, CANADA

Aim: The benefit of insecticide use against environmental concerns is a problem that persists to the present. It is imperative that we develop and evaluate insecticides that promote sustainable development. The project in its present form examines the effect of a synthetic chemical insecticide (carbaryl) and two biological insecticides (pyrethrin and insecticidal soap) on soil components.

Methods and Results: First, evaluate effect of the insecticides on aneicic Lumbricus terrestris (earthworm) populations by assessing mortality rate after direct exposure. Carbaryl, pyrethrin and insecticidal soap respectively caused 80%, 47% and 40% earthworm mortality rate. Second, surface of the soil and Raphanus sativus radish leaves and stems were treated with the insecticides to determine how crops develop in response to insecticides. After 21 days, average shoot system height stood at 12 cm and 11 cm after application of carbaryl and pyrethrin, in comparison to control values at 9 cm. However, insecticidal soap caused plant injury, lowering average radish height to 8.5 cm. Third, soil pH and nutrient content was measured using a soil quality test kit. pH was substantially lowered following the application of carbaryl and insecticidal soap, but was unaffected by pyrethrin. Also, soil nitrogen content was increased by 12.5% when treated with carbaryl. Finally, efficiency of the insecticides was compared based on ability to eradicate the target pest, Gryllus assimilus (crickets). Carbaryl, pyrethrin and insecticidal soap respectively caused 100%, 76% and 36% cricket mortality rate.

Conclusion: Pyrethrin satisfies agricultural need for insecticides, while maintaining the lowest environmental impact. Looking into more factors such as leaching rate in soil is the next logical step.

Awards won at the 2012 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2012 - EV032

THE REMOVAL OF HARMFUL CONTAMINANTS IN WATER USING LOW TEMPERATURE MICROPLASMA

Mervy Atif Michael

Union City High School/ Academy For Enrichment and Advancement, Union City, NJ

As the demand for clean water is increasing, research targeting the use of ozone to efficiently purify water has become a focus in the scientific community. I hypothesized that by flowing air across a microplasma reactor, ozone can be generated and bubbled through water for proper purification. The purpose of this study was to create low temperature plasma using dielectric barrier discharges (DBD) with minimal voltage in a portable device in order to purify water. The effectiveness of ozone on the removal of harmful contaminants in water was also investigated. Plasma was produced using a DBD and ozone was formed from the electric breakdown of air. Previously, it was determined that the most efficient dielectric material in producing plasma was ceramic (Al₂O₃) due to its high dielectric constant, in contrast to Polyether-Ether Ketone (PEEK) and Quartz (Jose Lopez, Ph.D. and Mervy Michael, unpublished). The efficiency of the DBD reactor with quartz as the dielectric material was tested. My results show that ozone generated using quartz was successful in purifying water samples. Data collected indicates a significant decrease in Nitrate (NO₃⁻), Nitrite (NO₂⁻), Peracetic Acid (CH₃CO₃H), Lead (Pb), DPD Chlorine (N, N-diethyl-p-phenylenediamine chlorine) and other less abundant contaminants in water samples taken from various locations throughout the state of New Jersey .

Awards won at the 2012 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

First Award of \$3,000 - Air Force Research Laboratory on behalf of the United States Air Force

2012 - EV033

EFFECTS OF FERTILIZATION AND TEMPERATURE ON GREENHOUSE GAS AND NITROGEN OXIDE EMISSIONS FROM SOILS

Vincent Huang Lin

Falmouth High School, Falmouth, MA

Global climate change may accelerate feedbacks from greenhouse gas (GHG) and nitrogen oxide (NO_x) emissions from terrestrial soils. As the growing human population puts pressure on agricultural and biofuel production, nitrogen fertilizer use has rapidly increased. Therefore, it is important to quantify GHG and NO_x emissions in response to increased fertilization and temperature.

Agricultural soil samples from Amherst, MA, were incubated at 10°, 20°, and 30°C in 18 separate containers with soil depth of 30 cm and 20% soil moisture. CO₂, N₂O, NO_x, and CO fluxes were measured from all samples 27 times over three nitrogen treatment periods of 10 (agricultural equivalent), 5, and 2.5 g m⁻², yielding over 2000 final flux values. Measurements were made using CO₂, NO₂, and NO_x analyzers, and the first in situ N₂O and CO analyzer. Total carbon and nitrogen analyses were performed using a CHN analyzer.

CO₂, N₂O, NO_x and CO emissions all increased with fertilizer addition. GHG emissions also increased with temperature: the CO₂ flux at 30°C was 6-8 times greater than the flux at 10°C, while the N₂O flux at 30°C was up to 100 times greater than the flux at 10°C (N₂O has a global warming potential ~300 times greater than CO₂). Extrapolating these data to global soils, a 2°C rise in temperature and an increase in global fertilizer use could significantly increase soil GHG and NO_x emissions. These increased emissions could further adverse human health effects from nitrogen oxides and accelerate global climate change in a cycle of positive feedback.

2012 - EV034

BIOMASS DENITRIFICATION OF SALT WATER ESTUARIES

Steven Michael Spall

Falmouth High School, Falmouth, MA

The goals of the project were to find out if woodchips could be used to denitrify saltwater and, also, to determine how long they would last. It was hypothesized that the woodchips would not be able to denitrify as successfully in salt water as in fresh water, but they would last long enough to be a viable denitrification option.

Four Mariotte bottles were filled with groundwater and a nitrate solution. Filtered seawater was added to two of the bottles to a concentration of 10-12 ppt. Water was dripped from the bottles into tubes filled with 18" of woodchips at a flow rate of 6" per day and run for two weeks in order to equilibrate. Water samples were extracted at various depths in the woodchips daily for 5 days. Nitrate concentration was measured using a spectrophotometer, producing profiles of nitrate as a function of depth in the woodchips. In a second set of samples, a gas chromatograph was used to measure dissolved inorganic carbon concentration, which is a byproduct of nitrate reduction.

Within statistical uncertainties, fresh and salt water were found to denitrify at the same rate, and the rate of DIC production due to woodchip decomposition was the same. By comparing with data one year ago, it was found that older woodchips were more effective at denitrification than newer woodchips. Based on the rate of carbon extraction from the wood chips, the volume of woodchips, and the flow rate, it was estimated that 18" of woodchips would last approximately 300 years. It is concluded that biomass denitrification using woodchip barriers can provide a practical and cost effective means to denitrify ground water near salt water estuaries.

2012 - EV035

ENVIRONMENTAL ANALYSIS OF A HYDROCARBON-CONTAMINATED SOIL TO IDENTIFY THE ALK3 GENE BY BIOCHEMICAL-MOLECULAR TECHNIQUE

Jordanalys Berrios-Colon

Jose Rojas Cortes, Orocovis, PUERTO RICO

This investigation deals with the analysis of hydrocarbon-contaminated soil for the identification of alk3 gene using molecular biochemical techniques. The problem was: Is it possible to identify the alk3 gene in bacteria that allow the degradation of hydrocarbons in contaminated terrestrial environments? Scientific studies lead to this hypothesis: If the alk3 gene that is present in hydrocarbon degrading bacteria found in contaminated soil is identified using biochemical-molecular tests then the current soil bacteria will allow degradation of the compound.

Soil samples contaminated with hydrocarbons were obtained. Several biochemical and molecular techniques were carried out such as: the isolation of bacteria from the soil, bacteria preservation, DNA isolation technique (DNA was isolated from the bacterium to identify whether it has the resistant alk3 gene that survives in hydrocarbon biodegradation), UV spectroscopy technique using computer NanoPhotometer to determine concentration and purity of nucleic acids, PCR technique to amplify the gene and Agarose electrophoresis technique to analyze band samples. There was also a characterization of the bacterium through biochemical tests and qualitative identification. For the electrophoresis test Pseudomona aeruginosa which contains alk3 gene, was used as the control positive. It was found that the DNA of the obtained bacteria was aligned with the control positive and that it had the same gene expression as evidenced by its bioluminescence. It can be concluded that the alk3 gene is present in the sample of hydrocarbon contaminated soil which is capable of biodegrading it, because there was much alkane hydroxylase gene expression. The hypothesis was accepted.

2012 - EV036

APPLIED ELECTROCHEMISTRY FOR THE ANALYSIS OF HEAVY METALS IN VIEQUES SOILS

Natalia Nahi Olmeda

Petra Mercado Bougart, Humacao, PUERTO RICO

In this study, the concentration of heavy metals (Pb, Hg, Cd, Zn and Cu) in soil samples of the island of Vieques, were scrutinized through the electrochemical method. The purpose of this work was to prove the effectiveness of this method for the direct extraction of heavy metals in the land adjacent to the "Solid Waste Management Unit 6" (SWMU 6), in the western side of the island, thus finding a method for the complete heavy metal extraction from the area. The method consisted in creating a pilot project to apply the electrodeposition of these metals, directly from the studied soil. After the extraction over the platinum (Pt) electrodes, a digestion of the nitric acid 50% v/v was conducted, in order to dissolve the heavy metals that were deposited on the electrodes. Then the evicting electrochemical technique was applied to corroborate the presence of these metals in the soil, making a sweep to more positive potentials. The evicting current of each metal is proportional to the concentration of the solution under study. In all of the soil samples studied, mercury (Hg) was found along with an unknown substance. The greater the depth of the sample (B2 and C2), the higher is the amount of Hg found. Hence, it may be concluded that the electrochemical method of extraction may be effective for the extraction and analysis of heavy metals in the soil of Vieques.

2012 - EV037

A COMPARATIVE STUDY OF THE EFFECT OF SALINITY IN SOME WETLANDS OF PUERTO RICO DURING DROUGHT AND FLOOD SEASON

Kelianet Roque-Rodriguez

Thomas Armstrong Toro, Ponce, PUERTO RICO

Wetlands are vital ecosystems that filter water and serve as refuges for different species of flora and fauna. The salinity of wetlands can determine the wetland flora. Salinity can increase or decrease due to environmental factors such as floods and drought. Currently there are man-made factors that directly affect the wetland causing an increase in salinity. These factors include logging, dredging, construction and illegal dumps. This research aims to establish the parameters of salinity in times of drought and flood relating their effect on the increase or decrease of the flora present in the habitat. A registered Natural Reserve wetland

was identified as a control. In this research 10 water samples were taken during the time of drought and flood from 20 wetlands not registered as Natural Reserves in Puerto Rico. Specific gravity was measured using the hydrometer and salinity was obtained by conversion tables. The wetland flora was counted during drought and flood times. Temperature and the wetland approximate distance from the sea were also considered. It was found that the flora of wetlands increases as the salinity decreases at flood time and decreases as the salinity increases in times of drought. The wetlands are susceptible ecosystems that must be preserved by decreasing man-made detrimental factors in order to maintain the flora in its natural habitat with the natural increases and decreases of salinity. Using the results of this research a proposal was developed for the conservation of wetlands in Puerto Rico and to educate the population.

2012 - EV038

PERSISTENT BIOACCUMULATIVE AND TOXIC CONTAMINANTS

Nickolas Aubrey Hines
Shallowater High School, Shallowater, TX

This project evaluated persistent bioaccumulative pesticides that are toxic to humans and animals. The hypothesis was if contaminated water and soil samples were taken from an agricultural, commercial, industrial and residential areas and were tested for the following harmful pesticides and herbicides: DDT, DDE, Thiamethoxam, Pendimethalin, Permethrin, Trifluralin, Atrazine, Heptachlor, Lindane, Endrin, Dieldrin then DDT and DDE would be present in the samples. Samples were condensed and standards prepared. Atrazine was tested with an Immunoassay Test kit. Gas chromatography and mass spectrometry was performed to evaluate for the other pesticides. The following pesticides were found in the samples: Water Samples: DDT, DDE, Thiamethoxam, Trifluralin, Atrazine, Permethrin. Heptachlor, Lindane, Pendimethalin, Lindane, Aldrin, Endrin, Dieldrin Soil Samples: DDT, DDE, Thiamethoxam, Trifluralin, Atrazine, Permethrin. Heptachlor, Lindane, Pendimethalin, Lindane, Aldrin, Endrin, Dieldrin The hypothesis was supported; DDT and DDE were found in the samples. There was a greater abundance of DDT and DDE in the soil samples. However, there were other persistent pesticides and herbicides also found in the samples. . Our knowledge of the toxins presence, persistence and modes of transport is vital to educating other countries of the risk factors related to their effect on their country as well as our country.

2012 - EV039

SODIS EFFICACY IN A COLD-WEATHER CLIMATE

Kaitlyn Child
Canyon View High School, Cedar City, UT

The SODIS method states that UV radiation will kill diarrhea-generating pathogens in contaminated water placed in a transparent PET bottle for six hours in direct sunlight. I wanted to see if SODIS would work in a cold-weather climate with less direct sunlight. I filled twelve 20-ounce plastic bottles with water from Coal Creek. Three bottles were my control, left in the cold but out of direct sunlight. Three bottles were treated with a store-bought water purification tablet and placed in the same condition as my control. Three bottles were placed against the black backdrop of my roof, and the last three bottles were also in direct sunlight, though on my concrete porch. After six hours, I recorded the temperature of the twelve samples and had them tested for coliform bacterial content and whether or not they were safe to drink. The samples treated with a purification tablet had no harmful bacteria and were all safe to drink. My control samples had the most bacteria, an average of 111 colonies, and were not safe to drink. The group placed on my porch had an average of 24.1 colonies, a noticeable decrease from my control, though not potable. The group on my roof had an average of 13.3 coliform colonies, also not potable. The concentration of E. Coli bacteria in all samples was less than one. Despite the decrease in bacterial content in the water treated with the SODIS method, this is not a safe way to purify water under cold-weather conditions.

2012 - EV040

THE INFLUENCES OF CHEMICAL REACTANTS ON EUTROPHICATION

Andrew John Steffl
Sleepy Eye St. Mary's High School, Sleepy Eye, MN

This experiment was done to prove which chemical reactant most effectively rids water of algae while still maintaining a healthy living environment. Water was gathered in pails and set in a warm, lit environment so that algae would grow. After the algae had grown, chemical reactants were added to the water to try to remove the algae. Sodium Carbonate Peroxyhydrate was most effective at raising dissolved oxygen levels and lowering turbidity levels while maintaining healthy pH levels. Copper Sulfate also raised dissolved oxygen levels and maintained pH levels but did not have much effect on turbidity. Ferrous Sulfate initially dropped dissolved oxygen levels significantly, but after time levels rose again. It also lowered pH levels to unlivable conditions and raised turbidity levels higher, beyond acceptable. Ferrous Sulfate is an unsafe and impractical way to clean waterways because instead of binding with phosphates, it binds with the oxygen in the water, which causes rust. Copper Sulfate and Sodium Carbonate Peroxyhydrate appeared to kill the floating algae making the water more clear and still allowed some algae to grow on the bottom for organisms to live off of.

2012 - EV041

TOXICITY OF AG AND AU NANOPARTICLES ON SHEWANELLA ONEIDENSIS

Anushua Bhattacharya
East Ridge High School, Woodbury, MN

Nanotoxicology- the study involving the effect of nanoparticles (NPs) on cell toxicity- has received attention due to the increased prevalence of nanomaterials in consumer products. Hence, the possible exposure to manmade NPs in the environment is a concern. The effect of citrate capped Ag and Au NPs at concentrations of 0.01, 0.05, 0.1 and 0.5 µg/mL on the growth of Shewanella oneidensis MR-1 was evaluated. The particles were characterized using

ultraviolet-visible absorption spectroscopy, dynamic light scattering, and transmission electron microscopy. The diameters of the Ag and Au NPs were approximately 45 nm as determined by TEM. Using dynamic light scattering, the stability of the NPs was monitored over time in different solvents (water, bacterial growth broth, and natural organic matter solution) at different, environmentally relevant temperatures. LB Broth showed the greatest change with an increase in size ($p<0.05$). Bacterial growth tests were performed in broth medium. Results indicate that the growth rate and the bacterial population were adversely affected by both metal NPs, even at the lowest concentration level (0.01 $\mu\text{g/mL}$). To determine a possible cause for changes in growth upon exposure to NPs, reactive oxygen species were quantified using various fluorescent probes. The growth rate and the bacterial population were adversely affected by both metal NPs, even at the lowest concentration level (0.01 $\mu\text{g/mL}$). Furthermore, both NPs showed various levels of inhibition on colony formation. At the concentrations used in this study, it is clear that both Ag and Au NPs are to this bacterium.

2012 - EV042

ST. LOUIS RIVER ESTUARY: THE EFFECT OF LOCATION ON WATER QUALITY FOR DIFFERENT BODIES OF WATER WITHIN THE LAKE SUPERIOR/ST. LOUIS RIVER WATERSHED

Madison Marie Pallin
Cloquet Senior High School, Cloquet, MN

A watershed is sets of streams or rivers that eventually flow into one body of water. Surface run-off and infiltration are very important sources of sediment and pollution. Rain gardens trap run-off removing sediment and pollution. An Estuary is a drowned river mouth including a zone of transition from a stream to Lake Environment (LGL, 1997). The original hypothesis was if the location of different bodies of water within the Lake Superior/St. Louis River/Spring Creek watershed were compared than the water quality would be affected. The hypothesis was supported as the water moved from Spring Creek to the open water of Lake Superior the water quality varied according to location. Spring Creek, St. Louis River, and Lake Superior's open water were similar in temperature, oxygen and turbidity for different reasons. Spring Creek is possibly colder because of ground water input, fast moving water, along with a healthy riparian zone. Lake Superior is possibly colder because of the lakes large surface area, with a small watershed input. Barkers Island, Wisconsin Point/Superior Inlet and the 53 Bridge are similar in turbidity/clarity, conductivity, oxygen and pH. All are located within the St. Louis River Estuary where the river and the lake meet. There are only two outlet discharges into the lake from these areas. Sediment and organic matter are trapped elevating, conductivity and turbidity, while bacterial respiration decreases oxygen and water pH. The temperature was warmer when compared to the lake and stream because of the reduced riparian and increased urban runoff area.

2012 - EV043

A BIOASSAY METHOD USING BACTERIAL BIOLUMINESCENCE TO SCREEN FOR TOXIC LEVELS OF CHEMICAL WATER CONTAMINANTS

Chengzhen Li Dai
Detroit Country Day School, Beverly Hills, MI

As the world becomes more industrialized, humans face the issue of water contamination due to toxic chemicals. Currently, chemical tests are the most widely used method to screen for chemical contaminants. While effective, chemical tests lack the efficiency of detecting multiple contaminants at once. This study thus sought to test the effectiveness of using the bioluminescent bacteria *Vibrio fischeri* as a bioassay method to screen for toxic levels of chemical pollutants. Since the bioluminescence intensity of *V. fischeri* reflects the overall health of the organism, the influences of six regulated water contaminants (Copper, Mercury, Zinc, Nitrate, Atrazine, and Permethrin) on the bioluminescence of *V. fischeri* were examined. Contaminants were added according to the U.S. Environmental Protection Agency's Maximum Contaminant Levels (MCL). Bacteria were exposed to chemicals at both toxic (3x MCL) and nontoxic (MCL) concentrations. The change in bioluminescence intensity after the addition of chemicals were recorded and analyzed. The results reveal that a decrease in bioluminescence can be induced with the presence of chemical contaminants at toxic concentrations (3x MCL) but not at regulated concentrations (MCL). Overall, this study suggests that *V. fischeri* can differentiate between toxic and nontoxic levels of chemical contamination.

Awards won at the 2012 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2012 - EV044

AUXIN: INCREASING PHYTOREMEDIATION IN HYPERACCUMULATING PLANT SPECIES

Anna Middleton
Lone Peak High School, Gallatin Gateway, MT

It was hypothesized that placing fresh *Salix* cuttings and the hyperaccumulating aquatic plant *Nastursium Officianale* in a tank of water contaminated with high levels of arsenic would increase the levels of phytoextraction of the arsenic due to the release of auxin by the *Salix* plant. To test this hypothesis, three ten gallon tanks of contaminated water were collected from the Madison River, near Yellowstone National Park in Montana and the arsenic level was tested at 500ppb. Three separate tests were then run using the same amount of plant matter: *Salix* alone, *Salix* and *Nastursium Officianale* combined, and *Nastursium Officianle* alone.

Within the first 24 hours the arsenic in the tanks containing *Salix* and *Nastursium Officianale* dropped to 200 ppb. The tank with only *Nastursium Officianale* continued to drop over four days, eventually stabilizing at 300 ppb. The *Salix* dropped to 300 ppb in 24 hours and stabilized. A second test two weeks later showed the same immediate effect. The mixed approach of using both plants together was both faster and more successful than utilizing either plant alone, with arsenic levels dropping from 500 to 200 in just 24 hours. As both of these plants grow worldwide, this approach could be used as a simple, affordable, quick and low tech solution to quickly removing significant arsenic from personal drinking water supplies as well as other larger bodies of water.

2012 - EV045

MODELING SALINITY TO EVALUATE SALTWATER INTRUSION: A CASE STUDY OF THE LOXAHATCHEE RIVER

Christopher X. Wan

Alexander Dreyfoos School of the Arts, West Palm Beach, FL

ter intrusion induced by anthropogenic drivers often leads to degradation of the ecological function of pristine freshwater floodplain forests. One of the most prominent examples is saltwater intrusion into the Loxahatchee River, a federal designated Wild and Scenic River in Florida, where salinity beyond 2 parts per thousand begins to endanger bald cypress [*Taxodium distichum*] floodplain swamps. The purpose of this project is to evaluate the historical saltwater intrusion into the Loxahatchee River by developing a model that predicts river salinity with given freshwater inflows. Over 20,000 flow and salinity data collected since 2003 were used for model development. Due to the dynamic nature of salinity change in the river, a single mathematic equation was found to be insufficient to model the flow-salinity relationship. Thus, the model was created based on extensive computer programming to effectively organize the data and relate salinity responses under varying flow conditions. The final model contained several if loops to account for the dynamic relationship between the instantaneous flow change and the gradual salinity response. With an r^2 of 0.87 between the observed and modeled salinities, the model was used to effectively hindcast historical salinity back to 1971 and forecast future salinity levels under the restoration condition. The results showed that severe saltwater intrusion occurred in the period from 1973 to 1976, 1988 to 1990, and 1999 to 2007. Restoration of the river depends largely on delivery of sufficient amount of freshwater during the dry season.

Awards won at the 2012 ISEF

Second Award of \$750 - American Geosciences Institute

Full tuition scholarship - Drexel University

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2012 - EV046

GOT METALS? IN YOUR SEAFOOD! EXTRACTION OF METALS FROM SEAFOOD FOR INDUCED COUPLED PLASMA MASS SPECTROMETRY DETERMINATION

Shane Michal Flanagan

Castle High School, Newburgh, IN

The purpose of this experiment was to gain an understanding of how to remove metals from seafood before cooking. In today's environment, effects of metals on your body are under review. It is common knowledge that some seafood can contain metals. Due to the growing ability to obtain seafood locally from global resources, I wanted to understand the global risk of metals from seafood as well as a simple way to extract the metal before consumption. Keeping the process simple but effective, by using a common household item of lemon juice, could help prevent future health issues.

Data obtained by analysis of leachate using an ICP-MS, showed that at common baking temperatures for short periods of time, Total Arsenic can be easily extracted from seafood using lemon juice.

In addition and unanticipated, data obtained also indicated that Tuna analyzed 2-3 times higher in total arsenic than my online research indicated. Studies indicate the total arsenic could be inorganic or organic, but all reference further study is required.

Based on this conclusion, I recommend validation of my test by a 3rd party and notification to the public of the results.

I also recommend further research be performed to validate risk levels for consumption, impacts when used in dog food, transfer of arsenic across fish breeding cycles and if the impact of consumption varies by age and weight.

Awards won at the 2012 ISEF

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2012 - EV047

ACID MINE DRAINAGE REMEDIATION: A NOVEL APPROACH, PHASE III

John Tyler Barnes

Northwestern High School, Kokomo, IN

The purpose of the research was to determine chitosan's viability as a remediating agent of acid mine drainage (AMD). The hypotheses were 1) if chitosan is tested on its ability to remediate copper and iron AMD, then chitosan will have a statistically significant effect upon the hydronium ion and metal concentrations of the drainage, 2) if treated AMD is tested on its ability to support *Bacillus subtilis*, *Euglena gracilis*, and *Daphnia magna*, then the organisms will survive in the treated AMD, and 3) if chitin is tested on its ability to remediate AMD, then chitin will not have a statistically significant effect upon the hydronium ion or metal concentration of AMD tested. Chitosan was tested in 5 replicate samples with 0.8%, 1.2%, and 1.6% concentrations on AMD produced in the laboratory using 3% H₂O₂, FeS₂, and Cu₂S. After one week, iron concentrations were 950ppm at pH=2.495. Experimental iron concentrations were 26ppm (t=18.5>t.01=3.36), 17ppm (t=18.7>t.01=3.36), and 6ppm (t=18.9>t.01=3.36) for 0.8%, 1.2%, and 1.6% chitosan groups respectively. Experimental pH values were 2.90 (t=22.2>t.01=3.36), 4.08 (t=51.1>t.01=3.36), and 4.23 (t=117.0>t.01=3.36) for the 0.8%, 1.2%, and 1.6% chitosan groups respectively. By Student t-test, all results were highly significant. Chitosan caused a highly significant decrease in copper concentration and [H⁺]. Chitin treatment had no significant effect. The result confirms that the amino group is essential for AMD remediation. *Daphnia magna*, *Euglena gracilis*, and *Bacillus subtilis* tests showed that chitosan treated AMD can support basic indicator species in aquatic and edaphic ecosystems confirming chitosan's potential for application.

Awards won at the 2012 ISEF

Second Award of \$1,500 - Environmental Sciences - Presented by Intel

2012 - EV048

MINERAL ACCRETION POWERED BY SOLAR ENERGY ACCELERATES CRASSOSTREA VIRGINICA GROWTH

Jia Wen Lin
Francis Lewis High School, Fresh Meadows, NY

Crassostrea virginica, commonly called the American oyster or the Eastern oyster, is a keystone species in the ecosystem. It increases marine biodiversity because its reefs provide homes for over one hundred organisms, including mollusks, polychaete worms, crustaceans, sponges, fish and birds. C. virginica also improves water quality and slows bank erosion. Recently, C. virginica has been labeled as “ecologically extinct”. This experiment examined the effect of electrical stimulus, known also as the mineral accretion method, on C. virginica on the coast of Flushing Bay. There are three DNA-shaped helices, each with a mesh bag containing 150 oysters. Oysters in helix 1 received no electrical stimulation. Oysters in helix 2 oysters received 24 volts and 2 amperes of electricity by having two 20 Watt Suntech Panels wired in series. Helix 3 oysters received 24 volts with 4 amperes of electricity by having two 20 Watt Suntech panels wired in parallel. From August 2011 to December 2011, oyster lengths are measured monthly using a digital caliper, which measures to the nearest 0.01 mm. At the beginning of December 2011, the average oyster lengths were 24.99, 48.46, and 65.24 mm for helix 1, 2, and 3, respectively. Results indicate that electrical stimulus has a positive effect on C.virginica growth. In the future, scientists can use electrical stimuli on C.virginica to increase its population, which in turn, benefits an entire ecosystem. Future experiments can calculate the oyster dry tissue mass to study further and confirm the effects of electrical stimulation on C.virginica.

2012 - EV049
INFLUENTIAL FACTORS THAT LEAD TO INCREASED LEVELS OF ATMOSPHERIC HAZE

Kristina Marie Thoren
American Heritage School, Plantation, FL

The purpose of this study was to see the type of effect various factors had in increasing and lowering the level of atmospheric haze. If atmospheric haze measurements are collected at 4:00 PM, then the amount of atmospheric haze will be at a lower level, when compared to measurements taken at 8:00 AM. In this study, the atmospheric haze was measured using a solar photometer and a GLOBE photometer. It was then compared to the measurements taken from NASA aeronet. If atmospheric haze measurements are taken in Miami, then the level of atmospheric haze will be at a higher level compared to measurements collected at Hollywood Beach FL. Measurements from Hollywood and Miami were compared. If 20 atmospheric haze measurements are collected at 12:00 PM during June, July, and August, then haze will be at a higher level, when compared to 20 measurements taken at 12:00 PM obtained during September, October, and November. If the humidity level is greater than 60% and the barometric pressure is less than 29.98, then atmospheric haze will be at a high level. These readings were compared to measurements collected when the humidity is less than 60% and the barometric pressure is greater than 29.98. The humidity levels caused great contrast and the conclusions had significant difference. The conclusions that were gathered are that high levels of atmospheric haze contains high amounts of pollution. The level was significantly lower in Hollywood, with high barometric pressure, during fall, and at 4 PM.

Awards won at the 2012 ISEF
Certificate of Honorable Mention - American Meteorological Society

2012 - EV050
HOME-BASED ARSENIC BIO-SAND WATER FILTER USING NANOTECHNOLOGY

Thabit Farrukh Pulak
Richardson High School, Richardson, TX

Nearly 1.1 billion people in the world lack access to safe drinking water. 65 million of these people are at risk of arsenic poisoning in poor regions like Southern Asia, and even the United States. The Bio-Sand water filter is one of the popular types of filters used worldwide, especially in developing countries like Southern Asia. However, this filter cannot filter arsenic. Current ways to reduce arsenic from water are inefficient, due to their large size, costliness, and inability to filter other impurities in water besides arsenic. This experiment shows how to synthesize iron-magnetite nanoparticles that have been shown to reduce arsenic from water using third world country-friendly household materials, then to be used inside a Bio-Sand filter to effectively filter arsenic. First the experiment calls for making soap. This soap can be either made of olive, mustard, or coconut oil. A fatty acid mixture (FAM) will be extracted from the soap, which will then be used to produce nanocrystals through the heating and mixing of the FAM and rust particles that are collected from any source of rust. After 2 hours of cooking, the nanoparticles are now able to be separated. These particles are to be used in Bio-Sand filter. When the water passes through the Bio-Sand, it will be filtered of both arsenic and other impurities. One of the most important aspects of this solution is that it is open-sourced, allowing for free use within poor countries, with room for others to further innovate and advance the solution.

Awards won at the 2012 ISEF
EPA Patrick Hurd Sustainability Award - United States Environmental Protection Agency
Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2012 - EV051
THE CHEMICAL AND MICROBIAL ANALYSIS OF WELL WATER

Kelsey Rae Gaukler
Hankinson High School, Hankinson, ND

PURPOSE: To analyze the quality of drinking water from five different well water locations in South East North Dakota. Secondly, to perform bacterial analysis on all five well waters. Finally, to determine the efficiency of two water purification devices. PROCEDURES: Water Analysis: Collected 5 different well water

locations during a six week testing period. Determined the chemical concentrations for six different contaminants by using the Hach Pocket Colorimeters. Determined the chemical concentrations of three different contaminants through titration methods. Determined the pH. Determined conductivity. Bacterial Colonization: Selected and labeled five nutrient and five EMB agar plates. Applied the water from each of my locations. Placed the plates into an incubator for 24 hours at 37 degrees Celsius. Coliscan & ECA: Obtained five Coliscan and five ECA Easygel kits. Used a one ml pipette to add four mls of sample water to the different Easygels. Incubated plates for 24 hours at 37 degrees Celsius. After the incubation period, determined the level of bacteria. Water Purification: Analyzed the efficiency of two water purification devices. Filtered water from all five locations through each of the purification devices. After the water had been filtered, it was tested for the contaminants as in Water Analysis. CONCLUSION- In the Water Analysis test, Gaukler's had the best water quality. In the Bacterial Colonization, Gaukler's was the least contaminated with bacteria. From Water Purification, I found that EcoWater was the best purifier. Overall, I found contaminants in well water do have an effect on the consumer's health.

2012 - EV052
USING MAIN GROUP ELEMENTS TO DIMINISH OZONE DEPLETION

Johnathon Ross Long
Timberland High School, St. Stephen, SC

The effects of ozone in the upper atmosphere are essential to the survival of life on Earth. In the upper atmosphere (specifically, the stratosphere), ozone filters harmful ultraviolet radiation from sunlight. Ozone is the most intensely studied compound in the atmosphere because of its ability to filter biologically harmful wavelengths of radiation (Elliott & Rowland, 1987). This ultraviolet radiation is highly energetic and would damage both plants and animals exposed to it. Ultraviolet radiation with wavelengths between 240 and 290 nm is not absorbed by oxygen molecules. This radiation is instead absorbed by ozone.

If chlorine is the cause of ozone depletion in the upper atmosphere than what could be used to remove the chlorine from the upper atmosphere? Using an ozone generator model ZO-30N and an ozone detector model 106-M, compounds representing elements in the alkaline earth metals of the periodic table were tested as to their effectiveness at reacting with the chlorine in the stratosphere. The chlorine was generated and injected into the ozone chamber. Compounds were then added to the chamber and the ppm of the ozone and chlorine were monitored for 2 hours each. Barium Hydroxide was the only compound tested that actually caused the ozone levels to rise above the initial amounts.

2012 - EV053
ECO SYSTEM SOLUTION

Blaine Kyle Durward
Trenton High School, Trenton, ND

The purpose of this experiment is to find the cleaning solution that is the most eco friendly and biodegradable on a plant. It is hypothesized that Samari Brake Clean is the most eco friendly and biodegradable on seed growth. Samari Brake Clean will not kill bacteria due to all the eco friendly materials. WD-40 will kill the most bacteria due to the harmful ingredients in it. WD-40 will inhibit seed growth. Simple green will kill minimal bacteria and will inhibit seed growth also.

Make Trypticase soy agar plates. Swab plates with Staphylococcus epidermidis, Escherichia Coli, and Bacillus subtilis.

Dip sterile disks in each of the solutions and placed in the plates, then labeled. Prepare 1% solution to distilled water for each of the corn, bean and pea seeds. use filter paper to hold in place in the disk.

Samari Brake Clean at full strength worked the best in killing each bacteria. Samari Brake Clean also had growth in each seed tested. WD-40 killed no bacteria at full strength and inhibited seed growth. Simple Green killed only two out of the three bacteria. Simple Green had the best growth in the corn seed out of each solution.

Samari Brake Clean was the most eco friendly solution tested based off of each seed grew in the 1% solution. Samari Brake Clean effectively killed each bacteria tested in this expirement. Samari Brake Clean would be the best solution in cleaning parts and tools and avoiding all the hazardous toxins.

2012 - EV054
DETERMINING THE IRON CONCENTRATION OF WATER USING MODERN TECHNOLOGY: HOW IOS DEVICES CAN INDICATE WATER QUALITY

Brandon Joseph Bocklund
Battle Creek Area Math and Science Center, Battle Creek, MI

In the economical times of today, finding ways to do things differently for less money has become a focal point for our society. In doing so, the value on things such as water quality can be diminished. To remedy the cost of purchasing a test, a free iOS application was created. Behind the application, basic chemistry methods are used to color Fe+3 ions in a solution. The ferrous solution is mixed with SCN- ions to form a red complex. Usually, the concentration of this solution is found by examining the solution in a spectrophotometer, but in this case, the iOS application takes a picture of the solution and converts the pixels to a relatively precise and accurate concentration.

Awards won at the 2012 ISEF
Third Award of \$1,000 - Environmental Sciences - Presented by Intel
Second Award of \$1,500 - Air Force Research Laboratory on behalf of the United States Air Force

2012 - EV055
AGRO-BASED WATER TREATMENT FOR RURAL COMMUNITIES

Benjamin Wong Ngie Xiong
Sekolah Menengah Kebangsaan Batu Lintang, Kuching, Sarawak, MALAYSIA

This study aims to research the possibility of using natural coagulants to precipitate out colloidal particles which causes turbidity in untreated water in rural areas. The goal of the investigation is to help villagers to get clean water supply using natural and economical resources. Furthermore, to be able to find natural coagulants that does not have negative side effects but at the same time is safe to use. Different natural coagulants will be tested out to find which gives the best results and has the least costs incurred. In my study, I chose to use Jackfruit seeds, Ridge gourd and Breadnut seeds as these plant materials are readily available locally and are cheap which makes the end product economically viable if marketed on a commercial scale.

My study showed that Jackfruit seed powder(JFSP) are the most effective in treating turbid water. Therefore, I determined the optimum dosage of the (JFSP) used to clean simulated turbid water. Parameters of water quality tested include turbidity, conductivity, TDS, pH and time taken for turbid water to clear. The effectiveness of (JFSP) is compared with Alum. Furthermore, the use of (JFSP) as a coagulant aid was tested using raw river water collected from Rejang River, Sibuluan. One-Way ANOVA was conducted to see whether there are any significant differences in the data obtained. Results show that 2.0g of Jackfruit seed powder is as effective as Alum in treating moderate turbidity water to below safety standards set by WHO without lowering the pH. I conclude that (JFSP) can be used as a coagulant and coagulant aid to reduce the use of Alum.

Awards won at the 2012 ISEF

Third Award of \$1,000 - Environmental Sciences - Presented by Intel

2012 - EV056

ELECTRICAL CONDUCTIVITY AS A SIMPLE COST-EFFECTIVE INDICATOR OF HEAVY METAL WATER POLLUTION

Conrado Andres Asenjo-Molina

Academia del Perpetuo Socorro, San Juan, PUERTO RICO

Pollution is a major problem affecting the water resources used for recreation and consumption. Determining water quality specially for toxic heavy metals is of critical importance in maintaining public health and the sustainability of ecosystems. Developing a fast, simple and economical assay for screening possible contaminated bodies of water with heavy metals is of great importance due to the limited resources available by the government such as the EPA and Armed Forces as well as the private sector.

Water conductance is a simple assay that measure the velocity of electrical conduction affected by dissolved and suspended components. The purpose of this investigation is to determine if water conductance can be used as a simple cost effective screening method to determine heavy metal water pollution.

The study compares conductance with levels of heavy metals, filterable residue and inorganic components from lakes in Puerto Rico. A linear relationship between heavy metals and conductance was not established but the metals with the highest concentration did correlated with the highest rate of conductivity. This finding suggest the importance of specific water conductivity as a fast and cost-effective marker in more polluted bodies of water. Total dissolved solids did correlate at higher concentrations with conductance. This also points to electrical conductivity as a valuable measure of water pollution at higher levels of contamination.

This study points to conductance as a marker for heavy metal contamination in bodies of water with higher concentrations of contaminants. This simple and economical method can be performed on site with immediate determination of results. The long term sustainability of ecosystems can be easily monitored using this assay.

Awards won at the 2012 ISEF

Full tuition scholarship - Drexel University

2012 - EV057

EFFICIENCY OF BIOGAS PRODUCING MATERIALS

Jose Manuel Alvarez Medina

Colegio San Ignacio de Loyola, San Juan, PUERTO RICO

One of the major concerns of the 21st century is the effect of global warming on the climate. To prevent its development, new ways of generating energy are being developed, one of them being biogas. Biogas, mostly composed of methane, is produced when anaerobic bacteria digest organic waste during decomposition. It can be burned to move turbine or utilized as gas for a stove or any similar instrument. During this investigation horse manure, plantain leaves, orange peels, and coffee pulp were chosen as reactants to produce methane. The organic products were placed in 16, 1 gallon recipients, four samples per each group, with an attached helium balloon recipient to catch the generated biogas. It was predicted that the horse manure would produce more gas than the plantain leaves and orange peels, and the coffee pulp will be the least to produce. For a period of 21 days the circumference of the 43.18 centimeter balloons was measured. The horse manure produced an average of 40.64 centimeters, surpassing the plantain leaves and orange peels, which had an average of 30.48 centimeters and 32.39 centimeters respectively. As predicted, the coffee was the least producer, with an average of 4.45 centimeters. The results indicate that biogas can be produced from the local area. Farmers could use the horse manure to power tools, while restaurants could use pounds of waste food to give gas to their stoves. There are many other biogas producing waste products that could provide energy to the world.

2012 - EV058

ECO-FRIENDLY PESTICIDE FOR CONTROL OF TEA MOSQUITO BUG (HELOPELTIS ANTONII SIGN.) IN THEOBROMA CACAO L.

Sindura Saraswathi Bangaradka

Vivekananda English Medium High School, Puttur, Karnataka, INDIA

Recent days due to environmental pollution, deforestation and inquisitive human interference we are in a position in which nothing can be grown without employing pesticides. Cocoa (Theobroma cacao) is a worldwide commercial crop widely grown in semitropical region. Cocoa is the base material for chocolate industry. The tender cocoa pods are severely damaged by the tea mosquito bug - Helopeltis antonii. If the cocoa pods are unattended majority of the crop loss may occur. This loss may be controlled using the standard chemical pesticide worldwide but may be harmful to the ecosystem.

Hence, a plant based extract was formulated and evaluated for managing the pests. Plants used in the preparation of the extract are Strychnos nux-vomica (Strychnine tree), Vitex

negundo (Chaste Tree), Holoptelea integrifolia(Indian Elm tree) and Azadirachta indica (Neem tree) in Sapindus laurifolius (Soap nut tree) solution.

The standard pesticide effectively controls H.antonii, but could be harmful to environment due to their chemical contents. The Bio-pesticide is inexpensive when compared to the standard chemical pesticide. The plant extract does not harm environment during the preparation as well as during implementation. The crushed leaf waste left over after preparation of the extract may be used as a source of manure. Thus, an eco-friendly bio-pesticide from plant materials could be an effective pesticide to control pests effectively and also preserve our environment for the future.

Awards won at the 2012 ISEF

Second Award of \$500 U.S. savings bond - Ashtavadhani Vidwan Ambati Subbaraya Chetty Foundation

2012 - EV059

ECOFILTERS

Adaliz Miranda Larios

Colegio de Bachilleres del Estado de Puebla Plantel 6, San Juan Ixcaquixtla, Puebla, MEXICO

For years, the contamination of the environment by smoke has been a major problem worldwide. The use of services such as public transportation and industries produces pollutants in the air. Air pollution stems from the substances emitted into the atmosphere, causing an imbalance of the atmosphere's original composition. CO, NOx, SOx e hydrocarbons and particulates are the top five pollutants, contributing to more than 95% of world's pollution. With an ECOFILTER, a device developed with the use of natural fibers proper of the Ixcaquixtla region in Puebla, Mexico, it is hoped that harmful emissions could be reduced and respiratory illnesses could be prevented. Also, the production of this filter can be helpful in the creation of micro-enterprises dedicated to manufacturing such a product. The ECOFILTER is a tube with a length of 25 cm and a diameter of 10cm. In this filter six different types of fibers:sawdust, shaving, chiname, izote, mezote and palmon, are placed one over the other in an orderly manner in order to carry out a filtering process. In laboratory trials, it was observed that when grey smoke passed through the filter, clean air came out of it. Other trials testing the filter's flammability, physical absorption and fiber size characterization were made in order to evaluate the filter's functionality.

2012 - EV060

AN ANALYSIS OF AQUATIC PHYTOREMEDIATION OF STORM WATER CONTAMINANTS UTILIZING AN AQUAPONICS SYSTEM

Morgan Alexis Hertz

St. Patrick Catholic High School, Biloxi, MS

Aquaponics has the potential to reduce nutrient concentrations in water through the process of phytoremediation. Phytoremediation utilizes plants to remove selected contaminants from ground water or surface water. Phytoextraction, a form of phytoremediation, removes contaminants from the environment by uptake of nutrients through the root systems. Storm water contamination occurs when products and chemicals mix in the water causing it to become unsafe.

This project sought to use an aquaponics system to effectively phytoremediate contaminated groundwater. Four different types of plants were utilized for the project: Lettuce (Lactuca sativa), Basil (Ocimum basilicum), Parsley (Petroselinum citrata), and Orange Mint (Mentha citrata). Each plant had a different root density with Lettuce being the largest then Parsley, Mint and Basil respectively. My hypothesis was that Lettuce, due to its high root density, would remove the largest amount of contaminants from the water.

A fifty-five gallon aquarium separated into four equal compartments was used for the experiment. Vertical aquaponics systems were constructed. Eight gallons of water from a retention pond was placed in each section of the aquarium and stocked with Koi (Cyprinus carpio). Koi have no natural habitat, but prefer still, freshwater environments with high mineral content. Water samples were tested initially and weekly to measure contaminant levels.

The hypothesis was proved incorrect; Parsley had the best average for contaminant removal. Parsley had the second largest plant density, but the largest amount of foliage, therefore the amount of foliage not the root density is the determining factor for successful aquatic phytoremediation.

2012 - EV061

THE EFFECTS OF ZINC CONTAMINATED SOIL ON WISCONSIN FAST PLANTS

Monica Sai Pasala

Alabama School of Fine Arts, Birmingham, AL

Heavy metal contamination is a major issue, especially in areas filled with factories who are allowed to dump certain amounts of waste into nearby rivers. The purpose of this study was to find out if soil surrounding contaminated waterways was deadly enough to effect a plants growth or even kill it. Too much zinc can disrupt the life in soil, creating a hostile environment for earthworms and microorganisms. Plants rely on a rich life in the soil to break down and make nutrients accessible. In this study, plants were grown in non-contaminated soil and in different amounts of soil contaminated by industrial waste. It was predicted that plants in contaminated soil will eventually die of zinc contamination or by not getting enough nutrients. As predicted the plants did have growth defects and in severe cases they did die. This can be a major problem for the organisms that depend on these contaminated waterways. Especially communities near these waterways can have there crop contaminated by dangerous chemicals, therefore getting into organisms diet.

2012 - EV062

IDENTIFICATION, INTERPRETATION AND ANALYSIS OF PARTICULATE-MEDIATED MANGANESE IN MID-OHIO VALLEY SOILS

Peter Scott Welcker

Parkersburg South High School, Parkersburg, WV

Manganese is not an uncommon element. Average soil concentrations of manganese are 330 parts-per-million (ppm). Ferromanganese facilities emit large

amounts of nanoscale manganese, and Eramet is the only ferromanganese factory in either the United States or Canada. Air monitoring data has been published for Eramet, but no information is available for manganese soil levels. This research developed a mathematical model based on air emissions to predict soil levels and then analyzed the soil to test the accuracy of the model.

 Spectrophotometric analysis determined manganese in local soils was within an average +/- 1.5 % of the amounts predicted by the mathematical model. This confirms the old adage “what goes up - must come down” and verifies the hypothesis that manganese in Mid-Ohio Valley soil is particulate-mediated. Soil nearest the factory contained 227,800-ppm manganese, approximately 700 times greater than normal. Other locations averaged between 100-500 times normal with school playground containing 162,000-ppm. All locations were statistically significantly higher than controls.

 The defense department has labeled manganese as crucial for homeland security since steel cannot be made without manganese. This means production will continue. Soil monitoring can track manganese emissions so schools and other sensitive establishments are not built in heavily contaminated areas.

2012 - EV063

AN ORGANIC OIL SPILL CLEAN-UP 2

Bryanna Isela-Inez Canales

The Good Hope School, Frederiksted, St. Croix, VIRGIN ISLANDS

Approximately 706 million gallons of oil end up in the ocean every year, causing damage to wildlife and habitats (Embach, 2011). The purpose of my project was to find the best Natural Organic Sorbent/s that would be the most effective when being used as a boom to absorb and contain oil in oil spills. I tested ten different Natural Organic sorbents for their ability to absorb oil, repel water, and float in the water. My results showed that the feathers absorbed an average of 73.5 mL of oil per 1/4 cup of sorbent which was my volume for each sample compared to the other sorbents which only absorbed from a range of 57.75mL to 33.75mL. Feathers and coconut fibers repelled the most water. They only absorbed an average of 1.2mL of water compared to the other sorbents which absorbed from a range of 1.4mL to 46mL. The pine mulch was the most buoyant with an average of only sinking 3 mL. In conclusion, feathers performed best in two of three categories and second best in the third category. The feathers absorbed the most oil because they have a scaly outer layer that allows oil to seep into them and they absorbed the most water and were the second most buoyant because of the barbs and barbules that form the structure of the feather which keeps out air and water (FAQS, 2011). Future research could test different kinds of feathers and compare them with each other.

2012 - EV064

THE EFFECTS OF PHOTODYNAMIC INACTIVATION AND UV LIGHT IN WATER DISINFECTION TREATMENTS

Asha Marie Bethea

Hillside High School, Durham, NC

Many types of bacteria and viruses are resistant to current methods of drinking water treatment. In the United States, alone, an estimated 4 million to 33 million cases of gastrointestinal illness resulting from contaminated water supplies occur annually. There is a need to explore alternative methods of disinfection methods that are more effective and rely on different mechanisms than those currently employed. Photodynamic inactivation (PDI) is a disinfection process rarely applied to aqueous media, which requires a photosensitizer (PS), light, and oxygen. UV light, a commonly used disinfectant for water treatment, has the potential to drive PDI. The combination of PDI and UV light, which are both proven methods of disinfection, could offer a more efficient disinfection than UV alone, and PDI could be used to supplement this widely used process. In the present study, using a specific cationic porphyrin as a photosensitizer, the inactivation of bacteriophage MS2 by a combination of PDI and UV light was examined at various time periods. Using a literature-based, pour-plate method, PDI under UV light was observed to offer a greater inactivation of MS2 than UV light alone. The addition of the 1 µM porphyrin to UV disinfection decreased the concentration of MS2 an additional 4-15% from the use of UV alone, which proves that PDI can be used to successfully supplement UV disinfection and produce a more efficient cumulative inactivation.

2012 - EV301

DETERMINATION OF SOIL LEACHING USING CHEMICAL ANALYSIS

Briley Brendon Bourgeois, Lauren Luce,

Lutcher High School, Lutcher, LA

To determine if metal fractioning in the soils surrounding a local landfill was being altered by material in the landfill leaching from the landfill underlayment into the soil, chemical analysis of the soils was performed. A modified Tessier digestion procedure and flame atomic absorption spectrophotometer (FAAS) analysis were employed to determine if changes in metal fractionation in various metals commonly found in landfills had occurred. Soil samples were taken from public areas around the landfill. A control sample .5 miles west of the landfill was taken. Results from the original experiment showed that the control sample actually has a higher concentration of metals in comparison to the test samples. There are several possibilities for these results, but underground water flow is the suspected cause. Access to private locations around the landfill are currently being requested in order to confirm whether or not underground water flow is a factor in the results. The area in which the control sample is taken from will also be moved in a final trial of the experiment.

2012 - EV302

THE EFFECTS OF SILVER NITRATE AND SILVER NANOPARTICLE IMPREGNATED CERAMIC DISKS ON WATER PURIFICATION

Matthew Yukio Smith, Charles Jacob Perry (Jacob),

Albemarle High School, Charlottesville, VA

The objective of this project was to design and test a sustainable point-of-use water treatment technology for the developing world. Ceramic disks are fabricated from clay, water, and sawdust and impregnated with silver. These disks can be added to water storage containers to gradually release silver ions into

solution and disinfect water in the home. Redart clay, sawdust, and water were combined and compressed into 32 disks. The disks were fired in a kiln at 900 C; eight were fabricated with 0.83 g of silver (as silver nitrate) prior to firing. After firing, the remainder were treated by painting on an aqueous solution containing 0.02 g of silver nanoparticles, 0.83 g of silver nanoparticles, or no silver (control). The disks were then added to 150 mL of water containing a non-pathogenic strain of E. Coli. Over time, the concentration of E. coli, ionic silver, and total silver in the water was quantified. Ceramic disks with 0.83 g of silver nanoparticles resulted in a ten- to twelve-log reduction of bacteria after 3.5 hours but released unacceptably high levels of zero-valent silver into the water; the ceramic disks with silver nitrate added prior to firing resulted in a six- to eight-log reduction of bacteria after 3.5 hours and released silver into solution at a slower rate, presumably increasing the effective performance lifetime of this type of disk. Our data suggest that silver-impregnated ceramic disks are a viable form of point-of-use water purification.

2012 - EV303

ASSESSING OIL SPILL CLEANUP: THE ECOLOGICAL RAMIFICATIONS OF CHEMICAL TREATMENTS

Andrea Elise Green, Catherine Rose Mitchell,
H-B Woodlawn Secondary Program, Arlington, VA

Since the Deepwater Horizon explosion in 2010, much research has been conducted concerning oil spill cleanup technologies. Dispersants, commonly used in oil spill cleanup, have been shown to be highly toxic. Bioremediation agents, although considered less toxic than dispersants, require specific environmental conditions to effectively remove oil. This experiment examined the toxicity of bioremediation agents and dispersants. It was hypothesized that bioremediation agents would be less toxic than dispersants. The toxicity of four bioremediation agents (DualZorb, Micro-Blaze, RemediAde, and S-200) and two dispersants (Accell Clean DWD and Sea Brat #4) was measured through the survival rate of Artemia salina over a five-day period. The chemicals were tested in environments with and without motor oil. Two controls, one with oil and one without, were also tested. Overall, both chemical treatments had a significantly ($p < 0.00002$) negative effect on Artemia salina. On average, bioremediation agents were less toxic than dispersants, but DualZorb and S-200 were more toxic to Artemia salina than oil. This indicates that both chemical treatments could potentially harm the environment and further testing of these treatments is required. A concentration profile was also conducted on S-200 and Accell Clean DWD to determine the LC50 values. Nine different concentrations were tested using the same experimental method as the first phase. It was determined that the 48-hour LC50 value of S-200 was 633 ppm, while that of Accell Clean DWD was 15.4 ppm, further supporting the claim that, on average, bioremediation agents are less toxic than dispersants.

Awards won at the 2012 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel
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2012 - EV304

ENVIRONMENTAL REFRIGERATOR

Fawzi Moh'd ghassan Almitwalli, Nour Maraqa,
Al-Ra'ed Al-Arabi School, Amman, AL shimaaisani, JORDAN

This device was designed in order to preserve food, save money, save electricity and help the environment. The main purpose behind designing this device is to preserve food for a plenty of time depending on the solar energy. It has two functions: the cooling process using a pottery and the other is sterilizing depending on an UV Ozone lamp. The pottery will decrease the temperature to reach 9c when the water inside the device filters and evaporates using the pottery's heat. In addition, to two unidirectional fans which were added to remove the water's vapor above the water's surface and this increases the speed of the evaporation which leads to a faster cooling. On the other hand, the UV OZONE lamp will sterilize the chamber by inactivating and killing the microorganism in order to preserve food from any micro's damage. These two functions work together to preserve your fruits and vegetables in a simple, cheap and eco friendly way to protect your health, your financial conditions and most important your environment.

2012 - EV305

CAR EXHAUST PURIFICATION SYSTEM TO REDUCE AIR POLLUTANTS OF CAR ENGINES.

Sohaib Ali Maghnam, Hazem Husam Aldean Khadash,
Jubilee School, Amman, JORDAN

One of the main reasons for excessive pollution in the world is the huge amounts of Carbon Monoxide (CO) and Carbon Dioxide (CO2) emitted by car engines. According to the U.S. Centers for Disease Control and Prevention (2011); 20,000 cases are registered every year as unintentional CO poisoning in the U.S. alone, and 400 of those cases end with death. Therefore; the aim of this research is to investigate car engines' pollution and to suggest a better way of treating CO and CO2 gases respectively. Could the amounts of CO and CO2 harmful gases emitted by car engines be minimized using Car Exhaust Purification System (C.E.P.S)? Two special parts have been designed to treat both gases. The first part is stuffed with rock wool to insulate heat and contains the substance Hematite (Fe2O3) which will be responsible for treating CO gas by converting it to CO2. The second part contains Potassium Hydroxide (KOH) which will be responsible for treating CO2 gas by converting it to Potassium bicarbonate (KHCO3). The result of this study pointed out reduced amounts of CO and CO2 gases emitted from car exhausts, producing in the end completely safe substances using low cost technology. In the final analysis; C.E.P.S is strongly recommended to be used in treating CO and CO2 gases emitted by car engines.

2012 - EV306

MUSSELS, A NATURAL APPROACH TO WATER QUALITY IMPROVEMENT: ASSESSING THE IMPACT OF ENVIRONMENTAL FACTORS ON P. AMERICANUS AND G. DEMISSA STATUS IN LONG ISLAND BAYS AND APPLYING G. DEMISSA AS BIOFILTERS

Jane Elizabeth Smyth, Arianne Elizabeth Papa,
Long Beach Senior High School, Lido Beach, NY

Catches of *Pseudopleuronectes americanus* (winter flounder), a commercially and recreationally important species in the Northwest Atlantic, have plummeted since the 1980s. In this study, *P. americanus* growth and mortality were estimated in Jamaica Bay, Moriches Bay, and Shinnecock Bay on Long Island from June to August, 2011. *P. americanus* were least abundant in Jamaica Bay, which experienced the highest mean temperature (25.34°C) and lowest median dissolved oxygen (6.79 mg/L) along with the highest input from sewage treatment plants (STP). STP effluent containing high nutrient levels and anthropogenic pollutants is known to degrade environmental quality. Our previous two years of research demonstrate that *Geukensia demissa* (ribbed mussels) are a hardy species capable of filtering such pollutants, including DEET and chlorine. This year, *G. demissa* filtration rates and condition indices (CI) were studied in relation to *P. americanus* population status in Long Island bays. *G. demissa* filtration rates and CI varied with environmental quality, with highest CI in Jamaica Bay and Reynolds Channel, the sites with the most STP effluent input. To assess their long-term effectiveness as biofilters in the field, caged *G. demissa* were deployed in Reynolds Channel at the Long Beach STP and marsh. After four weeks, *G. demissa* from both sites maintained filtration abilities and similar CI (n.s. Tukey HSD). The high tolerance of this species to chemical stress and their ability to filter pollutants supports that *G. demissa* could function at STP discharge points as efficient and cost-effective biofilters.

Awards won at the 2012 ISEF

First Award of \$1,000 and a plaque - American Veterinary Medical Association
Second Award of \$1,500 - Environmental Sciences - Presented by Intel
First Award of \$3,000 - Consortium for Ocean Leadership

2012 - EV307

HAIR ISSUE: PRESERVING THE WATER RESOURCE

Henry Diaz Castillo, Nicolas Antonio Castillo Cofre, Jorge Patricio Gutierrez Aguirrez
San Agustin de Atacama, Copiapo, Region de Atacama, CHILE

Copiapo city (Atacama Region, Chile), has one of the most arid climate, it rains each five years and today, hydric depletion is serious, due to agriculture and excess of rights water granted to privates.

The technology of padded leads the methodologies of agricultural exploitation of Copiapo valley.

An technological and sustainable innovation, economic and environmentally, is urgent to address the water issues in Atacama.

In our research was replaced the padded of polyethylene by human hair, experiencing in controlled systems of Triticumaestivum (wheat) crops, with irrigation protocols of 1000mL to 0 mL, with three applications by week. Was systematically measured the soil relative humidity, biomass production and other environmental variables.

Experimental wheat crops, with human hair, demonstrated significant advantages respect the polyethylene technology, in terms of stabilization of soil relative humidity, biomass production (20% more respect to use of polyethylene), sustainable biomass production up to 50% of irrigation reduction, also a better quality of vegetable tissue.

It was concluded that incorporation of human hair, in experimental conditions, is an efficient

technological innovation for agricultural activities in an arid zone, satisfying economical end

and protecting water resource

Projecting the results to bigger scale is an environmental opportunity and of competitiveness for Atacama Region.

2012 - EV308

USE OF A WASTE AS AN ANAEROBIC FILTER MEDIA

Irene Barrantes-Ortiz, Natalia Barrantes-Ortiz,
Colegio Científico Costarricense Sede San Pedro, Montes de Oca, San Jose, COSTA RICA

The project seeks to identify ordinary waste material that can replace the volcanic rock as a filter medium in biological treatment systems of wastewater known as Up-flow Anaerobic Filters (Filtros Anaeróbicos de Flujo Ascendente FAFA- in Spanish).

The material of choice must meet characteristics to be described and its cost should be according to the economic and environmental context. The contribution aims to reduce construction costs and help reduce the environmental impact when looking for practical applications for such wastes.

In the first stage, preliminary tests were made with different alternative media (plastic bottle caps, computer keys, Styrofoam, polystyrene, seashells and volcanic rocks). We evaluated the pH and temperature as control parameters. Biomass formation around the medium, the environmental impact and the availability of material were used as comparison parameters, in order to measure the suitability of the medium.

Plastic caps were chosen for the next evaluation stage. In the second stage, two full-scale systems were built, one with the medium chosen and the other one with volcanic rocks as control. The variables to be evaluated were Biochemical Oxygen Demand and Total Suspended Solids. The caps demonstrated to be equivalent or superior to the control medium. With their use there were 20% savings on the cost of FAFA and 10% savings on the total cost of the treatment plant. According to the above, it is concluded that these caps constitute an alternative filter medium for efficient wastewater treatment.

2012 - EV309

UTILIZATION OF VARIOUS GRADES OF WASTE PAPER FOR THE PRODUCTION OF ETHANOL AND BIO-PRODUCTS THROUGH FERMENTATION

Spandan Shah, Vishal Nallanagulgari,
Upper Arlington High School, Upper Arlington, OH

The United States alone used 140 billion gallons of gasoline in 2011. Dependence on fossil fuels has raised multiple concerns, including dependence of foreign nations and air pollution. An emerging alternative to gasoline is ethanol. America generates 71 million tons of a paper every year. Since paper is composed of cellulose, one of the sources of biofuels, this study experimented with different grades of paper and their respective success in producing ethanol as a product through fermentation.

The experiment was divided into 3 trials comparing 8 grades of paper. In each trial, 5 grams of each grade of paper were added

to individual flasks along with the selected enzymes, buffers and water. The paper was fermented for 7 days in a shaking incubator. After the fermentation process was completed, a small sample of the liquid from each flask was tested in the High Performance Liquid Chromatography (HPLC) machine. All grades of paper yielded two major bio-products: ethanol and lactic acid. Further tests confirmed that lactic acid was also a product of paper fermentation. Overall, this study concluded that paper could be used as a source of bio-fuel and biodegradable plastic.

Awards won at the 2012 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

2012 - EV310

MICRO DESALINATION PLANT

*Pedro Alecsei Caballero, Genesis Cedeno,
Centro Educativo de Progreso, Chiriqui, PANAMA*

The main objective is to create a low cost micro desalination plant capable of producing fresh water for consumption by people, animals and plants which can be located anywhere, especially in those areas where drinking water is a scarce commodity. Sea water contains dissolved minerals that precipitate when it evaporates. Because of this, it is not suitable for human consumption, and if it is drunk in great quantities it can cause death. The idea is to come up with a system that provides a continuous and cheap source of good quality water. Sea water follows a continuous purification cycle; it is from it that comes up the idea of making a desalination plant which can solve the scarcity of drinkable water. 15 minutes after turning on the heater, the process begins, and it can be seen that the heat allows water to condense and pass through the PVC tubing to a hose, which must have a semi-incline angle of about 20 degrees to avoid the condensed drops to return to the original container, and thus, it can drain easily into a collection container. With the plant, the byproduct is not returned to the sea, but would be used by people. Perhaps this is not a long term solution, but a viable future alternative. Get drinkable seawater is one of the possible solutions to the shortage of the vital liquid. Using this technique we obtain fresh water suitable for human consumption. Water desalination involves several problems, among them: more energy use and dependence on fossil fuels.

2012 - EV311

THE EXXON MOBIL OIL SPILL EFFECT ON MACROINVERTEBRATES IN THE YELLOWSTONE RIVER

*Crystal Ann Scoles, Molly Porter,
Billings West High School, Billings, MT*

On July 1st, 2011 the Exxon Mobil pipeline in the Yellowstone River near Laurel, MT broke spilling gallons of oil into the river. We wanted to see if the spill had an impact on macroinvertebrates in the river. We took random samples of macroinvertebrates in similar habits above and below the breakline. The test above the breakline was used as the control. We hypothesized that the biodiversity and abundance would be lower where the oil spill had occurred, however our results should differ. We used the Simpson's Biodiversity Index and got a value of .63 below the break, and .33 above the break. This shows us that there is a higher biodiversity where the oil spill occurred. We calculated a Chi-Squared test to see how significantly different the data is between the two sites. With a p-value of nearly 0, we conclude there is a difference between the two groups. We then compared individual taxonomic groups using a 2 proportion z-test to compare the mayflies, stoneflies, and midge larva. Qualitatively, we observed that the macroinvertebrates above the oil spill were quite a bit larger than the ones below. We hypothesized that this could be due to the oil killing off the older stages of mayflies and stoneflies, allowing for the first stage larva to colonize the rippled zone later that summer. This would explain why the biodiversity and abundance is higher in the site affected in the oil spill, and why the insects appeared smaller.

2012 - EV312

PURIFICATION OF WATER THROUGH MIRROR DISTILLATION

*Kelly Taylor Roddick, Andrea Cuevas, Lauren Huffstetler
Ashbrook High School, Gastonia, NC*

The experiment tests whether or not mirrors can purify water collected from nylon mesh. The square pyramid of mirrors will produce enough heat to vaporize the water and purify it through a distillation process. The procedure includes constructing a square pyramid of triangular mirrors and an overhang for the flask of water to reside in. It also includes directing light onto the mirrors, allowing the reflection of light to heat the water and testing the condensed water collected after it has been distilled. After three trials of the experiment, the collected water was tested using both coliform and turbidity testing equipment. The water that traveled through the distillation process tested clean and suitable for human consumption, while the water that had not undergone the mirror distillation tested unclean and unsuitable for drinking. This proved that the mirror distillation technique for purifying water was successful. The square pyramid of mirrors concentrated enough heat to vaporize the unclean water through the glass distillation piping--producing purified water at the end of the experiment.

2012 - EV313

REGENERATING CORAL FRAGMENTS ON BAMBOO ARTIFICIAL REEFS

*Hazel Anne Jurado Hernandez, Julian Paolo T. Biyo, Paul Caesar M. Flores
Philippine Science High School - Western Visayas Campus, Iloilo, Iloilo, PHILIPPINES*

Widespread use of coral rehabilitation efforts such as coral transplantation and artificial reefs are utilized due to the global decline in coral reefs. But the prohibitive cost of ARs limits its use in poor communities. Thus, there is a need to explore inexpensive alternative materials like bamboo for AR construction. The study determined if coral fragments can survive and grow using bamboo as artificial reef material. Specifically, percent survival of Acropora and Stylophora

fragments on concrete and bamboo ARs were determined monthly for 10 months (Feb-Dec 2011). Mean Projected Circular Area (PCA) of the transplants on both ARs were determined quarterly (Feb, June, Sept and Dec). Water quality parameters such as temperature, salinity, transparency and suspended solids were monitored monthly for the first seven months.

 Results showed higher percentage survival in Stylophora (concrete=65%; bamboo=35%) than Acropora (concrete=35%; bamboo=15%). Stylophora fragments also showed higher growth in terms of mean PCA than Acropora transplants. One-way ANOVA showed a significant difference in the mean PCA of Stylophora on both concrete (F=6.373; p=0.001) and bamboo (F=3.71; p=0.025) ARs but no significant difference was noted on the regenerated Acropora. Water quality of the site was within the tolerance range of corals. This study showed that coral fragments can survive and grow on bamboo, which is a cheaper alternative to concrete. The use of bamboo will help not only reduce the financial problems encountered by the Banate Bay local management but also in other areas in the world where coral reefs are degrading and bamboo is readily available.

Awards won at the 2012 ISEF

Fourth Award of \$500 - Environmental Sciences - Presented by Intel

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2012 - EV314

PRODUCTION OF “DENSIFIED” LOGS FROM THE INVASIVE TUMBLEWEED SPECIES SALSOLA IBERICA (RUSSIAN THISTLE) AND OTHER SPECIES FOUND IN THE FOUR CORNERS AREA

*Lawrence William Redhorse, Cyrus Mcdonald,
Newcomb High School, Newcomb, NM*

This study focuses on the production of “Densified Wood Log”: from the invasive tumbleweed species (Salsola iberica) and the common Southwest weed (Chrysothamnus nauseosus). Russian Thistle (Salsola i.) and Rabbit Brush (Chrysothamnus n.) are common plants in the Southwest. There are no uses of Russian Thistle, as even grazing animals avoid it due to its thorny stems when full grown. Rabbit brush on the other hand has been commonly used for mined – land rehabilitation, effective landscape plants with its bright yellow color. Since these two species are almost always avoided by animals, it has no known value and therefore just grow anywhere abundantly. In this study the procedure is started by obtaining bushels of said plants and hang dry them until they are brittle enough, and then process into smaller pieces. After collection and processing, they are weighed into 0.28 kg batch mix with 0.11 kg of piñon sap with 10 mL of canola oil & 20 mL of water, compressed and baked for 35-40 minutes at 350 degrees Fahrenheit. The 2 samples are cooled before they are cut into blocks measuring 6.9 cm x 10.16 cm x 10.16 cm. The ignition time, temperature, mass and amount of ashes produced are measured after the burning of these 2 samples and are compared with commercial densified wood log products that have been burned with in a set time. The result of this study shows that there is a potential to produce densified wood logs from the chips of S. iberica and C. nauseosus.

2013 - EV001

FLUORESCENT QUANTUM DOTS AS A SOLID-PHASE DETECTION MEDIUM FOR HEAVY-METAL CONTAMINATES IN DRINKING WATER

*Rikhav Shah
Lake Highland Preparatory School, Orlando, FL*

The goal of this research project is to develop a solid-phase Quantum Dot (Qdot)-based optical sensing probe for the detection of toxic heavy metal ions (HMI) in contaminated drinking water. Qdots are semiconductor nanocrystals in the size ranging from 2 nm to 10 nm. Heavy metal ions are known to strongly interact with Qdots in aqueous solutions, causing Qdot fluorescence quenching. It is hypothesized that heavy-metal induced Qdot fluorescence quenching phenomena can be exploited for rapid detection of heavy metal contaminants in drinking water. To test the feasibility of this concept, a pilot study has been designed and carried out. A yellow emitting CdS:Mn/ZnS Qdots were embedded in cellulose paper strip to fabricate a paper based sensor probe for HMI detection. Under a hand-held UV-excitation source, the Qdot embedded dry paper strip emitted yellow light brightly, suggesting that Qdot fluorescence property did not change. In the next step, the Qdot sensor strip was challenged with drinking water intentionally contaminated with Cu and Pb ions at different concentrations. The United States Environmental Protection Agency's (U.S. EPA) regulations for Maximum Contaminant Level (MCL) of heavy metals in drinking waters were used to select the minimum concentration of for Cu and Pb ions. Qdot fluorescence was quenched by Cu ions at EPA standard, and by Pb ions at 1000 times EPA standards (detected visually). It was observed that these Qdots were fairly insensitive to Cd ions, as expected. This research strongly suggests that a simple paper based Qdot sensors can be designed and fabricated for quick testing of drinking water for potential contamination with HMIs.

Awards won at the 2013 ISEF

New American University Provost Scholarship - Arizona State University

Second Award of \$1,500 - Environmental Sciences

Honorable Mention - SPIE, the international society for optics and photonics

2013 - EV002

AN INVESTIGATION ON THE EFFECTS OF AIR-POLLUTANTS ON PLANT GROWTH

*Jayde Caroline Bromwich
Creston College, Port Shepstone, SOUTH AFRICA*

The aim of the investigation was to determine whether air pollutants will affect the growth of plants.

Three week old tomato seedlings were divided into three groups of thirty each: The control group, the group exposed to Propane gas, and the group exposed to Sulphur dioxide gas. The growth of each plant was measured every two days over a twenty two day period. The plants were kept in a confined environment and did not come into contact with each other; the plants were watered every day with 20mls of water. Each plant spent six hours each day in the sunlight.

Sulphur dioxide had a more significant effect on the growth of plants than Propane gas had on the growth of the plants over the twenty two day period. The differences in colour to the plants exposed to

Sulphur dioxide gas were more drastic than that of the changes to the plants colouration exposed to Propane gas. The percentage of the number of leaves lost from the plants exposed to Sulphur dioxide was higher than the percentage of the number of leaves lost from the plants exposed to Propane gas.

The air pollutants, Propane gas and Sulphur dioxide gas have a negative effect on the growth of plants. The percentage growth for the plants exposed to Sulphur dioxide was lower than that of the plants exposed to Propane gas and thus the investigation proved that air pollutants affect plant growth negatively.

2013 - EV003

IMPACTS OF BIOCHAR ON SOIL GREENHOUSE GAS EMISSIONS, SOIL MOISTURE, AND CROP POLYCYCLIC AROMATIC HYDROCARBON (PAH) CONCENTRATIONS

Rena Dorothy Weis
New Prague Senior High School, New Prague, MN

The purpose was to study the impacts of biochar on soil greenhouse gas emissions, soil moisture, and polycyclic aromatic hydrocarbon (PAH) concentrations in specialty crops.

I required six plots (each 23.8 square meters), which allowed for two treatments, each replicated three times. Three of the plots were amended with 0.763kg/m2 biochar, and three were untreated and served as control plots. Sweet corn, lettuce, carrots, and squash were planted in each of the plots in a consistent layout.

One static PVC gas flux chamber was installed in each plot. Each had a removable top with gas-tight fittings for sampling using a sample collection port and syringe. Gaseous fluxes were measured weekly for each plot. Samples were injected into helium flushed headspace vials and analyzed by a gas chromatograph. The biochar plots emitted significantly less methane than the control plots to the point that methane was oxidized. However, there was no statistical difference between the flux rates of carbon dioxide or nitrous oxide soil emissions when the biochar and control treatments were compared.

Volumetric soil moisture was measured once a week using a TDR probe. Nine measurements were taken from each soil treatment on each sample date. The biochar plots had significantly higher moisture content than the control plots.

PAH content was measured using an acetonitrile extraction. Concentrations were determined by a gas chromatograph-mass spectrometer. There was not statistical difference between PAH concentrations in the crops obtained from the biochar plots compared to the control plots.

In conclusion, amending biochar to the soil reduced soil methane gas emissions, increased soil moisture content, and had no effect on PAH concentrations within the harvested crop.

Awards won at the 2013 ISEF
Fourth Award of \$500 - Environmental Sciences

2013 - EV004

TITANIUM DIOXIDE NANO- AND MICROPARTICLES: TRANSPORT AND FATE IN WASTEWATER TREATMENT SYSTEMS

Leah Gage Huling
Ada Senior High School, Ada, OK

Hundreds of commercial products containing nanoparticles (NPs) (1-100 nm in size) are produced and consumed in the U.S. Titanium dioxide (TiO2) NPs, produced in greatest quantities relative to other NPs, are released into wastewater collection systems, ultimately reaching wastewater treatment plants (WWTPs). Here, the fate of TiO2-NPs and microparticles (MPs) was investigated in rural (Ada, OK) and urban (Norman, OK) WWTPs. Removal (>98%) of TiO2 was measured in both WWTPs and found to accumulate in biosolid residuals. TiO2 was absent in drinking water in both cities (<1 µg/L), indicating the source was from disposal of commercial products into the wastewater treatment system. Soil TiO2-NPs/MPs concentrations at the biosolids disposal sites did not measurably accumulate relative to biosolids-free background soil or between surface soil intervals. Future TiO2-NP manufacturing and production trends indicate exponential increases in the U.S. Applying these trends to TiO2-NPs at WWTPs, it was projected that TiO2 concentrations at these biosolids disposal sites in Ada and Norman will increase ten-fold in 7-19 years. TiO2, a known photocatalyst through solar photoactivation mechanisms, enhanced (14x) the photo-oxidation and mineralization rates of natural organic matter, indicating the potential for TiO2 residuals to negatively impact soil quality and fertility. Additional efforts are needed to quantify TiO2 NP dispersal at biosolids disposal sites and to assess current and future environmental impacts, including post-disposal enhanced photo-oxidation mechanisms. There are 12,960 WWTPs in the U.S., and even more internationally, where biosolids are disposed in soil. Given these results, future actions are proposed to alleviate excessive accumulation of TiO2 NPs in soil.

2013 - EV005

MINING MYSTERY: THE EFFECT OF ACID MINING (SULFUR COMPOUNDS) ON BACILLUS MYCOIDES FOUND ON THE STALK OF WILD RICE (ZIZANIA PALUSTRIS)

Cassandra Lynn Roy
Cloquet Senior High School, Cloquet, MN

Sulfate, entering aquatic systems, is microbially reduced to sulfite and sulfide, which has been shown to be toxic to aquatic organisms (MPCA, 2011). The question was: What effect does acid mining (sulfur compounds) have on Bacillus mycoides growth found on wild rice stalks? Initially, nutrient agar was serially diluted to 0, 10, 50, 100, and 500 mg/L of sulfate and inoculated with B. mycoides, showing enhanced bacterial growth. To determine the effects of just sulfate minus the nutrient affect, another set of sixty plates were serially diluted, but this time with sulfate dilutions of 10, 100 and 300 mg/L of plain agar. This process was repeated twice and no growth was recorded. Next, a set of dilutions made with agar and wild rice stalks, showed only microscopic growth on stalks. Finally, 95% plain agar and 5% nutrient agar were mixed with similar sulfur compounds and procedures as above. Finally, measureable growth occurred, as the sulfur compound concentrations increased, when compared to the control, bacterial growth significantly decreased (p<0.017), yet not when compared to the sulfate (S04) and sulfite (S03) concentration of 10 mg/L (p<0.301). Predominantly, at sulfate levels above 10 mg/L no natural wild rice stands exist in Minnesota (Maccabee, 2011). Possibly, a large biomass of decomposing wild rice litter could simulate a high nutrient (agar) situation and a low nutrient (agar) situation simulates a low rice litter year. There appears to be a relationship between Sulfur compounds, Bacillus mycoides growth and that of Wild Rice in Minnesota Lakes.

Awards won at the 2013 ISEF

Fourth Award of \$500 - Environmental Sciences

2013 - EV006

THE EFFECTS OF PLUEROTUS OSTREATUS ON THE DETERIORATION OF PETROLEUM

Andrew John Steffl

St. Mary's Cathloic High School, Sleepy Eye, MN

The purpose of this experiment was to see whether or not pearl oyster mushrooms deteriorate petroleum and whether or not the application method of the petroleum to the mushrooms affects the effects the mushrooms have on the petroleum. If so this could be used for cleaning up oil spills or used as a buffer zone around lakes and ponds.

This experiment tested three different applications of the petroleum to the mushrooms. The first being the mushrooms being placed into a container with petroleum already in it to simulate the mushrooms being brought to an oil spill. Another application involved the adding of the petroleum to the mushrooms to simulate the mushrooms in a buffer zone and the petroleum flowing to it. The last application involved mixing the petroleum with gravel to simulate a petroleum into soil or sand. The fumes given off by the petroleum were tested by a photoionization detector (PID). Less fumes that was detected by the PID meant less parts per million (ppm) of the petroleum.

The results showed that the group added to the mushrooms was the most successful, followed by the group that had the mixture of gravel and petroleum, and the least successful being the petroleum added to the top of the mushrooms. The group that was added to the petroleum broke down an average of 5.31 ppm per twelve hours, the group with the petroleum mixed with the gravel averaged 4.93 ppm per twelve hours, and the group that had the petroleum added to the top averaged 4.34 ppm.

The data shows that the group that has the most petroleum in contact with the "roots" or mycelium of the mushrooms breaks down the most petroleum. This means that the most effective way to use pearl oyster mushrooms to deteriorate petroleum is to have the mushrooms in the position so that the mycelium have the most contact with the petroleum.

2013 - EV007

WOULD YOU LIKE SALT WITH THAT?

Madison Chyanne Evans

Vici High School, Vici, OK

The purpose of my experiment was to determine which bluegrass, Kentucky, Texas, or the Bluegrass Hybrid was more salt tolerant therefore making it more drought resistant. I hypothesized that the Bluegrass Hybrid would be the most salt tolerant.

The independent variable of my experiment was the different grasses I used. The dependent variable was the growth, germination, and weight of the grasses. My three controlled variables were how much water, length of grow time, and the temperature for all the grasses.

My procedure was to plant and water the grasses once or twice a week with different salt proportions. In salt proportions I had a high with a conductance of 10ds m-1, medium-5ds m-1, low-2ds m-1 and control (tap water)-0.4ds m-1 solution. Then I counted the germination amount. I cut them three different times and measured their mass each time. Then I calculated the production percentage to determine which bluegrass has the most salt tolerance.

The data indicated that Kentucky Bluegrass had the highest production percentage compared to the control. The production percentage of Kentucky Bluegrass was close to 80% of the mass of the control while the worse production percentage belonged to Texas Bluegrass, at around 10%.

My data did not support my hypothesis. It showed that Kentucky Bluegrass had the highest salt tolerance out of all the other bluegrasses. The least tolerant of the bluegrasses was Texas.

2013 - EV008

DEVELOPMENT AND OPTIMIZATION OF A NOVEL VOC BIOFILTER TO REMEDIATE INDOOR AIR POLLUTION (IAP) SUSTAINABLY PLUS AN ANALYSIS OF ITS IMPACT ON HUMAN LUNG HEALTH AFTER INTEGRATION

Naomi Chetan Shah

Sunset High School, Portland, OR

1 death every 20 seconds and nearly 2 million deaths annually are attributable to poor indoor air quality (WHO, 2011). This three-phase investigation shows promise as a next generation, cost-effective, and sustainable solution for targeted remediation and indoor air pollutant filtration to improve environmental safety, mitigate lung disorders, reduce mortality, and decrease healthcare costs. Previous research suggests strong positive correlations between Particulate Matter (PM10), Total Volatile Organic Compound (TVOC), and target VOC (Styrene, Toluene, Xylene) concentrations and human lung health degradation (measured by Peak Expiratory Flow Rate).

In Phase 1, a novel VOC biofilter was developed with various plant species, peat, vegetable mulch, and 50% moisture content. Integrating and testing the biofilter prototype in an independently-constructed HVAC simulation yielded promising results; TVOC and PM10 levels declined by 44% and 18%, respectively. In Phase 2, four combinations of plant species were tested in effort to optimize biofilter treatment efficiency in removing target VOCs. The pollutant-degrading microbes present on the root nodules of the plants metabolically break down the complex carbon structures of VOCs into innocuous byproducts, CO2 and H2O. TVOC, Styrene, Toluene, and Xylene levels declined by about 21%, 14%, 19% and 24% respectively. Follow-up experimentation proved that reduction in VOCs was caused by metabolic breakdown and not adhesion by analyzing effectiveness of living and non-living biofilter treatments. The biofilter costs under 30 dollars to construct and deploy; further, its electrical usage and risk of secondary pollution from current incineration techniques is significantly less than traditional purification systems.

Awards won at the 2013 ISEF

Intel ISEF Best of Category Award of \$5,000 - Environmental Sciences

Trip to attend the Taiwan International Science Fair. - K. T. Li Foundation Special Award

2013 - EV009

NEW SORBENT FOR WATER PURIFICATION FROM OIL AND PETROLEUM

Bogdana Bandurko

Donetskyi Oblastnyi Sanatornyi litsey-internat "Erudit", Donetsk, UKRAINE

Oil is top of ten major pollutants of the biosphere, according to UNESCO because oil and oil products exert toxic effects on living organisms. 1 dm³ of oil deprives oxygen from 40 thousand liters of seawater. Therefore the aim of my project was development of cheap and effective sorbent for oil and petroleum spills from water surface.

Analysis of the sorption capacity of various tested sorbents was studied in relation to petroleum products by dynamic and static methods.

We developed series of sorbents based on the combination waste from fertilizer production and agricultural waste. Sorbents were tested for absorption capacity. Different additives to the brown coal included were apricot seeds, sawdust, husks of sunflower seeds and corn cobs mixed in different ratios. In total 9 combinations of sorbents were tested on sorption of gasoline, diesel and crude oil in experimental setting. It was shown that combination of brown coal with saw dust was more effective and cheaper than the commercial sorbent sample. 1 g of derived sorbent was sufficient for absorption of 7.14 grams of oil. Cost of 1 gram of sorbent is 0.15 USD. The cost of 1 gram of industrial sorbent is ranging from 0.62 USD to 1.49 USD.

Thus my project helps to solve three problems: cleaning water from oil, utilization of agricultural and carbon waste and rational use of resources due to the possibility to collect and burn absorbed pollutant as fuel.

2013 - EV010

STUDY ON THE EFFECT OF THE COMBINATION OF CRATONEURON FILICINIM AND ALGAE TO PURIFY WATER

Yun Zhu

Gaojing No.3 Junior High School, Shanghai, CHINA

Eutrophication has attracted extensive attention in recent years, the situation of which in China is getting worse at present. In the present report, ecological restoration technology was studied, which used Cratoneuron filicinim combined with five different kinds of algae to absorb nitrogen and phosphorus in the water via photosynthesis. Using five combinations after one period of treatment, the average removal efficiency of total NH₃-N (NH₃-N) is 87.2%; of total phosphorus (TP) is 78.6%; of total nitrogen (TN) is 71.4%. We further studied the efficiency of water purification by the best combination of Cratoneuron filicinim and different biomass of Myrmecia incise. The results indicated that the combination of 50g/m³ Myrmecia incise and 20head/m³ Cratoneuron filicinim results in the best efficiency, with 99%, 95% and 82% removal efficiency for NH₃-N, TP and TN, respectively. This result suggests the feasibility of applying this combinative method to treatment of sewage and provides preliminary data for the future study of the efficiency of water purification by algae in different seasons.

2013 - EV011

EFFICIENT DEGRADATION OF COMMON HERBICIDE METOLACHLOR BY A FUNGUS

Meng Xiao

The High School Attached to Hunan Normal University, Changsha, CHINA

The herbicide "Du Er" namerly, Metolachlor is one of the most widely used herbicides, which caused pollutions to water and soil. However, the degradation of metolachlor mainly depends on natural light, and has the defects of low degradation rate and long period. Inspired by the theory "co-evolution between microbe and environment" from the high school biology knowledge, this work has isolated and screened a fungus Fcl-3 possessing biodegradability for metolachlor by enrichment culture for the first time. Through morphologic observation and ITS sequence analysis, this fungus was identified as Fusarium sp.. In condition of laboratory, the degradation character was studied, and I found that the growth period 2-4d is the fastigium of metolachlor degradation. Meanwhile, the degradation condition for Fcl-3 was optimized, and then the degradation efficiency could reach 95.4% after cultivation for 7 days. Finally, some preliminary exploration on the toxicity of degradation products was carried out, the results show that the water pollution was effectively solved, and there did not produce new other toxic substance during degradation process. This research provides an effective solution for eliminating the pollutions of metolachlor and other similar chemicals.

2013 - EV012

PROSPECTIVE STUDY OF LOGARITHMIC SPIRALS AND HURRICANES

Neil Ferdinand Nathan

Caddo Parish Magnet High School, Shreveport, LA

This purpose of this project is to determine if the pitch angles of logarithmic spirals in hurricanes are correlated with their intensity and to determine if the external pitch angles are more accurate than the internal pitch angles. The hypothesis is that it is possible to predict hurricane intensity in a prospective manner using the pitch angle scale, based on logarithmic spirals in the hurricanes, devised in a previous retrospective study.

Logarithmic spirals were traced in all hurricanes from the 2012 Atlantic hurricane season. Pitch angles were drawn on each hurricane using both the external and internal logarithmic spirals. Two predictions of ultimate hurricane intensity were made for each hurricane using the pitch angle scale. Data was tabulated and compared to actual hurricane intensity. Statistical analysis was performed using Spearman Rank Correlation Analysis and Wilcoxon Signed Rank Test. Both of these tests yielded highly significant results. The p value was <.01 which is extremely significant.

 It is concluded that hurricane intensity can be predicted by using pitch angles of logarithmic spirals found in the hurricanes. The external logarithmic spirals prove to be more accurate than the internal spirals. This method is very reliable and simple, unlike those used commonly by meteorologists. This method of hurricane prediction can lead to significant savings in terms of life and property by letting future victims properly prepare for hurricanes to come.

Awards won at the 2013 ISEF

Award of \$2,000 for best overall project in ocean science and exploration. - Consortium for Ocean Leadership

2013 - EV013

REDUCTION OF NANOPARTICLE CONTAMINATES FROM WASTEWATER USING ION EXCHANGE CAPABILITIES OF ALUMINOSILICATE MINERALS

Michaela Zae Denniston
Greybull High School, Greybull, WY

Manufactured Metallic Nanoparticles are present in products that the general population uses every day. Oxides such as Zinc and Copper nanoparticles are useful, but they also have the potential to contaminate the environment through wastewater that may enter agricultural soils. To eliminate these contaminants a filtering system was constructed. The filtering apparatus was first set up using a stand, a glass tube, two screens, cheese cloth, and bentonite. The screens were placed over the beaker and the glass tube was placed on top of the screens held up by the stand. The cheese cloth was then place at the bottom of the tube and 150 g of bentonite were added to the tube. The zinc oxide and cupric oxide standard solutions were then added (95 mL) and collected in the beaker. The samples were processed through the bentonite three times and allowed to filter until 50 mL of the filtrate was collected. The filtrate was then passed through filter paper to eliminate any remaining bentonite that may have been present. It can be concluded that copper oxide and zinc oxide can be adsorbed effectively using the ion exchange capabilities of bentonite. A working purification system was built that was successful in filtering the oxides present in the standard solutions. This filtration system could be used for wastewater that goes into fields that grow plants such as soybeans and radishes. This would potentially eliminate the hazardous zinc and copper oxides that are capable of stunting plant growth. The system showed positive reduction rates in both zinc and copper oxide. This process should be capable of being scaled to a much larger system, one which could be used in the near future to eliminate a number of different environmental contaminants from several water supplies.

2013 - EV014

AN INQUIRY INTO THE EFFECT OF THE ENVIRONMENTAL POLLUTANT ACRYLIC ALDEHYDE ON NEUTROPHIL ACTIVATION

Sanjana Jagdish Rane
duPont Manual Magnet High School, Louisville, KY

Acrolein is an acrylic aldehyde that is present in exhaust smoke from cars, cigarette smoke, and refried oils. These acrylic aldehydes are toxic as they can modify proteins in the cell and alter their cellular function. Given that smokers are immunocompromised, we wanted to determine effects of acrolein exposure on neutrophil functions. Whenever we have an infection, the neutrophil lifespan is prolonged to combat the infection. Uncontrolled neutrophil activation can cause tissue damage. We hypothesized that acrolein exposure will alter neutrophil apoptosis by promoting neutrophil survival. Neutrophils were treated with low (1 micro M) and high (10 micro M) doses of acrolein overnight with or without lipopolysaccharide and neutrophil lysates were generated. Lipopolysaccharide was used as positive control for neutrophil survival. The neutrophil lysates were immunoblotted with anti-cleaved caspase-3 antibody, as a marker of apoptosis. The immunoblot data was significant with $p < 0.05$. We also subjected neutrophils to an apoptosis assay by staining cells for annexinV and caspase-3 and cells were analyzed by confocal microscopy. Moreover, the ability of acrolein to stimulate neutrophil actin-polymerization was also determined. The results demonstrate that low dose acrolein promoted accelerated apoptosis while higher doses of acrolein promoted neutrophil survival. Moreover, acrolein stimulated actin polymerization of neutrophils. Thus, the hypothesis was partially supported by the data as only high dose acrolein promoted neutrophil survival. However, both low and high doses of acrolein exposure to neutrophils is detrimental, as the accelerated rate of apoptosis can prevent effective clearance of bacteria, while prolonged neutrophil activity causes tissue damage.

Awards won at the 2013 ISEF

Second Award of \$1,500 - Environmental Sciences

2013 - EV015

SPREAD NO MORE III

Suchinkumar Sunil Patel
Grants High School, Grants, NM

Oil spills occur at a daily basis, but the impact they have vary in complexity. Oil spills can happen on land, in waterways, or in ocean waters. This oil is contained using a floating barrier known as an oil containment boom. Booms can vary in structure, shape, and material. In the prior projects, it was determined that a diamond-like boom structure with a rigid internal structure and repellant covering was most effective in containing oil spills. The purpose of this project is to assess several types of oil containment booms at a large scale so that their overall effectiveness can be determined in real world applications. Four different booms were constructed for experimental purposes, having either being constructed of a rubber or polyethylene material, and having a solid or segmented structure. It is believed that of the four different oil containment booms being tested a rubber boom with a solid structure will be most effective in containing oil spills within the ocean.

For testing purposes, a water flow system was constructed and attached to each container in order to simulate ocean currents. Oil was then placed in the boom and observed over time to determine the amount of breach from each boom.

The overall results of the test show that a rubber/solid boom was most effective in containing oil spills. This was followed by the polyethylene/solid boom, rubber/segmented boom, and polyethylene/segmented boom, respectively. However, the rubber/segmented boom was proven to be most effective in the first set of experiments.

2013 - EV016

GOT MALE? DOES TRICLOSAN CAUSE ENDOCRINE DISRUPTING EFFECTS IN DAPHNIA MAGNA?

Anna Elizabeth Sappington
South River High School, Edgewater, MD

This study investigated the potential of the antimicrobial chemical, triclosan, to cause endocrine-mediated effects in the aquatic crustacean, *Daphnia magna*. The widespread use of triclosan in numerous personal care products that frequently get washed down the drain (e.g., soaps, hand sanitizers, cosmetics, and toothpastes) has led to its detection in wastewater effluent, rivers, streams, and in tissues of aquatic organisms. Although levels of triclosan in the environment are relatively low, its potential to disrupt endocrine systems of animals is of concern. In *Daphnia*, as with other crustaceans, a set of juvenile hormones determines gender while ecdysteroid hormones regulate growth and development. To test whether exposure to increasing concentrations of triclosan disrupts the endocrine systems of *Daphnia*, 8-day old daphnids were exposed to environmentally relevant concentrations of triclosan ranging from 5 to 100 parts per billion (ppb) over three brood cycles with 5 replicates per concentration. Negative and positive controls were also tested. The results indicated higher concentrations of triclosan (50 and 100 ppb) reduced the number of young produced by *Daphnia* by up to 44%. The juvenoid hormone system of *Daphnia* did not appear to be affected because the *Daphnia* continued to produce female young. However, the results suggest triclosan may have disrupted the ecdysteroid system of *Daphnia* at concentrations as low as 5 ppb, demonstrated by underdeveloped antenna, shortened/curved shell spines, dead neonates, and premature births. Although confirmation of specific hormonal interaction is needed, these results indicate triclosan may be affecting crustacean endocrine function at real world concentrations.

Awards won at the 2013 ISEF

First Award of \$500 - Endocrine Society
Fourth Award of \$500 - Environmental Sciences

2013 - EV017
USE OF BIOSORBENT FOR REMOVAL OF COLOUR AND HEAVY METAL FROM DYED WASTE WATER

Sarah Jia Xin Wong
SMK Batu Lintang, Kuching, MALAYSIA

Fish scales are byproducts of fishery. In this study, raw fish scales and treated fish scales were used to investigate the feasibility of using fish scales as biosorbent to remove dye colour and heavy metals. I have therefore investigated the effects of treated and untreated (raw) fish scales, (i) on the removal of methylene blue (ii) on dyed wastewater from batik factory and (iii) on the removal of heavy metals. The results were analysed by using UV spectrometer. Sorption percentage, specific uptake of heavy metal per gram of fish scale, and removal rate of heavy metal per minute were calculated. The results have shown that fish scales are effective in removing methylene blue and heavy metals. The findings of this study can be summarized as follows: (i) Alkali treated fish scales with contact time of only 3 hours were able to achieve percentage absorbance of 81.41%. (ii) Larger amount of alkali treated fish scales added, higher percentage absorbance after 3 hours of treatment. (iii) The optimum removal of dye concentration is between 50mg/L and 100mg/L with 5g of alkali treated fish scales. (iv) Dyed wastewater collected from batik factory shows 92.14% absorbance with acid treated fish scales. (v) 98.34% of copper and 9.50% of chromium were removed after 12 hours of treatment with raw fish scales, The specific uptake is 3.8mg/g for copper, 0.31mg/g for chromium whereas the removal rate is 15.9 mg/hr for copper 1.3mg/hr for chromium. Therefore, I conclude that there is a great perspective of application of fish scales as biosorbent for dye colour and heavy metals in dyed waste water. The use of this bio waste is cost effective, minimal energy usage and environmentally-friendly and thus creating a greener environment for the sustainable future.

Awards won at the 2013 ISEF

Third Award of \$1,000 - Environmental Sciences

2013 - EV018
A FOUR YEAR MATHEMATICAL ANALYSIS AS A PREDICTOR OF DAMS IMPACT ON BIODIVERSITY AND STREAM RECOVERY

Aimee Michelle Turner
Ballard High School, Louisville, KY

Purpose: To create a mathematical formula based on four years of study of detritus from the Green River as well as temperature, PH, dissolved oxygen, and conductivity to show a correlation consistent to the changing levels of biodiversity in the stream. This formula could be used as a predictor of levels of biodiversity and aid the recovery of dam impacted streams. Recent data collected from the Salt and Licking Rivers is used to test the validity of the model and its application to other rivers. Procedures: Multiple timed trials for sampling of detritus both floating and submerged were taken along with flow speeds, levels of conductivity, PH, dissolved oxygen, and water temperature, computing both linear and nonlinear regression analysis using Excel, and comparing analysis to values of Salt and Licking Rivers for validity. Results: Taking into account variables such as peak time of season, stream flow speeds, outliers, and flood/landslide impacts; the best equation is of conductivity. $y = (-.0009x^2) + .2045x + 72.326$, x is the conductivity measured in uS/cm, y is the distance from the dam used to predict biodiversity zone; percent accuracy being 81.48% Conclusions: Each omission of a lurking variable increased the R2 value making the model more reliable to world application, but even though the model showed improvements, based on detritus levels it still is unable to accurately predict distance from the dam and the correct zone of biodiversity. Based on percent accuracy, conductivity proved the most applicable in predicting distance and biodiversity.

Awards won at the 2013 ISEF

Third Award of \$1,000 - Environmental Sciences

2013 - EV019
INVESTIGATION OF ESTROGENIC ENDOCRINE DISRUPTORS

Nickolas Aubrey Hines
Christ the King Cathedral School, Lubbock, TX

This project was a continuation from 2011 science fair project. Last year, persistent pesticides were found in lake waters and soils. With continued investigation and research, it was found that the pesticides isolated could be endocrine disruptors.

 Contaminated water samples were collected from an agricultural lake, residential lake, commercial lake, industrial lake and Lake W.#1. After standards were derivatized and silylated to be processed, the water samples were processed through a solid phase extraction vacuum (SPE) manifold and gas chromatography mass spectrometry analytical method was used to detect the presence of Estrone (E1), Estradiol (E2), Estriol (E3) and Ethinylestradiol (EE2) ions. After all standards and samples were analyzed, testing was performed using a Transcriptional Activation Assay to further evaluate estrogenic activity.

 The mass spectrometry analysis showed small amounts of estrogens in all of the samples at all locations. The Transcriptional Activation Assay revealed 13% estrogenic activity at the agricultural lake and 9% estrogenic activity at the residential lake. The commercial lake revealed 5% estrogenic activity.

 The hypothesis was supported; estrogenic endocrine disruptors were discovered in the lakes. These xenoestrogens can be harmful to our community and environment and warrant continued investigation.

Awards won at the 2013 ISEF

Full tuition scholarship - Drexel University

2013 - EV020

SIMPLE AND COST-EFFECTIVE DETECTION OF CADMIUM USING AN ELECTROCHEMICAL SENSOR MADE WITH GOLD NANOPARTICLES

Seung Hye Choi

University High School, Fresno, CA

This project was conducted to develop simple, cost-efficient sensors that can detect cadmium ions and have potential to monitor water quality. Through this research, I also sought to answer the following questions: (1) Are my sensors feasible to detect metal ions such as sodium, magnesium, cadmium ions, etc.?; (2) Are my sensors' selectivity and sensitivity good enough to discriminate interferences?; and (3) Do my sensors have a potential for future developments in regards to high accuracy and reproducibility, less energy consumption, miniaturization, and ease of measuring and carrying? Before experimenting, I hypothesized that sensors made with gold nanoparticles would provide better sensing capabilities than sensors made with bulk materials due to their high surface-area-to-volume ratio. Gold nanoparticles of ~1.6 nm diameter were synthesized with three types of surface-protecting ligands (hexanethiol, mercaptoundecanoic acid, and 18-crown-6-undecanethiol). Gold nanoparticle films were prepared by drop-casting on an interdigitated array (IDA) electrode, and this film electrode worked as a prototype electrochemical sensor. In order to characterize sensor performance, I prepared various standard solutions containing sodium, magnesium, and cadmium ions. Conductance of a sensor was determined from a current-voltage curve, and the obtained data were analyzed in terms of selectivity and detection limits. Various concentrations of sodium, magnesium, and cadmium ions were successfully detected resulting in different figures-of-merit. The gold nanoparticle with the 18-crown-6-undecanethiol showed the best selectivity, sensitivity, and detection limits for cadmium ions, and produced weak signals for magnesium and sodium ions, making it a desirable cadmium ion sensor.

Awards won at the 2013 ISEF

Certificate of Honorable Mention - American Chemical Society

2013 - EV021

THE EFFECTS OF ACID PRECIPITATION ON LEMNA MINOR AND LOCAL INVERTEBRATES

Lydia Ann Marie Heald

Van Buren Community School District, Keosauqua, IA

I tested to see if acid precipitation affects heart-rate of Daphnia magna, the wellbeing of D. magna, as well as the wellbeing of Tardigrades. I also wanted to see if Lemna minor (duckweed) could act as a bioremediation agent. I hypothesized acidic levels of precipitation would decrease, the heart-rate of Daphnia would decrease, and produce a negative effect on their health. I also hypothesized a decreasing pH level in precipitation will have a negative effect on the health of Tardigrades. I also hypothesized duckweed will act as a bioremediator.

 After several replicate experiments, results showed my first hypothesis was partially upheld. The heart-rate Daphnia magna was negatively affected, but not as significantly as I predicted. My second hypothesis was upheld: lower pH levels of precipitation did affect the wellbeing of D. magna. My third hypothesis was not upheld: lower pH levels of precipitation didn't affect wellbeing of Tardigrades. My fourth hypothesis was upheld: duckweed did act as a bioremediator, removing nitrogen and increasing the pH levels in the aquatic system. If nitrogen levels increase, pH levels become more acidic, resulting in the exacerbation in an aquatic habitat. This means as too much nitrogen will produce too much duckweed and competition for space and light will cause a reduction in oxygen needed for aquatic animals resulting in population loss. In the mean time, while nitrogen levels increase, pH levels become more acidic creating a more acidic ground water, potentially affecting aquatic critters.

Awards won at the 2013 ISEF

Full tuition scholarship - Drexel University

2013 - EV022

WILL ANTHROPOGENIC PRESSURES AFFECT THE OSPREY AND FISH VIA SEDIMENTS OF THE MISSOURI RIVER? IS ARSENIC (AS), CADMIUM (CD), COPPER (CU), LEAD (PB), ZINC (ZN), MERCURY (HG) AND SELENIUM (SE) CONTAMINATING THE MISSOURI RIVER WATERSHED? PHASE II

Whitney Ashton Clinger

Cascade Public High School, Cascade, MT

tudy was conducted to find bioaccumulation of heavy metals in the fish and Osprey via sediments of the Missouri River. In this study, 69 fish livers were collected, 11 Osprey chicks were sampled, and 8 sediment plots were sampled along the Missouri River from Craig, Montana to Cascade, Montana. Fish were

collected with the help from Montana Fish, Wildlife and Parks, blood and feather samples were collected with help from University of Montana professors, and sediment samples were collected with help from the Department of Environmental Quality. The three fish species, Rainbow Trout, Brown Trout and Mountain Whitefish were chosen to be studied based on population levels in the river and as quality control for FWP state records. The Osprey chicks chosen for this study were selected by truck accessibility and location along the Missouri River. Sediment collection location was based on location of fish and chick sample collections. Four statistical tests were chosen to prove significance between samples. These tests were a Student's T-test, ANOVA single factor, Regression analysis tests and Chi-Square Distribution test. These results show that the reported data is best explained to be a baseline for the Missouri River due to the levels reported. Further research will need to be conducted to prove or disprove the theory of bioaccumulation of heavy metals occurring in the Missouri River between fish and the Osprey due to the inconclusive reported data.

2013 - EV023

THE TOXIN IN RICE- ARSENIC IN OUR FOOD

Anuush Krishna Vejalla
Detroit Country Day Upper School, Beverly Hills, MI

The purpose of this experiment is to measure the levels of inorganic arsenic in different types of rice. Arsenic is a deadly toxin that leads to various cancers; many heart problems, and death. Since there is no published method to measure the amount of arsenic in rice, a procedure had to be innovated. To measure the levels of inorganic arsenic, in the form of Arsenic (III) Oxide and Arsenious Acid, powdered rice was dissolved into distilled water. Then Hydrogen Sulfide was oxidized into Sulfate, to prevent its interference with the Mercury Bromide test strip. Next OxoneMonopersulfate was also neutralized to prevent interference. Finally Zinc and Sulfamic acid were added to convert Arsenious Acid and Arsenic (III) Oxide into Arsine Gas. The Arsine Gas reacted with a mercury bromide test strip to form a certain color, which showed the level of inorganic arsenic. To verify the first hypothesis, that rice grown domestically would contain higher levels of arsenic than rice grown in foreign countries, rice from different parts of the world. Another hypothesis, that brown rice would have higher levels of arsenic than white rice, was verified by testing both brown and white rice. The rice has four to nine times the EPA limit on arsenic in water, 10ppb. The results show definitely that brown rice has higher levels of arsenic than white, but the correlation between where the rice is grown and the level of arsenic varies. Limits should be put on the level of arsenic in rice.

Awards won at the 2013 ISEF

Second Award of \$500 U.S. savings bond - Ashtavadhani Vidwan Ambati Subbaraya Chetty Foundation
Third Award of \$1,000 - Environmental Sciences

2013 - EV024

EXAMINING THE GLOBAL CARBON CRISIS: THE IMPACT OF INCREASED CARBON DIOXIDE ON THE BIOLOGICAL PROCESSES AND CARBON SEQUESTRATION OF THE DIATOM LICMOPHORA FLABELLATA

Rachel Elizabeth Sereix
University School of Nova Southeastern University, Fort Lauderdale, FL

The purpose of this experiment was to evaluate the global carbon crisis's effect on the smallest form of aquaculture, diatoms, by examining the impact of increased carbon dioxide on the organic carbon production, diatom colony quantities, and carbon sequestration mechanisms of Licmophora flabellata; in addition to assessing the photochemical energy yields of Sargassum fluitans with epibiotic diatom growth in both an ambient and elevated carbon dioxide environment. The use of mesocosms allowed for indirect effects, biological compensation and recovery, and ecosystem resilience to be monitored. All measurements and experimentation tested direct and indirect samples to understand the efficiency of the biological pump and subsequent ocean stratification and acidification in both environments. The diatoms' productivity and carbon-concentrating efficiency was measured through net and gross primary production. Quantum yield measured the photochemical energy production. Microscopy allowed for in depth examination of the physiological impacts of CO2 . The organic carbon production in the elevated CO2 environment was slightly lower despite having far more diatoms per sample. Therefore, there was a substantial disparity in primary production; diatoms in an ambient environment had greater photochemical energy production. The photochemical energy production of diatoms developed on the surface of Sargassum fluitans in the elevated CO2 environment was significantly reduced. Microscope examination revealed impaired function of the strutted processes, a damaged basal siliceous layer, and other dysfunctional physiological elements. The results proved my hypothesis valid; the diatoms' productivity, photosynthetic efficiency, and physiological functions were drastically hindered under increased CO2 exposure; consequently revealing further humanistic and aquatic implications.

Awards won at the 2013 ISEF

Third Award of \$1,000 - Environmental Sciences

2013 - EV025

NATURAL ALGICIDE TO COMBAT EUTROPHICATION OF WATER BODIES

Muhammad Ali Zuhazim Bin Rosli
Maktab Rendah Sains Mara Taiping, Taiping, MALAYSIA

Eutrophication refers to continuous enrichment of waters by addition of non-organic substances particularly nitrate and phosphate that serve as nutrition for the increasing growth of aquatic life. Hence, creating the algae-bloom phenomenon which is also a type of water pollution To date, there is no environmental friendly algicide to solve this problem. This project is to study the potential tea, cinnamon and clove as natural algicide based on their reported anti-microbial activities. These plants contain active yet safe phytochemical such as eugenol and catechin. In this study aqueous extracts were obtained from 250 gram of cinamon bark, clove flower buds, and dried leaf of tea respectively, were evaluated for their algicide activity in algae-polluted water sample. Observations were

made on the pH and turbidity of the water samples and death of the algae for seven days. Comparisons were made using non-polluted water sample and commercial algicide chemical. At the end of seven-day observation, it was found that the water extract of clove gave the highest algicide activity with the concentration of 10 µg/ml followed by cinnamon and tea, both at the concentration of 100 µg/ml. It also found that these plants extracts did not cause significant changes in the pH and turbidity of tested water. As a conclusion, the water extract of clove, cinnamon and tea, particularly clove extract which has shown great potential to be developed as a natural biosafe algicide to combat water pollution through eutrophication of water bodies.

2013 - EV026

ELECTRONIC DRAINAGE MANHOLE (EDM)

Hadeel S.A Yassin

Talae Al-Amal, Nablus, PALESTINE

Due to the extreme weather conditions experienced in Palestine, especially during the last heavy raining storm, loss of lives and material damages took place, it was important to find a mechanism to alleviate this problem in the coming year, especially in light of poor infrastructure for storm water drainage, and to prevent drains clogging by dust and dirt.

EDM operates by trying to lift and break up the dirt and dust accumulated in storm water manhole when the power supply to a spiral coil (solenoid) switched on generating a magnetic field. The magnetic field pushes an arm having pieces of iron up complementary holes and back down when disconnect the mains from the spiral and file.

The EDM invention provide Palestinian public with an automated, easy, and inexpensive way of storm water manhole operation using humidity and pressure sensors for automatic operation when rain falls. The two sensors are connected in parallel to ensure both (storm water and dirt and dust accumulation) conditions fulfilled.

EDM could be used in several other places such as sport stadiums, homes, roofs of buildings, and public courts. EDM works fully automatic when rainfall and mud and dirt accumulate in manholes, and when maintenance workers are not available to do the job.

2013 - EV027

SILENT PROTECTION

Raghda O.J. Eshstayeh

Salem Secondary Girls School, Nablus, PALESTINE

The harsh economic conditions that many communities of the less developed and even some developing countries are facing, along with the fact that the prices of oil derivatives and electricity are in a continuous rise, have pushed the people of those communities to seek old and unsafe cheap alternative sources of energy for home heating. One of which is the burning of wood and coal, which has being used for centuries, and is increasingly causing Carbon Monoxide Poisoning, specially in poor air-circulated areas.

 Protecting our beloved families from this silent killer has always been my motivation for this effort. The proposed model is not only a CO detector with alarming mechanism; it is tailored to the common environment that everyone can expect and find in a less developed country poor house: high level of noise and a cultural tendency not to take alarms into serious consideration. The model takes immediate action rather than alerts only, it is connected to a network of well located fans through which they'll run for a period of time and in varying speeds based on the continuous sensing and monitoring of CO. This mechanism will protect from an accelerated or soaring accumulation of CO concentration in the atmosphere, eliminating the risks of slowed responses in the case of using CO detector alarm units and saving the time and effort of civil defense crews.

 Writing this proposal came as a result of an extensive search in scientific and academic sources and after the collection and analysis of a questionnaire that I distributed to 13.2% of homes in my hometown of Salem, Palestine. The goal was to count the occurrences of CMP and the level of knowledge people had on how to act. Finally, I have managed to build a working prototype of my model and achieved its basic goal

Awards won at the 2013 ISEF

Fourth Award of \$500 - Environmental Sciences

2013 - EV028

STUDY OF THE USE OF HUMAN HAIR AS A NATURAL TOOL TO CLEAN POLLUTED WATER

Xuewei Ni

Robinson School, San Juan, PUERTO RICO

Water pollution can be classified as groundwater, microbiological, oxygen depletion, nutrients, suspended matter, and chemical pollution. The purpose of this research is to look for an alternate way of cleaning water that has been affected by common pollutants. The question addressed was: Can strands of human hair naturally clean polluted water?

The research started with the collection of straight wavy strands of hair from both females and males (dyed and natural colored). Fifteen (15) beakers were used: 250mL of potable water were added in each. The cups were sub-divided into control and experimental groups. Twenty drops of oil were added to five (5) beakers with potable water; the same was done with five (5) other beakers, but with 70% ethyl alcohol. Additionally, 40mg of soil were added to another five (5) beakers. Later, 150mg of different hair strands were added to each cup and left in for ten days. Control groups just stayed with the polluted water. After ten days, the same parameters as above were measured.

It was concluded that the hair strands worked as a natural way of cleaning the water. Both the pH and the turbidity changed positively after the hair was added to the mixes of water and other substances. On the other hand, hair did not work well after 22 days. According to the gathered data, it can be said that hair can be considered a sort of natural tool to clean water affected or polluted with certain substances.

2013 - EV029

PERCOLATION VS. HOMOGENIZATION: THE EFFECTS OF PHOSPHATE AMENDMENT ON LEAD CONTAMINATED SOIL

Annika Daniels

Mount Ogden Junior High School, Ogden, UT

The purpose of this experiment was to determine if percolating phosphate through lead contaminated soil would decrease the leachability as effectively as homogenizing the two substances would . To test this hypothesis three samples of lead contaminated soil were collected and were mixed. In a glass bowl four hundred fifty grams of soil was weighed out and placed in a twelve by two inch PVC pipe, then twenty five grams (3%) of phosphate amendment was weighed out and placed on the top of the soil. Another four hundred fifty grams of soil was weighed out and placed in a bowl with twenty five grams of phosphate amendment, the two substances were homogenized and placed in the other PVC pipe. One hundred grams of distilled water was filtered through the apparatuses every day for five days. After letting the soil dry for five days, a one hundred fifty gram sample of each was submitted for Toxicity Characteristic Leachate Procedure (TCLP) analysis, a non-treated sample wasalso submitted as the control. The analytical results showed that allowing the phosphate amendment to percolate through the lead contaminated soil lowered the leachability rate of the soil from 19.9 to 0.531 compared to the homogenized sample which was lowered from 19.9 to 0.738.

2013 - EV030

THE ROLE OF HEAVY METAL RESISTANT BACTERIA (BACILLUS MEGATERIUM, BACILLUS LICHENIFORMIS) ON THE BIOACCUMULATION OF LEAD IN HELIANTHUS ANNUUS

Cindy Y. Jiang

Central High School, St. Joseph, MO

Heavy metals, such as lead, pose a huge threat to society by eliminating dwindling arable land and putting the health of humans and animals alike in danger. In the past remediation methods, like acid leaching, have been costly. Recently new methods like bioremediation and phytoremediation have become popular due to their low cost and environmental friendliness. At the moment though most research on these two techniques have been singularly focused, none has been done regarding a combination of the two.

The purpose of this study was to determine if heavy metal resistant bacteria can aid sunflowers in the bioaccumulation of the lead. If heavy metal resistant bacteria are present in the soil then the amount of lead bioaccumulated in sunflowers will increase. This study has four groups: control (no bacteria or lead), just bacteria, just lead, and both bacteria and lead. Two different species of bacteria were isolated from soil known to be heavily contaminated with lead. After a set growing period the amount of lead accumulation in plants was determined using atomic absorption.

The results of this experiment revealed, for the first time, that heavy metal resistant bacteria do aid sunflowers in bioaccumulating an increased amount of lead. The plants growing in the environment with both lead and bacteria contained 53.83 g/ppm more lead accumulation than the plants in just lead. This experiment could provide for a cost effective option of remediating heavy metal contaminated soil.

Awards won at the 2013 ISEF

Second Award of \$1,500 - Environmental Sciences

2013 - EV031

HOME-BASED RAPID ARSENIC WATER TEST USING NANOTECHNOLOGY

Thabit Farrukh Pulak

Richardson High School, Richardson, TX

Cancer is among the largest health risks that results from arsenic poisoning. One in five deaths are caused by drinking arsenic water in Bangladesh, a country with over 40 million people affected by arsenic. Due to the lack of rapid and universally accessible arsenic detection technology, arsenic eradication attempts throughout the world become ineffective, despite decades of effort by WHO, UNICEF and local governments. Thus there is an urgent need to find an arsenic detection technology that is cheaper, faster, and environmentally sustainable.

A simple home-based arsenic paper sensor was developed that rapidly and inexpensively detects dangerous levels of arsenic in drinking water. The sensor was constructed simply by stapling a piece of table-top tissue paper on a strip of business card. Home-based iron nano particles were made by cooking rust, vinegar and soap. Iron nano particle-coated paper strips adsorb arsenic ions from water rapidly which increases conductivity. Higher conductivity change indicates a higher arsenic concentration. The strip's conductivity reading has been proven not to be skewed by dissolved solids in water, and has been field tested in Bangladesh. An inexpensive locally available multimeter from Bangladesh was used to measure the conductivity of the strips.

This paper sensor is over 1,119 times cheaper, 40 times faster and more environmental friendly than existing top arsenic detection technologies like Quick© Test. It can be made even from the kitchen of a rural village in Bangladesh. Such a versatile and affordable testing solution can help eradicate the decades-long problem of arsenic poisoning worldwide.

Awards won at the 2013 ISEF

Full Tuition Presidential Scholarship - Florida Institute of Technology
Award of \$3,000 - China Association for Science and Technology (CAST)
Second Award of \$1,500 - Environmental Sciences

2013 - EV032

OXIDATIVE ATTACK AND ELIMINATION OF BISPHENOL A BY MANGANESE DIOXIDE

Peter Scott Welcker III

Parkersburg South High School, Parkersburg, WV

Bisphenol A (BPA) is a ubiquitous environmental contaminant with endocrine disruptive potential. This research outlines a method of eliminating BPA from canned foods and bottled drinking water as well as from potable water or wastewater – using an inexpensive, commonly available chemical compound. Using standard laboratory equipment and chemicals, BPA solutions from 1000 uM to over 32,000 uM were prepared and reacted with concentrations of MnO2 from

4.4 uM-800 uM. BPA reduction was spectrophotometrically confirmed using the Ferric Chloride test. Results were dramatic with MnO₂ attacking and eliminating BPA through oxidative coupling forming dimeric products with monomeric products being formed by hydroxylation and dealkylation. BPA removal was directly related to MnO₂ concentration. MnO₂ levels of 800 uM resulted in 100% removal. Using 400 uM MnO₂, BPA removal ranged from 10-80% depending upon contact time and pH. Simulation of BPA removal in a wastewater environment was 100% efficient using a first-pass flow-through technique. Comparison between granular activated carbon (GAC) and MnO₂ efficiencies was initially similar but MnO₂ continued removing BPA long after GAC saturation. Coating cooking utensils with MnO₂ removed 97% of the BPA from treated chicken noodle soup while BPA removal from bottled water was 18-80% efficient. Although the BPA/MnO₂ reaction is extremely robust, pH determines the efficiency of the removal process with pH ranges of 4.5 being optimal. BPA may be easily and inexpensively removed from foods and bottled water. BPA may also be readily removed during either primary or secondary wastewater treatment by the addition of MnO₂.

Awards won at the 2013 ISEF

Renewable Tuition Scholarship Awards - West Virginia University

2013 - EV033

A MOLECULAR AND MORPHOLOGICAL STUDY OF 'CANDIDATUS PASTEURIA ALDRICHII' TO VARIOUS NEMATODE SPECIES AS A BIOLOGICAL CONTROL

Kiona Rajene Elliott

Northeast High School, Oakland Park, FL

Nematodes, simple roundworms, can be detrimental to important crops resulting in millions of dollars worth of damage and requiring the use of chemical pesticides. However, these chemical pesticides can be costly and cause pollution in the environment. The bacterium 'Candidatus Pasteuria aldrichii' attaches to the nematode species, Bursilla sp. RGD244 and kills it. It was found in a previous study that Pasteuria, a host specific endoparasitic bacterium, also attaches to the nematode species Mesorhabditis AF78. The purpose of this experiment was to determine the nature of the relationship between Pasteuria and its host nematode species in order to eventually harness Pasteuria as a nematicide. In this experiment, the molecular and morphological similarities of Bursilla and AF78 were studied through observational analysis, PCR amplifications and DNA sequencing. Template-DNA from Bursilla, AF78 and other closely related nematodes of the Mesorhabditis genus was taken and added into separate micro-centrifuge tubes and introduced separately to the two primers mtCOI and D2A/D3B. The amplicon for each PCR reaction was tested using Gel Electrophoresis and the results were sent to a biotechnology lab for DNA sequencing. The null hypothesis failed to be rejected because according to the DNA sequences, Bursilla and AF78 are separate species but congeneric with only a 10% base pair difference in both the mtCOI and D2A/D3B genes. Additionally, Bursilla and AF78 have very similar morphologies and reproductive modes. This suggests that AF78 is classified incorrectly and should be in the Bursilla genus and that host specificity in Pasteuria is a congeneric phenomenon.

Awards won at the 2013 ISEF

Fourth Award of \$500 - Environmental Sciences

2013 - EV034

DIFFERENTIAL GENE EXPRESSION IN LEAD-EXPOSED SACCHAROMYCES CEREVISIAE

Preksha Bhagchandani

Pine Crest School, Ft. Lauderdale, FL

Lead pollution, a persistent environmental hazard according to the World Health Organization, has been shown to adversely affect humans by damaging the nervous system, especially in children under the age of six and unborn fetuses. This research examines the effect of lead exposure on gene expression in Saccharomyces cerevisiae, a eukaryote that shares roughly thirty-one percent of its genome with that of humans. The ten genes tested in this study, classified into the four categories of tRNA charging, amino-acid biosynthesis, anion channels, and heat-shock proteins, were previously shown to be differentially regulated by lead exposure in alternate organisms; of the genes analyzed, KAR2, HSP10, and POR1 have neuronal homologs in the human genome. Following the incorporation of lead in a concentration-dependent manner ranging from 0-1000µM Pb, RNA was extracted from the lead-exposed yeast, quantified using spectrophotometry, and verified using gel electrophoresis. Primer design, cDNA synthesis by reverse transcription, PCR, and gel electrophoresis were performed to analyze differential gene expression. The genes HSP10, KAR2, DED81, MES1, THS1, and BAT2 were generally found to be up-regulated as expected, often with a decrease in gene expression at 1000µM Pb, a result of decreased cell viability at this concentration. The gene POR1 was down-regulated; TYS1, WRS1, and SHM2 need to be further investigated as no clear pattern can be discerned from the results. Differential gene expression found in yeast elucidates the molecular mechanisms behind the neuro-physical effects of lead in humans and is relevant in determining therapies targeting response pathways affected by lead exposure.

Awards won at the 2013 ISEF

Third Award of \$1,000 - Environmental Sciences

2013 - EV035

THE EFFECTS OF PESTICIDES ON INDICATOR SPECIES IN AQUATIC ENVIRONMENTS

Emma Rachelle Johnson

School Without Walls Senior High School, Washington, DC

Pesticides are an integral part of agriculture; yet continue to present health and environmental hazards to all organisms. Alternatives to pesticides are biologically derived pesticides, which are not thought to produce harmful effects on non-target species. My experimental goals included testing the effects of

synthetic and biologically derived pesticides on non-target aquatic organisms. I tested one synthetic pesticide known to be toxic to aquatic invertebrates - permethrin - and two biopesticides: *Bacillus thuringiensis* sub. *israelensis*, a strain of insecticidal bacteria, and allicin, the main chemical ingredient of garlic. I determined two concentrations per pesticide based on EPA values for LD50 tests and/or runoff values. These concentrations were then added to beakers with water and a small population of ghost shrimp. The shrimp were monitored for 48 hours, and the mortality rates, pH, DO, water clarity, and nitrate levels recorded. Permethrin yielded an LD100 value for the shrimp each round, with consistent mortality rates for three experimental repetitions. The allicin and Bti groups showed no significant difference in mortality rates from the control. From my data, I concluded that biopesticides do not significantly cause increased mortality rates in non-target organisms unless present in extremely high concentrations. Synthetic pesticides are highly toxic, even in very low concentrations, and present serious risks to human health and biodiversity in environments neighboring application sites. Based on their efficacy and safety, biopesticides should replace synthetic pesticides in both home gardens and large-scale agricultural applications.

2013 - EV036

MODELING ESTUARINE SALINITY USING ARTIFICIAL NEURAL NETWORKS

Christopher Wan

Alexander W. Dreyfoos School of the Arts, West Palm Beach, FL

Computer models serve as an important tool for prediction of the response of estuarine ecosystems to anthropogenic and natural changes. This study demonstrated for the first time that artificial neural networks (ANNs) can serve as an alternative modeling tool to simulate estuarine salinity as opposed to traditional physically-based hydrodynamic models. The multilayer perceptron algorithms were programmed (using Java) in an object-oriented manner, allowing for flexibility to easily change the structure of ANNs and to carry out multiple tests in a personal computer. Using eight years of data collected in the Loxahatchee River, a federal designated Wild and Scenic River in Florida, where saltwater intrusion has been of concern for decades, the ANNs were successfully trained and tested to simulate salinity at three ecologically important locations in the river. The network used freshwater inflow, rainfall, and tide as inputs. The r^2 values ranged from 0.83 to 0.90 during the training period (11/2003-5/2007) and 0.57 to 0.77 in the testing period (6/2007-10/2011). The trained and tested ANNs were further applied to predict historical salinity from 1972-2011 for evaluation of saltwater intrusion. The results showed that severe saltwater intrusion occurred in the period from 1972 to 1976, 1988 to 1990, 1999 to 2000, and 2007. Restoration of the river depends largely on delivery of sufficient amount of freshwater inflow during the dry season. Future research can be conducted to compare the versatility of different network structures such as recurrent neural networks or radial basis function networks.

Awards won at the 2013 ISEF

First Award of \$3,000 - Environmental Sciences

2013 - EV037

MICROBIAL FUEL CELLS: ELECTRICITY AND WATER QUALITY

Alexander James Thompson

Southeastern High School, Augusta, IL

e: The purpose of this scientific investigation is to determine if the process of using microbial fuel cells and the naturally occurring microorganisms in a river environment to generate electricity will improve the quality of the river water. Procedure: Anode and cathode containers were put together to make the microbial fuel cells. Salt bridges to be used between the water and mud chambers were made using salt and agar. Mud and water were collected from the river and placed in six fuel cells for testing. Autoclaved mud and water was placed in one microbial fuel cell as a control. Five different water quality tests were conducted prior to and at the end of testing. Results were averaged and graphed. Conclusion: After conducting the experiment and averaging the results, it was determined that the hypothesis for the experiment was partially true. It was hypothesized that the process of using microbial fuel cells and naturally occurring microorganisms in mud and water taken from the Mississippi River to produce electricity would improve the quality of river water. After the experiment was conducted, it was concluded that this hypothesis was incorrect because, overall, the water quality of the river water did not improve. In addition, it was hypothesized that the control, autoclaved mud and water, would in general have an overall higher water quality as compared to the water from the other fuel cells. The hypothesis was correct due to the fact that the water quality of the control was in fact higher than that of the other fuel cells.

2013 - EV038

CELLULOSE NANOFIBERS AS A COMPONENT OF A LOW-COST WATER FILTRATION SYSTEM FOR IMPLEMENTATION IN DEVELOPING COUNTRIES

Mary Ashleigh Butler

Bangor High School, Bangor, ME

Providing clean drinking water for developing countries is a critical issue. Current water filtration and treatment systems can be used to eliminate pathogens from drinking water, but these systems are expensive for people living in third-world countries like Haiti. This project looks at developing an inexpensive method of producing water filters using cellulose nanofibers (CNF). CNF is produced from wood or plant fibers through mechanical methods. CNF was coated onto paper. The samples were characterized in terms of coat weight and flow rate. The paper was mounted in a device to filter water spiked with latex particles a size of approximately 0.2 micrometers (μm). The water was tested after filtration using standard methods. As the coat weight of CNF increased, the flow rate decreased. The CNF treated paper shows promise in reducing the pathogenic organisms in these simulated tests. Preliminary data indicates that a 1.5% suspension allows for the optimum coating qualities. Preliminary data also suggests that a series of coats are necessary in obtaining a filter which provides a strong enough adhesion to the paper to withstand the abrasive forces of the water being poured onto the sheet. The project looks for a balance between gravity driven flow of sufficient flow rates, the coat weight of the CNF, and the purity of the water. The project shows promise in terms of providing a sustainable solution to water treatment using indigenous materials containing cellulose found in developing countries.

2013 - EV039

THE EFFECT OF LEMNACEAE ON NITRATE LEVELS IN THE SHELL CREEK WATERSHED

Brooke Elizabeth Pieke

Newman Grove High School, Newman Grove, NE

Can Lemnaceae (Lemna) be the answer to nitrate pollution in the Shell Creek Watershed? I hypothesized that Lemna can remove nitrates from the water and then become a nitrate rich cover material for fields. I ran a series of water quality tests on high nitrate concentrations that contained Lemnaceae. I had four holding tanks with the same amount of water, Lemna, and nitrate concentrations. I had one tank without any Lemna as a control. My results showed that Lemna does reduce nitrate levels in water. The levels were reduced by more than 50% over the course of my trials. I will further my research as a continuation project to see if the nitrate rich Lemna can be used as a cover material to release these nitrates back into a field for the next crop rotation.

Awards won at the 2013 ISEF

Full tuition scholarship - Drexel University

2013 - EV040

DOES SALICYLIC ACID AND CALCIUM CARBONATE SAFELY INHIBIT ALGAE GROWTH IN BUCK CREEK WATER?

Humza Shahid Bashir

Springfield High School, Springfield, OH

This experiment tested whether or not salicylic acid and calcium carbonate could safely inhibit algae growth in Buck Creek water. The real world application of this project is related to eutrophication. Eutrophication is the process in which algal blooms decay and absorb dissolved oxygen. This process kills local fish life. High phosphorus concentration in local waters is the main cause of the algal blooms that cause eutrophication. As indicated by last year's science fair, salicylic acid does inhibit algae growth in Buck Creek water by inhibiting the uptake of phosphorus. However, the inoculation of salicylic acid lowered the pH of the solution greatly, which would have harmed any kind of aquatic life as much as any algal bloom would have. Therefore, for this year's experiment, calcium carbonate will be added to each solution containing salicylic acid to maintain pH. Calcium carbonate is a weak base found in limestone. The addition of calcium carbonate to each solution should stabilize pH values and make salicylic acid a more realistic and affordable option as an algacide.

2013 - EV041

H2O₂ NO: PHARMACEUTICALS ARE IN MY GROUNDWATER! REMOVAL OF SULFAMETHAZINE BY HYPERCROSSLINKED ADSORBENT MN250 IN SIMULATED GROUNDWATER

Maria Elena Grimmer

Oxbridge Academy of the Palm Beaches, West Palm Beach, FL

Four hundred tons of sulfamethazine are fed to livestock annually in North America to prevent disease and promote growth, but most of the drug is excreted unmetabolized into the environment. Due to slow degradation and high mobility, sulfamethazine contaminates groundwater and causes harm. Current water remediation methods have considerable limitations, which necessitate newer techniques. Hypercrosslinked polystyrene adsorbents show promise because of high surface areas, high mechanical strength, and regenerable properties. Using batch adsorption techniques, this study investigated the capacity and rate of sulfamethazine adsorption onto Purolite hypercrosslinked adsorbent MN250 in simulated groundwater containing dissolved minerals and tannins. With common groundwater ions or dissolved humic acid, MN250 had a maximum capacity of 88.75 mg/g and 109.25 mg/g respectively, both highly correlated to the Langmuir model. Adsorption kinetics revealed prolonged adsorption of 99 hours with groundwater ions and 138 hours with dissolved humic acid and were best described by Ho's pseudo-second order model. Compared to distilled water, common groundwater ions decreased the capacity by 20% and prolonged equilibration 1.7 fold, likely due to ions interacting with the polymer and/or anionic fraction of sulfamethazine (e.g., electric double layer). Dissolved humic acid (4.8 mg/L) increased the capacity by 14%, likely due to humic acid acting as a carrier for sulfamethazine adsorption. Humic acid prolonged equilibration due to delayed intraparticle diffusion. MN250's high capacity for sulfamethazine adsorption with typical groundwater constituents and regenerable characteristics make it a practical solution for sulfamethazine removal in areas that have contaminated groundwater supplies.

Awards won at the 2013 ISEF

Third Award of \$1,000 - Environmental Sciences

2013 - EV042

EFFECTS OF ECOLOGICAL DIFFERENCES ON BIOFILM COMPOSITION IN THE RED SEA

Reem Ahmed Al Rabiah

Altarbia Alislamia Schools, Riyadh, SAUDI ARABIA

The Red Sea harbors the second largest coral reef system in the world. Unfortunately, many of those corals are starting to bleach. At the base of coral reefs are the benthic microbial communities, or biofilms; consisting of many microorganisms that play a role in the bottom-up controlled ecosystem. Biofilms can also induce coral larvae settlement, which is essential for reef preservation and expansion. In this research, we studied the effects of ecological differences of reefs along a latitudinal gradient. Three reefs were chosen on one longitudinal transect, with different distances from shore. Three months after setting glass slides in each reef, the samples were collected and the DNA was extracted, amplified, cloned, sequenced, identified using BLAST database and a classifier from the RDP and the Alpha and Beta diversity were calculated using the Muthur program. The results showed 115 OTUs (Operational Taxonomic Unit) only 7 of which were registered in the database. The Alpha diversity showed that the number of OTUs in the midshore reef is significantly less than in the other two

reefs.

By classifying the bacteria to families, we were able to compare between the biofilm compositions. The variation of the families confirms the hypothesis. By understanding the biofilm composition, we are closer to building a model of a coral reef that can be used to preserve the reef and setting a scientific infrastructure for further studies.

Awards won at the 2013 ISEF

Fourth Award of \$500 - Environmental Sciences

2013 - EV043

USING NATURAL MATERIALS TO BUILD A WATER FILTERING SYSTEM: MAKING POTABLE WATER FROM GREY WATER

Quinn Taylor Groff

Sheldon High School, Sheldon, IA

The purpose of my research project is to build a water filtering system that can be used to recycle grey water into potable water.

I believe through my research that a cheap water filtering system can be made to purify water into reusable and hopefully potable water that can be used in third world countries where water is very scarce.

I built a water filtering system made of rock, sand and charcoal and ran grey water through it to see how pure I could make it. I ran several water tests on it for purity and I also ran bacteria tests on the water to see if I could eliminate bacteria in the water.

The results of my research show that I did purify grey water using the filtering system I built but further testing will need to be done to find out exactly how pure the water is. I would like to eventually make a filter that can be mass produced and taken to third world counties to help the people there recycle, reuse and conserve water.

In conclusion, I would say that a simple water filtering system using natural materials like rock, sand and charcoal can be used to convert grey water to potable water and possibly drinking water. This type of filter could be made very cheap so that they could be used in third world countries for recycling water.

2013 - EV044

CONTAMINATED WATER DISINFECTION USING ZERO-VALENT IRON FILTRATION AS AN ALTERNATIVE TO CHLORINATION

Alexander Roberto Gasca

Walter Payton College Preparatory High School, Chicago, IL

Considering that 780 million people are unable to access clean drinking water annually, I set out to develop a cost effective method of disinfection that would not only be as efficient as other proven methods of disinfection but also be practical and easily applied in real world scenarios. Contaminated samples of water were created using E. Coli K-12 by diluting E. Coli broth in 3.79 L of distilled water. Using a combination of zero-valent iron and sand, two stand-alone filters were constructed. Upon completion of the construction, 3.79 L of distilled water were passed through each filter to allow the filtration media to settle. After the distilled water was passed through each filter, 2 contaminated samples, each of 3.79 L, passed through each filter. Samples were collected after 3L had passed through each filter. All samples were inoculated with ColiScan EasyGel and E. Coli counts were taken after 48 hours. E. Coli counts showed 100% disinfection efficiency from both filters. All contaminated water was completely disinfected of E. Coli. The filtration systems using a combination of zero-valent iron and sand were as effective as proven methods of disinfection at a fraction of the cost.

2013 - EV045

ACCUMULATION OF CALCIUM CONTAMINATION

Shay McKinzie Jackson

Mansfield High School, Mansfield, MO

The purpose of this project was to observe the effects of accumulating calcium on the growth and maturation of Brassica (Wisconsin Fast Plants).

One hundred and forty-four Brassica seeds were separated into three groups of forty-eight. The seeds were then placed into 4x6 centimeter sections of soil, one at a time. The plants were placed in a greenhouse for the duration of the procedure. The control group plants were given water. One experimental was given 10ml of .01 M of calcium nitrate, and the other tested group was treated with .05 M of calcium nitrate. This procedure continued for two weeks. Twenty-four control group plants germinated and twenty-two of the first experimental group plants germinated. No seeds in the second experimental group germinated so they were no longer tested. Each plant was removed from the soil, and the roots were rinsed of the remaining soil. The wet mass of each individual plant was taken. And then the dry mass of each plant was taken. Finally plants were separated into sections: roots, stems, and leaves, experimental leaves, experimental stems, and experimental roots. The total mass of each group was then taken.

The hypothesis calcium contamination will slow germination of Brassica, increased levels of calcium contamination will stunt the growth of Brassica plants, excess calcium contamination in plants will affect development of the various parts of the plant, and contamination of calcium will slow the rate of maturation of Brassica were all accepted because there was a significant difference shown using an ANOVA statistical test.

2013 - EV046

THE PRESENCE OF METALS IN DRINKING WATER AND ITS EFFECT IN THE CODIAEUM VARIEGATUM LEAVES

Karlen Marie Aleno

Specialized High School in Science and Math Thomas Armstrong Toro, Ponce, PUERTO RICO

Plants are food and oxygen producers. Metals produce a necrosis effect in the leaves of plants. The hypothesis was: the presence of metals in drinking water will cause a necrosis effect in the Codiaeum variegatum leaves. Ten Codiaeum variegatum plants were cultured in the Juan Morell Campos area and ten were cultured in the Santa Teresita area, both in Ponce. Plants were watered with drinking water four times a week for four months. Soil analysis evidenced the presence of macronutrients such as Fe 26,611mg/Kg, Mn 752.mg/Kg, Mg 1,239mg/Kg and Ca 17,505mg/Kg. The average concentration of metals in drinking

water from Juan Morrell Campos was 9.88mg/L and 76.738mg/L for that from Santa Teresita. Five samples of the plant leaves from each sector were analyzed. The Codiaeum variegatum leaves in the area of Juan Morell Campos had an opaque appearance, dust and necrosis. The average concentrations of metals in the leaves are: Ca 5,545.2mg/Kg, Mg 1,946.4mg/Kg, Si 816.2mg/Kg, Fe 379.6mg/Kg, Al 190.76mg/Kg, Mn 10.952mg/Kg, Hg 0.031044mg/Kg, and 7 others in small concentrations. The Codiaeum variegatum leaves from Santa Teresita had a good appearance and larger leaves. The average concentrations of metals in these leaves are: Ca 3,058.6mg/Kg, Mg 1,394.4mg/Kg, Si 272mg/Kg, Fe 77.44mg/Kg, Al 63.86mg/Kg, Mn 4.198mg/Kg and Hg 0.027656mg/Kg and 7 other in small concentrations. It is concluded that the high concentration of metals in plant leaves from both areas is not related to metal concentration in water. Further studies should consider metal concentrations in air to account for these results.

2013 - EV047
THE EFFECTS OF NOXIOUS WEEDS ON NAVY BEANS

Carter Joseph Mauch
Hankinson High School, Hankinson, ND

Purpose: To ascertain the efficacy of noxious weeds as natural growth enhancers on navy beans. Additionally, to analyze the impact of the natural solutions on the quality, nutritional values and production rates of the beans.

Procedure: Four noxious weeds were collected (Kochia, Common Ragweed, Lambsquarters and Russian Thistle) and one agricultural herbicide mix. Weed extracts were created using a 20:1 dilution rate, while the agricultural herbicide was created through standard application rates. A Field Test Plot Study was performed to see how noxious weeds affected the growth of navy beans in their natural environment. Grams of seed, percent protein, moisture content, percent fat, percent starch, percent fiber and pounds per acre were analyzed. The Plate Germination Test was utilized to assess the ability of the extracts to be used as pre-emergent applicants. Soil Testing was performed to determine if the weed extracts impacted soil nutrient levels. Tested the soil for nitrate-nitrogen, potassium, phosphorus, copper, sulfates, iron and pH.

Results: In the Test Plot Study, Kochia exhibited the greatest positive impact upon the navy beans, while the commercial herbicide had the least effect. In the Plate Germination Test, Russian Thistle most effectively enhanced growth, while the commercial herbicide had the least impact. From Soil Testing, Lambsquarters increased the soil nutrient levels most, with the commercial herbicide finishing last. After considering all aspects of this project, Kochia was the superior solution. Overall, I feel that noxious weeds can be utilized as a natural, effective enhancement in the navy bean industry.

2013 - EV048
PROTECTIVE ROLE OF SELENIUM AGAINST METHYLMERCURY POISONING IN HOUSE CRICKETS (ACHETA DOMESTICUS)

Devarshi Nikhil Patel
Red River Senior High School, Grand Forks, ND

Methylmercury (MeHg) accumulates in the environment, But recent findings about the ways it causes toxicity lead us to expect that dietary Selenium (Se) should protect against mercury's toxic effects. Bioaccumulation is common in fish which can lead to a major route of exposure to humans since fish is a global staple food. Research shows that MeHg in fresh water fish originates primarily from their diets, up to 90% of which consists of insects. Even though insects are a major portion of fish diet, research has not shown enough evidence on MeHg bioaccumulation and its effect on the aquatic food web. MeHg inhibits Se dependent enzymes, Se should protect against MeHg poisoning in animals that have selenoenzymes. The effort was conducted to understand if selenoenzymes found in house crickets (Acheta domesticus L.) show protective effects against MeHg poisoning. The study was initiated by providing basal diet. The crickets were fed torula yeast-based diets with dietary Se concentrations ranging at 0.1, 0.3, or 3 µmol of added Se/kg.Each Se diet was prepared with MeHg at 0.0, 10, or 30 µmol of added MeHg/kg (approximately 0 to 5 ppm MeHg). The treatments were setup into 9 dietary treatment groups (three levels of Se, each having three levels of MeHg exposures). Each dietary treatment consisted of 30 crickets which were measured on a weekly basis.

 The results of this study has demonstrated that dietary Se protects against MeHg toxicity in house crickets.Crickets fed diets containing higher Se ratios were not susceptible to MeHg toxicity. The data also indicates that crickets are very sensitive to Se, since there were results showing diminishing growth and death occurring when too much Se was fed. This suggests that Se and MeHg balance each other out in organisms body.

Awards won at the 2013 ISEF
Fourth Award of \$500 - Environmental Sciences

2013 - EV049
AQUATIC PLANTS: TODAY'S SOLUTION TO RIVER POLLUTION

Gage Connor Metzen
Hankinson High School, Hankinson, ND

Purpose: To analyze the water/soil quality of the Wild Rice River located in Southeast North Dakota. Secondly, to determine the decontamination ability of two aquatic plants (Frogbit and Coontail) and two cereal straws (Barley and Wheat).

Procedures: Water Analysis: Tested water samples from six different river locations for amounts of dissolved oxygen, carbon dioxide, nitrates, phosphates, sulfates, ammonia, pH, and conductivity. Repeated this procedure a total of eight repetitions.

Bacterial Colonization: Impregnated EMB agar plates with the water samples and observed the bacterial growth. Coliscan: Identified the presence and number of coliform bacteria in the water through the use of Coliscan Easygel kits.

Soil Analysis: Collected soil samples from six different river locations. Determined the amounts of nitrogen/nitrate, phosphorus, and potassium. Repeated this procedure a total of four repetitions.

Aquatic Plant Decontamination: Collected water from all six different river locations. Obtained two different aquatic plants (Frogbit and Coontail) and two cereal straws (Barley and Wheat). The water was then tested for all constituents tested for in the Water Analysis.

Results: After observing the results of the water and soil analysis, I found that the locations located next to farming operations were the most contaminated. In the aquatic plant decontamination analysis, I found that both plants and straws helped decontaminate the water. Overall, Coontail decontaminated the water the most.

Conclusion: Overall, I feel that even though Barley Straw was not the most efficient decontaminator, but due to the fact it is cheap and available, would

make it a more practical choice.

2013 - EV050

THE ROLE OF JUGLONE ON SOIL ORGANISM SURVIVAL

Rachel Naomi Johns

Northwestern High School, Kokomo, IN

The purpose is to test the effects juglone has on selective soil organisms. If the soil organisms are adversely affected, then juglone has an effect beyond plant inhibition. Juglone at varied amounts of black walnut extract was applied to earthworms, sow bugs, and *Pseudomonas fluorescens*. The juglone with 10 walnuts per 3 liters of water had a transmittance of 0.72%(430 nm by Vernier Colorimeter). The juglone with 7 walnuts/3L of water had a transmittance of 1.99%(430 nm by Vernier Colorimeter). A Ward's Behavioral Tray was used with earthworms and sow bugs to test the organisms' preference when choosing between unaltered soil and soil with juglone. Nutrient agar made with juglone(10 walnuts/3L of water) instead of distilled water stopped the growth of *Pseudomonas fluorescens*, but did not stop the growth at 5 walnuts concentration. Juglone plus chitin did not affect the growth of *Pseudomonas fluorescens*. The earthworms do not have a preference between juglone and unaltered soil in the 5 minute test. Earthworms live at least one day in juglone soil. Some earthworms survived up to 5 days and others died after 2 days. Sow bugs moved throughout the test between juglone soil and unaltered soil. The sow bugs have a greater living rate compared to the earthworm because of the outer shell. Four of the 5 sow bugs lived when put into juglone rich soil(20 mL of water/10 mL of juglone) and 2 earthworms survived after 72 hours. Higher juglone concentration effect can kill decomposers in the environment.

2013 - EV051

EMISSION REDUCTION THROUGH SOLVENT POLARITY

Tyler Gordon Toepke-Floyd

Wishek Public School, Wishek, ND

The purpose of my project was to see whether the concentrations of emissions changed if the exhaust from an engine flowed through a liquid solution using the property to polarity to draw out molecules from the exhaust and trap them in a liquid solution. I tested whether distilled water, canola oil, or an even mixture of the two would change the concentrations of compounds in the exhaust.

 Procedure: 1.) I created a container that could be attached to an engine to channel the flow of exhaust through liquid solutions. 2.) At selected times to eliminate temperature as a variable, I measured the amounts of CO, CO2, HxCx, NO, NO2, and O2 in the exhaust with an exhaust analyzer. I repeated this process with no liquid and with 3 different solutions. 4.) I took liquid samples after the exhaust flowed through it.

 In my first trial, I found I made a manufacturing error that compromised my control of the tests and I couldn't get accurate results. I ended trial one and fixed the problems with my equipment and procedure. In Trial 2, I repeated the tests and found that my new procedure and apparatus worked in that it changed the concentrations of compounds in the exhaust. I ran a third Trial to gain more data to find more conclusive results.

 My hypothesis was partially correct in that I found that different solutions absorbed different molecules due to general intermolecular forces involving polarity and unique properties and solubilities of certain compounds.

2013 - EV053

THE EFFECT OF BISPHENOL A (BPA) ON ARTEMIA SALINA SURVIVAL

Quinn K McCormick

Jefferson County International Baccalaureate, Birmimgham, AL

Bisphenol A (BPA) is a chemical contained in certain plastics and epoxy resins used in many products, especially food packaging. It is an endocrine disruptor because of its potential estrogen-like properties. Endocrine disruptors have adverse effects on reproduction, development and other neurologic and immune functions. Besides it notoriety in plastic drinking bottles, there are now grave concerns that BPA is leaking into the environment through landfills and industrial sources. Saltwater contamination with BPA may be especially significant if it enters the food chain. While numerous studies have examined BPA's effects in vertebrates and freshwater animals, little is known about its actions on saltwater invertebrates.

 Artemia Salina is an excellent experimental model to address whether BPA has detrimental effects on saltwater invertebrates. In this project, Artemia Salina eggs were incubated in saltwater with various concentrations (0.01- 1000 µM) of BPA. After 48 hours, the control eggs were 48 %± 8.4 alive. Between 10 and 100 µM BPA the percent alive decreased from 32.4% ±9.2 to 4.7% ±3.4. Development and survival ceased between 500 and 1000 µM BPA.

 Separate experiments with estrogen showed that BPA's inhibition was not due to an estrogen-like action. Additional outcomes might manifest with longer incubation times examining reproductive maturity. Regardless, this project is significant because the effects of BPA were apparent at comparable concentrations to other scientific reports in aquatic animals. Moreover, there is increasing environmental concern that long-term exposure to trace concentrations of endocrine disruptors may have unknown harmful actions, especially if these chemicals enter the saltwater food chain.

2013 - EV054

NEGATIVE IMPACT OF STORMWATER RUNOFF ON OSMOREGULATION IN ADULT PALAEMONETES VULGARIS AND ADULT AND JUVENILE LITOPENAEUS SETIFERUS

Bridgette Nicole Noonan

Hilton Head Island High School, Hilton Head Island, SC

ic White shrimp and Grass shrimp populations are important organisms in the estuarine food chain. Recreationally important marine fish and crustaceans populations could be negatively impacted if this food source is not abundantly available. The purpose of this experiment is to test the response of marine shrimp - adult Grass Shrimp (*Palaemonetes vulgaris*), and adult and juvenile Atlantic White shrimp (*Litopenaeus setiferus*)- when measured amounts of storm water

(freshwater) is added to their laboratory habitats. The laboratory containers were initially filled with high salinity sea water (34.28 ppt) from the Colleton River , South Carolina which is the natural environment for both species. It is predicted that rapid introduction of storm water will adversely affect the osmoregulation in these two marine species, and the response of the shrimp will be most impacted when stormwater is administered as a shock (below 9.48ppt). Results indicate that when Grass shrimp and Atlantic White shrimp, living in high salinity waters, are exposed to a rapid decrease in salinity in the laboratory, the Atlantic White shrimp responded with decreasing mobility at first, while Grass shrimp showed no change. Continued decline in salinity led to mortality in Atlantic White shrimp and lethargy in Grass shrimp. As expected, when stormwater runoff was introduced as a shock (immediate introduction) both species experienced lethargy. However, when the high salinity was reestablished within an hour, the organisms recovered. Although these shrimp are typical euryhaline organisms, storm water runoff introduced rapidly into high salinity estuaries is an anthropogenic problem for marine shrimp populations, especially as continued development and deforestation occurs along coastal wetlands.

2013 - EV055

REMOVAL OF DYES FROM TEXTILE WASTE WATER BY USING NANOFERRITES

Hilmi Oguzhan Ayan

Ozel Istanbul Fatih Anadolu Lisesi, Istanbul, TURKEY

As the world's population increases, human beings' needs increase as well. The biggest need for human beings has always been water. In textile industry, they produce over 7x105 tons and approximately 10.000 different dyestuffs and pigments. We can understand the importance of purifying wastewater by just looking at the dyeing process. As a result of the dyeing process, there is approximately %10-15 dyestuffs in the water. In this study, we used reactive dyes, which form an important part of textile industry. During the dye removal process, we synthesized nano ferrites (MnFe2O4 and NiFe2O4) by using automatic burning reaction. After synthesis, for their structural characterization, we ascertained that they were purely spinal with XRD; and with SEM calculations we found that the materials consisted of nano particles and they were porous. With EDS calculations, we obtained the amounts of Fe, Mn, Ni and O in the materials that were synthesized. With the magnetism calculations, we determined that the materials had very low ferromagnetic features at room temperatures. The fact that nano ferrites could not reach magnetic saturation showed us that super-paramagnetic features were dominant. With the nano ferrites that were prepared, we made the adsorption of reactive blue color (RB5). Dye removal has been made in different concentrations and with amounts of different adsorbents. All of the adsorption process was performed at room conditions and pH level of the medium was 1. In conclusion, MnFe2O4 was more effective in low concentration dyes while NiFe2O4 made better removal in the high concentration dyes.

KEY WORDS: waste water, textile dyes, nano ferrites and adsorption.

2013 - EV056

IN SEARCH OF FRESH WATER: EXPLORING VARIOUS METHODS OF DESALINATION FOR EMERGENCY USE

Abigail H. Millard

Windsor High School, Windsor, VT

In our world of modern conveniences, we take access to fresh water for granted. However, we can lose access when we may not expect it. A recent example includes areas of New York and New Jersey affected by Hurricane Sandy. When a natural disaster like this contaminates or prevents access to freshwater, the ocean can be used as a resource. The purpose of this experiment was to find which method of desalination was most effective for small scale, emergency use. Effectiveness was defined based on time taken to desalinate, salt removed, and quantity of water produced. The hypothesis was, if solar, steam, and freezing methods are used to desalinate seawater, equal amounts of fresh water with similar salinities will result, because research showed comparable efficacies.

A simple solar still was used for the solar method. For the freezing method, a plastic container was filled with seawater and placed in the freezer. After 24 hours, the unfrozen salt water was separated from the frozen fresh water block. The steam procedure went through two stages. It was first done using a steam hood, but the resulting salinity was extremely high. The procedure was redesigned with a teapot and copper tubing to eliminate salt contamination during boiling.

Steam proved to be the most effective method in all aspects. Freezing was less effective due to a procedural flaw and solar due to lack of sunlight. In the future, the procedure would be further developed to increase the quantity of water produced.

2013 - EV301

A NOVEL MODEL FOR INFLAMMATORY BOWEL DISEASE: USING U937 AND COLO320DM CELL LINES, TO PROPOSE A PATHWAY BY WHICH ENVIRONMENTAL TOXIN, 4-NONYLPHENOL, MAY PROMOTE AN INFLAMMATORY RESPONSE

Albert Kim, Byeong Ho Jung

Manhasset Secondary School, Manhasset, NY

4-Nonylphenol (4-NP) is a ubiquitous hormonal toxin that is formed as a byproduct in the manufacturing and/or sewage treatment of household cleaning agents, liquid detergents, paints, etc. 4-NP has been suggested to induce adverse effects relating to the progression of autoimmune diseases. Inflammatory bowel disease (IBD) is an autoimmune disease in which macrophages (U937 cell line) mistakenly attack the intestinal linings and/or tissues (COLO320DM cell line), causing chronic inflammation. Several key pro-and anti-inflammatory genes have been shown to be involved in the regulation of IBD, including IL-23A, COX-2, IL-8, TLR-4, and IL-10. 4-NP's effect on these known mediators as well as new, potential mediators of IBD were effectively analyzed using a novel model for IBD, by which 4-NP may promote an inflammatory response. Genetic and substrate data were collected using DNA Microarray, PCR, and ELISA, after 48 hour treatment with nanomolar concentrations of 4-NP. In U937 cells, results showed significant dysregulation of the expression of both pro- and anti-inflammatory genes in such a way that would promote and prolong inflammation. However, TLR-4, IL-8, and COX-2 gene expressions showed unprecedented effects in COLO320DM cells. Upon further research, it was found that these genes mediate apoptotic processes in COLO320DM cells, and results demonstrated 4-NP's ability to dysregulate this process in a way that would promote apoptosis. Macrophages play a major role in apoptotic processes, so a dysregulation of apoptosis may play a role in triggering autoimmunity. Finally, 4-NP increases the risk of autoimmunity and promotes/prolongs adverse progression of inflammation in the intestines.

Awards won at the 2013 ISEF

Fourth Award of \$500 - Environmental Sciences
First Life Science Award of \$ 2,000 - Sigma Xi, The Scientific Research Society

2013 - EV303
PREDICTING EARTHQUAKES BY MONITORING THE ELECTRON CONTENT OF THE IONOSPHERE

Nicolas Javier Marone, Aviv Rabinovich
Ort Henri Ronson, Ashqelon, ISRAEL

Purpose of the Experiment

Earthquakes threaten human life, causing thousands of fatalities and injuries, mostly as a result of buildings collapsing on people. Yet, the most advanced systems are only capable of alerting about one minute in advance. In this project, we found a way to alert people long before a major earthquake strikes, regardless of the distance from the epicenter.

Procedures Used

Recent research suggests that about 40 minutes before a major earthquake occurs, the Total Electron Content (TEC) of the ionosphere changes. Deep analysis of the TEC behavior enabled us to discover a reliable way to predict earthquakes way before any known method can today.

The proposed system calculate the TEC using GPS signals received at ground stations, process it and implement a novel algorithm to predict a major earthquake 20 minutes before it occurs. The system can then send an alert to all cellular phones at the region, directing their owners away from the epicenter.

The algorithm we developed choses the right GPS satellites, calculate the TEC, process its variance and moving average in real time to predict the occurrence of an earthquake.

Observation/Data/Results

The algorithm was tested on historic data and was able to 'predict' the two major earthquakes that occurred in Honduras (2009) and Costa-Rica (2012). A very large amount of historic data proved negligible false alarm percentage.

Conclusions/Applications:

The ionosphere TEC can be used to predict major earthquakes at least 20 minutes before they occur. The proposed system is very simple, cheap and easy to implement and can save millions of lives in the future.

Awards won at the 2013 ISEF

Third Award of \$250 - American Geosciences Institute
Award of \$3,000 - China Association for Science and Technology (CAST)
Honorable Mention - Sigma Xi, The Scientific Research Society

2013 - EV305
REMOVAL OF HEAVY METAL IONS USING FRUIT WASTE

Fatima Moin Veera, Hania Hasan, Umme Salma Gadriwala
The Mama Parsi Girls' Secondary School, Karachi, PAKISTAN

Contamination of the environment with heavy metals has motivated the development of purification and extraction methods. Research into the contamination of water by metal species has attracted our special attention due to the high dilution capacity of water, the possible accumulation of heavy metals in plants, fish, and consequently humans, and the need to protect all life forms. Dried, powdered fruit waste can extract heavy metals such as lead, chromium and copper from their solutions.

Orange, lemon and banana peels were dried, thoroughly crushed and sieved, separately. Accurately weighed samples of these were added to known concentration solutions of KMnO4, CuSO4 and Pb(NO3)2. The solutions were filtered out at different time intervals, and the metal concentrations were determined through Atomic Absorption Spectrometry. Another, more cost-efficient procedure we adopted was of constructing a column to remove these metals. There was as much as 65% reduction in the metal concentration with these peels, through stirring and 40% through the column.

Banana peels have nitrogen, sulfur and carboxylic acids which bind with positively charged heavy metals, allowing them to draw heavy metal ions. Citrus fruits such as oranges and lemon have pectin which is structurally similar to alginate: a molecule that is responsible for the high metal uptake by algal bio sorbents

Over 30% of the world's total waste constitutes of fruit waste. This biomaterial is cost effective, free of any harmful side effects, and also aligns itself with the green chemistry. The materials can be used in industry for the treatment of effluents, especially because it does not have to be chemically modified in order to work.

2013 - EV306
THE ENVIRONMENTAL REFRIGERATOR

Fawzi Moh'd Metwalli, Nour Maraqa
Al Raed Al Arabi, Amman, JORDAN

Nowadays, people are conscious of the importance of preserving

food without causing any environmental harm and without depending

on nonrenewable energy sources.

In addition, it is well known that many countries suffer from frequent electricity discontinuation and do not even have electricity supply.

That's why this project was designed physically, styled ergonomically, and checked financially in order to supply thousands of people with the right device to store their food.

The device has three main systems: cooling system, insulation

system and solar energy power source. The three systems provide the

customer with the suitable environment to store fruits, vegetables and dairy products.

The device contains a cabinet of stainless-steel to place the food, and

clay sheets to allow the inner water inside the device to leak out which

in its turn evaporates and absorbs the cabinet's heat which makes the

device a cooling one.

Two fans were installed to pass an air flow in order to increase the efficiency of the cooling system.

These three systems work together to create a movable, low cost and Eco-friendly refrigerator to protect your health, your financial conditions and most important your environment.

The environmental refrigerator is an Eco-friendly and affordable

device that targets the owners of food stocks and factories, and the

residents in the deserted and remote areas.

2013 - EV307

ALGAE: A BLOOMING FUEL SOURCE

Madeleine Claire Guyant, Mitchell Gillin
Governor's School at Innovation Park, Manassas, VA

The purpose of this experiment was to analyze local algae strains in Prince William County, Virginia, for their viability as a source of biofuel, as determined by the percentage of dried biomass composed of lipids. By testing algae strains in the species combinations in which they naturally occur, as opposed to testing a strain specifically engineered as a fuel source, multiple problems can be solved simultaneously. The process used in this experiment would remove algae from areas where harmful blooms occur, provide a source of biofuel, and have a positive effect on water quality. In this experiment, algae samples from three locations, Quantico Creek, Lefty Hamilton Pond, and the Potomac River, were tested. It was hypothesized that the sample from Lefty Hamilton Pond would be the most viable due to the higher percentage of planktonic algae present compared to the other samples, although the biomass was primarily filamentous. The procedure was broken down into four main steps: collecting the samples, performing identification and water quality analysis, preparing the algae, and lipid extraction/transferrification. Results showed that the hypothesis was correct. The algae sample from Lefty Hamilton Pond had a lipid yield of 12.3%, while the samples from Quantico Creek and the Potomac River yielded 8.9% and 7.82% respectively. However, while the sample with the highest lipid percentage is the most optimal fuel source of those tested, it is not a high enough percentage to make the process cost effective or viable when compared to strains that are currently being used for fuel. Using the methods from this experiment, algae samples that are primarily planktonic should be tested in order to develop a process that is environmentally sound as well as cost effective.

2013 - EV308

DETRIMENTAL CONCENTRATIONS OF AIRBORNE FUNGAL SPORES

Patrick James Colossi, Nicole Simineri
Staten Island Technical High School, Staten Island, NY

While some fungi are relatively harmless, others, such as Aspergillus, can be detrimental. They release spores that contain mycotoxins which can severely damage people's health when exposed to them for long periods of time. Despite the dangers they pose, treatment and diagnosis for them are insufficient or nonexistent. Because they live off of compost and waste, we theorized that fungi would exist in higher amounts near landfills or garbage dumps. To test this, we rented air sampling equipment from EM Laboratory and collected air samples from 18 different locations throughout Staten Island. All results were taken in colony forming units per meters cubed (CFU/m3). Our results showed that 25 different fungal genera are present in Staten Island in addition to 7 species of the Aspergillus genus. Because this field is relatively uncharted, the United States doesn't have CFU safety standards, showing the need for more research. However, according to standards set by a European commission, the spore concentrations we found are considered high and, thus, dangerous. Based on the pattern of concentrations we observed, we were able to conclude that concentrations increased with closer proximity to the Fresh Kills Landfill. This helped to confirm our initial hypothesis. Consequently, we highly recommend that immunocompromised individuals avoid such areas, thereby avoiding contact with the fungi and preventing potentially lethal fungal infections. With this knowledge, researchers could make people increasingly aware of this potential health risk and bring attention to a field that requires more than it gets.

2013 - EV309

THE EFFECT OF POLLUTION AND THE GREENHOUSE EFFECT OVER THE SOLAR CONSTANT AT GROUND LEVEL

Constantin Popa, Ciprian Suiu, Cristina Nedelcu
"Nicu Gane" National College, Falticeni, jud. Suceava, ROMANIA

Our work's purpose is to highlight the greenhouse effect in different areas, using devices we designed but also using other scientific materials such as maps and charts. The idea of building new devices was born from a widely discussed problem: air pollution.

In order to find the required explanations, we designed a device measuring the solar constant at the ground level. We used a box which had one side painted in black and the other ones insulated. It was filled with water and the temperature was monitored by a probe. We noticed unusual values which we explained by the presence of the main pollutants: greenhouse gases and sedimentary particles.

In order to further investigate the influence of the gases on the solar constant, we build yet another device, made up of one sealed glass balloon, into which we placed a pyranometer and connected a vacuum pump to enable us simulate any altitudes. The balloon has another exit and a valve, through which we can place different greenhouse gases.

Analyzing all the results, we finally concluded that the air in the Falticeni region is polluted with SO2 . We hope that this project will draw the authorities attention, so that protection measures will be taken.

2013 - EV310

WINTER ECOLAB AT YOUR HOME

Anastasia Maslighin, Vladislav Sincari
Lyceum "Nicolae Miclesu Spataru", Chisinau, MOLDOVA

This project in its present form is the result of physico-chemical analysis and bioassay experiments of the bean seeds reaction on environment contamination.

Snow can serve as an indicator of air pollution with different harmful substances which influence negatively on state of environment.

The initial idea was to determine the toxicity of snow cover, as a reaction of plant test organism on contaminated substances accumulated in snow. Contaminants were analyzed prior to biotesting in samples collected from main functional zones of the town. The results showed different level of pollution in comparison with a fresh snow (reference conditions).

The bean seeds were used as a biotest material. Totally 7 samples with snow collected from different districts of the city: - 1 of fresh snow and 6 samples after 24 days of exposure of snow under open air were tested. Experiment duration was 10 day with identification of germination of seeds and its growth rate.

According to the result of bioassay the level of contamination for main functional zones of our town was determined: no pollution, low, average and severe. The results were presented on the map, with further use in decision making process.

This method

of analysis is easy and fast. It can be applied in school labs, home conditions etc for estimation of the level of pollution in any place and planning of the necessary actions.

2013 - EV311

A NOVEL METHOD FOR LABORATORY WASTEWATER TREATMENT USING A COMBINATION OF LIMESTONE, SAWDUST AND BACTERIA

Hoang Quoc Pham, Dat Pham, Hiep Nguyen, Dat Pham, Hiep Nguyen, Dat Pham

Chu Van An Highschool, Hanoi, VIETNAM

Wastewater generated from chemical laboratories, inorganic and analytical, contains high concentration of heavy metal ions, anions and strong acids. This is a great pollution problem in many developing countries.

In this study, a novel method combining limestone, sawdust and bacteria was applied to treat laboratory wastewater in a lab-scale system. It is a combination of physical, chemical and biological methods.

The system was operated continuously in three phases of A, B, and C at the hydraulic retention times of 3, 1.5, and 1 day, respectively. In phases A and B, the system included two limestone tanks and one mixture tank, containing a combination of cultivated limestone, sawdust and bacteria. In phase C, one limestone tank was removed, so there was one limestone tank and one mixture tank.

In this system, limestone removed H+, heavy metals almost completely, creating a suitable environment for bacterial activities in the mixture tank. Sawdust, on one hand, plays the role of an absorption material. On the other hand, cellulose from sawdust was hydrolyzed by bacteria into short chain organic compounds, utilized by bacteria to grow and remove sulfate, nitrate. The effluent COD was relatively high, about 83 mg/L, affected the sulfate removal rate about fifteen times higher comparing with the single methods. Also, the heavy metal ions concentration in the outflow were very low.

Combining limestone, sawdust and bacteria can create a simple, low cost, effective and environmentally sound technology. Therefore, this could become a great application for wastewater having the same characteristics.

2013 - EV312

WOCHEKIYE BEATS RADIATION LEVELS ON THE PINE RIDGE RESERVATION

Savannah Leigh Jensen, Robert Pourier

Red Cloud Indian High School, Pine Ridge, SD

The purpose of this experiment is to identify the radiation levels near a home where the prayer is frequently used, compared to the radiation levels located further away from the home to determine if prayer has an effect on radiation levels. Radiation levels were determined by using a Geiger counter, a GPS to pinpoint the location of each reading, and a map to identify the geographical area under investigation. Readings were recorded every minute for five minutes, conducted 70 times in different areas surrounding the home. Google Maps was used to reveal the exact location of each reading taken from the GPS coordinates. Four sections of an Isopach map were created. The readings of the four sections were added together to establish a cumulative average of 18 microRems/hour of the entire area tested. Two sections closest to the home had an average of 15.8 and 15.944 microRems/hour while the last two sections had an average of 19.16 and 21.42 microRems/ hours. We discovered the radiation levels near the home were slightly less than that of the farther surrounding areas. In conclusion, the hypothesis was supported, revealing that prayer does have an effect on the radiation levels identified on the Pine Ridge Reservation.

2014 - EV001

NANOFIBER CELLULOSE ZERO VALENT IRON FILTRATION: POTENTIAL FOR REDUCTION OF WATER-BORNE PARTICULATE AND MICROBIAL CONTAMINANTS

Ceirra Danielle Carlson

Greybull High School, Greybull, WY, United States of America

A critical issue in the world today is providing clean drinking water for people throughout the world. Nearly 780 million people are unable to access clean drinking water today. Despite the fact that water covers approximately six tenths of our planet, uncontaminated drinking water is perhaps our most rare and endangered resource. Current research through coal mining drainage has revealed zero valent iron as a hopeful component that could possibly be implemented to reduce microbial contamination. The foundation of cellulose nano-fibers has also been viewed as a potential improved filtration source. This would be an economically effective resource because it can be obtained from recyclable products like paper, cardboard, wood and more. This improved particulate filtration, along with zero valent iron utilization could produce a major advancement in providing adequate amounts of clean water safely, effectively and economically. A working filtration system containing these elements was built that successfully removed water borne particulates and living microbial contaminants. Cellulose nanofiber paper was generated by shredding recycled paper and blending it to a fine consistency. The regeneration of the cellulose was accomplished by treating this pulp with sodium hydroxide and heat. Cellulose nanofiber paper, in addition to being very inexpensive and readily abundant proved to be 5% more effective at reducing particulates than regular filter paper, encompassing a decrease of about 92.3% of particulates. Zero Valent Iron, showed effective results in reducing microbial contaminants in water by 70%. This research could provide a feasible new filtration system that could be scaled to much larger systems and be implemented to benefit countries needing access to clean water.

2014 - EV002

CAN WOODY FIBER FROM THE INVASIVE EXOTIC TREE BRAZILIAN PEPPER (SCHNIUS TEREBINTHIFOLIUS) BE UTILIZED AS A FILTRATION MEDIUM TO REMOVE PHOSPHATE FROM WASTE WATERS?

Johnathan Forrest Fox

Okeechobee High School, Okeechobee, FL, United States of America

The purpose of my project was to evaluate if Brazilian pepper fibers could serve as adsorbent for phosphate removal, if fibers could be treated chemically to enhance adsorption, and test if solution pH affected adsorption. Phosphate concentrations of, 25ppm and 50ppm, at pH, 4, 7 and 10, were used as test

solutions. Wood fiber test treatments were; untreated, 12% ferrous chloride, and 4% carboxymethyl cellulose (CMC)/12% ferrous chloride. Wood fibers were prepared to serve as filter media through a series of soak and dry processes to adhere treatment compounds. A test series consisted of 5 replicates for each combination of phosphate test solutions, and fiber treatment, resulting in 90 samples. The filtrate for each sample was evaluated for change in phosphate concentration. For the 25ppm and 50ppm phosphate test solutions, all wood fiber treatments resulted in a significant ($p \leq 0.05$) change in the filtrate phosphate concentration. Filtering through fibers treated with ferrous chloride and CMC/ferrous chloride resulted in a significant decrease in mean phosphate concentration of the filtrate, with a significantly greater reduction occurring with the CMC/ferrous chloride treatment. Filtering test solutions through untreated Brazilian pepper fibers resulted in an increase in phosphate concentration of the filtrate. For the 50ppm solution adsorption was significantly higher at pH 10 for the ferrous chloride fiber treatments. No pH effect was detected for the 25ppm solutions. Brazilian pepper fibers can be treated with an iron compound, which increases phosphate attachment sites, and thus increases adsorption potential to reduce phosphate from polluted waters.

2014 - EV003

EFFECT OF TEMPERATURE ON RADON DECAY RATE

Bianca Montano

El Dorado High School, El Paso, TX, United States of America

in objective of this experiment was to determine whether temperature affects the rate of decay of an alpha particle resulting in radioactivity. During the resea
rch it was learned that radon is known as a radioactive isotope. When placed in an ionization chamber, the radon will lose its outer shell electron. The newly
formed ion and electron will make a small current of electricity that is measured to determine the radon found. Taking this knowledge, an ionization chamb
er was built simply with a negatively charged wire in the middle of a metal can. To make the electrons and ions move, in order to be able to test for the prese
nce of radon, a positively charged circuit was built and connected to the wire. In the experiment, the ionization chamber was exposed to soil samples place
d in environments with three different temperatures. After the experimentation, it could be observed that the sample placed in the room with the highest avera
ge temperature saw an average increase of 4.9 millivolts at the third recording. The control, placed in the average room temperature had an average millivolt
reading of 4.3 millivolts at the fourth recording. The sample in the lowest temperature never saw a significant millivolt increase. The experiment proved that the
highest temperature saw radon decay, an average, of 30 minutes faster than if placed at an average temperature. The lowest temperature never even saw the
decay begin to happen within the allotted time frame.

2014 - EV004

INSECT-REPELLING PLANTS & NEW ORGANIC PESTICIDE

Heeyong Huh

Newman Smith High School, Carrollton, TX, United States of America

Organochlorine pesticides in agriculture are not only powerful but also pollute the soil and destroy the ecosystem. As a result, scientists are currently looking for
organic pesticides that can repel pests without causing environment pollution and risk to human body. Some plants have a high potential of repelling pests and
have evolved to defend themselves from pests. If different organic pesticides were combined, then it would be a better pesticide because of the synergistic
effect between these components. Individual plant extracts from pyrethrum, tobacco, garlic, and red pepper were tested on how fast it killed the crickets. The
median lethal dose (LD50) which indicated the potency of the organic pesticides for pyrethrum, tobacco, red pepper and garlic was 0.42, 4.93, 20, and 50
respectively. Pyrethrum had the highest potency followed by tobacco, red pepper, and garlic. The sum of the individual death rate of crickets in tobacco which
was 3 and pyrethrum which was 36 was less than the death rate of 84 caused by the combination of tobacco and pyrethrum. This indicated a synergistic effect
between tobacco and pyrethrum. Synergistic effect was also seen between red pepper and pyrethrum. Because of its low LD50 and high synergistic effect with
other plant extracts, agriculture with pyrethrum pesticides would be eco-friendly and economical. Organic pesticide research is significant to prevent
environmental pollution and decrease the effect of bioaccumulative chemicals on humans and other living things. This project will help scientists find better
combinations of organic pesticides for practical use in agriculture.

2014 - EV005

ZERO VALENT IRON NANOPARTICLE ENHANCED POLYETHERSULFONE MEMBRANES FOR WATER FILTRATION: ISOLATING CASTING
PARAMETERS FOR GLOBAL APPLICATIONS

Hope Alexis Weinstein

Fairview High School, Boulder, CO, United States of America

Many newly identified organic contaminants and disinfection by-products have been found in natural water sources and treated drinking water. Current water
filtration membranes do not always remove these harmful substances, but new water treatment innovations such as nanoparticle enhanced filtration
membranes have shown increased interest and promise. This research focuses on the effect of embedded iron nanoparticles on the thickness and water flux of
polyethersulfone membranes produced by phase inversion. The study evaluated membranes that were cast from solutions that contain stabilized nanoparticles,
pore former, polyethersulfone and solvent. Parameters evaluated include the concentration of zero valent iron (ZVI) nanoparticles, the type of nanoparticle
stabilizer, the type of pore former, the concentration of ethanol, and the type of solvent. Membranes were evaluated using dead end filtration, micrometer
measurements, and scanning electron microscopy (SEM). Results indicate that casting parameters, in addition to nanoparticle concentration, affected the
behavior of the membranes. Additionally, oxidation of the iron nanoparticles was observed to cause morphological changes to the surface and internal structure
of the membrane as well as decrease the flux of the membrane. Only certain casting parameters, for example, those membranes cast from dimethylacetamide
or dimethylformamide, were observed to result in this oxidative degradation in the membranes.

Keywords: nanoparticle enhanced nanofiltration
membranes; water flux; polyethersulfone; organic contaminants; zero-valent iron nanoparticles

Awards won at the 2014 ISEF

Third Award of \$1,000 - Environmental Sciences

2014 - EV006

AN INVESTIGATION OF THE CONSEQUENCES OF AQUATIC SINGLE-WALLED CARBON NANOTUBE EXPOSURE CONCERNING DAPHNIA MAGNA AT VARYING CONCENTRATIONS

Jonathan James McCutchen

Keystone School, San Antonio, TX, United States of America

The widespread use of CNTs in aquatic devices has led to an alarming amount of CNTs entering aquatic ecosystems. Due to their relatively new introduction, researchers have only been working on determining the hazardous effects of these nanoparticles since late 2007, and little data has been published pertaining to aquatic organisms or ecosystems. Therefore, this experiment is designed to observe the effects of carbon nanotubes at varying concentrations (0-3%) concerning the planktonic filter-feeding crustacean *Daphnia magna* regarding key biological factors such as population/population growth, mortality, average length, parthenogenic reproduction, ephippial reproduction, heart rate, and dissolved oxygen consumption/metabolism. The researcher hypothesized that the presence of CNTs would result in a population decrease coupled with increased mortality, shorter length, a decrease in parthenogenic reproduction paired with an increase in ephippial reproduction, an increased heart rate, and lower dissolved consumption/metabolism; varying concentrations will provide arithmetic differences. *Daphnia* were exposed to the CNTs for a period of 10 days in 2.75 liters of 25 °C pH 7 natural spring water. The data received fully supported the hypothesis with a large differential between groups, following a general linear progression. This may be attributed to a buildup of CNTs in the intestinal tract of the *Daphnia*, restricting feeding in an environment of abundant food sources. Additionally, CNT/tissue fusion occurred in the instar stage of development, leading to an abnormally high mortality rate. Based on these results, it can be concluded that CNTs pose a significant threat to aquatic environments and CNT restrictions should be pursued.

Awards won at the 2014 ISEF

First Award of \$3,000 - Environmental Sciences

2014 - EV007

INVESTIGATION OF ENDOCRINE DISRUPTORS: THE PRESENCE AND EFFECTS OF NEONICOTINOID AND SULFOXIMINE PESTICIDES

Nickolas Aubrey Hines

Christ the King Cathedral School, Lubbock, TX, United States of America

This project was a continuation from 2012 when testing was performed on West Texas lakes, which revealed estrogenic endocrine disruptors.

This year the most widely used pesticide in the world, neonicotinoid pesticides, and a new class of pesticide, sulfoximines, will be evaluated. Water and soil from ten West Texas lakes were collected. Water samples were processed through the solid phase extraction vacuum (SPE) and nitrogen evaporator. The soil samples were filtered, agitated and condensed down with a Rotavapor machine. The samples were tested for the presence of the pesticides using high-performance liquid chromatography (HPLC) and gas chromatography-mass spectrometry (GC-MS). The effects of the neonicotinoid and sulfoximine pesticides were then evaluated on water and soil invertebrates. To evaluate soil invertebrates, young and older mealworm larvae were evaluated using the up-and-down method. Dose concentrations ranged from 5.5 µg/g to 55 µg/g. To evaluate water invertebrates, 5 day and 10-14 day *Daphnia magna* were evaluated. Dose concentrations ranged from 0.01 µg/mL to 5.0 µg/mL. Endocrine Disruption was evaluated using a Transcriptional Activation Assay.

The hypothesis was supported. The HPLC results revealed neonicotinoid pesticides in 50% of the water samples and 90% of the soil samples. Results were confirmed by GC-MS. The up-and-down testing with mealworms revealed median lethal doses ranging of 5.5 µg/g to 36 µg/g, and the *Daphnia magna* testing revealed 5-30% mortality. The Transcriptional Activation Assay did not reveal endocrine disruption. The 2014 project findings are positive for our environment, but further toxicity testing and accumulation investigation needs to be performed.

2014 - EV008

STORM WATER SOLUTIONS, II

Peyton Michelle Aulds

Ridgway Christian School, Pine Bluff, AR, United States of America

The purpose of this project is to design and develop a filtration system that will filter nitrates and/or phosphates from rain water. A media will be selected to test the pilot filter at one selected testing site to see if it is effective in filtering out the two elements. Samples of the rain water will be taken before and after entering the filter.

The second phase of this project is to add three additional test sites to the existing data. The rain water will be tested to see if there is different levels of pH, nitrate and phosphate in different locations. The procedures were ran from AP Environmental Science Kit.

The hypothesis is the filter will "reduce" the amount of nitrate or phosphates entering the ground and or surface water and that there will be a significant difference in the elements. The null-hypothesis is the filter will not filter enough nitrates or phosphates out to make any difference in the water samples.

The "non-filtered" results showed no significant change in nitrate, phosphate or pH levels. The "filtered" results showed no significant change in nitrate or phosphate levels, only a slight difference in pH.

A deviation experiment was performed to prove the filter and resin worked. Water samples were taken from the classroom aquarium, the same testing procedures was performed. The nitrate level went from 2.2 ppm to .88 ppm which proved the filter worked. There was not any difference in the phosphate or pH levels.

2014 - EV009

PREVENTING THE GLOBAL REPRODUCTIVE FAILURE OF AQUATIC LIFE THROUGH THE CATALYTIC TREATMENT OF ENDOCRINE DISRUPTING COMPOUNDS IN MUNICIPAL WASTE WATER

Zachary A. Loeb
Viera High School, Viera, FL, United States of America

Endocrine Disrupting Compounds (EDCs) have a profound impact on aquatic reproductive processes. Current municipal waste water treatment plants (MWTP) do not eliminate highly persistent EDC's such as Atrazine, Estradiol (E2), and Ethinyl estradiol (EE2). This project's goal is to see if catalytic municipal waste water treatment will eliminate these persistent EDCs. Water samples were collected at the MWTP's pre-chlorination and post-chlorination points. Samples of E2, EE2 and Atrazine in distilled water were prepared. Catalytic Treatment using Fe-TAML was performed on all samples. Concentration testing for E2, EE2 and Atrazine using enzyme linked immunosorbent assays was performed. E. coli membrane filtration testing was performed to determine total coliform for Fe-TAML treated pre-chlorinated municipal waste water and post chlorinated municipal waste water. For each EDC type (E2 EE2, Atrazine and municipal waste water effluent) three control groups (Untreated, Partially Treated, and FE-TAML treated) were created. For each group, 6 Medaka fish eggs were labeled, photographed and measured to determine the growth rate every 24 hours. EDC exposed untreated Medaka eggs developed at a reduced rate of more than 31%. EDC exposed Medaka eggs treated with Fe-TAML developed at the same rates as Medaka Eggs in distilled water within 5 percent. Atrazine was detected at 2 ug/Liter in the post chlorinated municipal waste water sample. After Fe-TAML treatment, the Atrazine was degraded to the point that it was below detection limits. Fe-TAML treatment degraded EE2, E2 and Atrazine by greater than 93% within 30 minutes according to the reaction kinetics study. Fe-TAML treatment was also 25 times more effective than the MWTP's chlorination process at removing E. coli.

Awards won at the 2014 ISEF
Third Award of \$1,000 - Environmental Sciences

2014 - EV010
THE EFFECTS OF APPLYING WASTEWATER BIOSOLIDS ON BIO ENERGY POLYCULTURE TEST PLOTS AND VARIOUS VARIETIES OF SWITCHGRASS, A TWO PART STUDY

Brian A. Prchal
New Prague High School, New Prague, MN, United States of America

With an interest in agriculture and renewable energy, I merged them into a two-part study to determine if biosolids from a wastewater treatment plant would enhance the growth of CP 25 Bioenergy Mix and eleven varieties of switchgrass. Because biosolids contain nitrogen, I hypothesized there would be enhanced growth. I applied biosolids to twenty four randomized test plots, conducted height checks, obtained soil samples which I prepared at the University of Minnesota utilizing 2N KCL to determine the amount of nitrogen in the soil. Using a homemade device, I collected cuttings, separated legumes from the grasses and weighed them before and after drying in a lab oven. The areas with biosolid additions, on average had more nitrogen in the soil. When biosolids were added to pretreated urea ground, plants grew taller and had more mass. I found an interesting difference between the legume and grass weights, with the grass benefitting from increased nitrogen. Grasses preferred a urea/biosolid combination. Legumes benefitted more from biosolids, than urea. For these reasons, I accept my hypothesis that biosolids generally enhanced the growth of the test plots. Concurrently, I conducted a home study with eleven switchgrass varieties by preparing the soil with 0 grams, 5 grams, 10 grams and 15 grams of biosolid. In the switchgrass study, I found mixed results when comparing fullness, height and dry weight. Growth of each variety was either not affected, enhanced or was negatively affected. Therefore, I reject my hypothesis as the amount of biosolid affected each variety differently.

2014 - EV011
REVERSING THE EFFECTS OF LEAD TOXICITY ON SELECTED BIOLOGICAL MODELS USING EDTA CHELATION THERAPY

Beau Taylor Bingham
Cascia Hall Preparatory School, Tulsa, OK, United States of America

For parts of Oklahoma, Kansas, and Missouri, lead mining was a prominent industry. This has created medical and ecological concerns in Picher, OK, which the EPA calls "the most toxic place in America." Burdened by negative health implications, citizens in and around Picher have experienced higher cancer rates, stunted cognitive function and development, and damaged cells and organ systems. The effects of lead are long-lasting, as lead from the local Tar Creek affects several waterways, presenting a continued medical issue. Thus, in an effort to both study and combat the effects of lead, the purpose of this investigation is to examine the effects of solutions containing 0.3125 to 10 ppm lead on the cellular regeneration, pulse rate, and mortality of Lumbriculus variegatus, the integrity of cell membranes, and the function of the enzyme polyphenol oxidase. This project also evaluated the ability of ethylenediaminetetraaceticacid, or EDTA, to remove lead ions and reverse the effects of lead on the selected biological models. The data suggests that lead inhibited regeneration rate at all concentrations as compared to the control group (p<=.036 for all groups tested), decreased heart rate, increased mortality, increased damage to the cell membrane, and denatured PPO enzyme function. EDTA showed limited ability to recover the biological models from lead exposure. EDTA showed the best results for the PPO enzyme recovery and mixed results with cellular regeneration, pulse rate, and mortality. EDTA restored the reaction rate of PPO denatured by 10 ppm lead to only .0074 AU/min below the spring water control. Overall, EDTA assisted in maintaining cell membrane integrity as compared to the lead only treatment.

2014 - EV012
THE IMPORTANT DISCOVERY OF A GREENHOUSE GAS "BIO-CATCHER": CARBON FIXATION IN TRENTEPOHLIA

Yiyang Lu
No. 1 Middle School Affiliated to Huazhong Normal University, Wuhan, Hubei, China

Blood red boulders are scattered across a large area above the creek in Hailuoguo, Gongga Mountain, Sichuan, the red matter attached to the stones is a species of Trentepohlia, a type of subaerial filamentous green chlorophyte algae which can be used as a greenhouse gas "bio-catcher" in the future. In order to

test the anti-stress ability and carbon fixing ability of Trentepohlia, chlorophyll fluorescence analysis and far-infrared gas analysis were used and I found that the algae's maximum photochemical productivity reached 0.67 ± 0.015 , and displayed no significant variation across a range of radiation intensities from 0 to 400 $\mu\text{W cm}^{-2}$; it also possesses strong tolerance for UV radiation. At 10°C , with a light intensity of $45 \mu\text{mol m}^{-2} \text{s}^{-1}$, its carbon fixation capacity is $351.57 \mu\text{mol CO}_2 \text{mg}^{-1} \text{Chl a h}^{-1}$ —2.6 times that of Nostoc, and 1.4 times that of Chlorella under similar conditions, reflecting the algae's relatively strong capacity for fixing carbon dioxide. The algae's light compensation point of photosynthesis is $28 \mu\text{mol m}^{-2} \text{s}^{-1}$, and its light saturation point is $565 \mu\text{mol m}^{-2} \text{s}^{-1}$, light of intensity over $800 \mu\text{mol m}^{-2} \text{s}^{-1}$ triggers a sharp decline in carbon fixation, that means the cells have a light protection mechanism; Calculations using the data from testing reveal that the Trentepohlia algae in Hailuoguo sequester approximately 10 tons of CO_2 a year.

2014 - EV013

ABSORPTION AND MECHANISM OF PEPEROMIA (PEPEROMIA TETRAPHYLLA) TO AUTOMOBILE EXHAUST

Luqing Qi
Beijing 101 Middle School, Beijing, Beijing, China

Automobile exhaust accounts for about one-third of the total amount of air pollutants in cities, which is the main reason for the formation of haze and acid rain. Therefore, the research work with the title of “Research on Absorption and Mechanism of Peperomia to Automobile Exhaust” was carried out. In the self-made environment simulation chamber and cooling system, based on the static fumigation experiments with 29 kinds of plant, peperomia with the better absorption and tolerance to automobile exhaust was screened out through the plant morphology, observation of the guard cell and stoma with microscope, superoxide dismutase (SOD) activity measurement, absorption kinetics of the exhaust components, non-invasive micro-test technique (NMT) and total nitrogen measurement. The results indicate that the absorption rate of peperomia to the exhaust gas in the experimental groups becomes higher at first and then slower. Compared with the control group, the sizes of guard cells and stoma in the experimental groups increase from 39.65 to 43.25 micrometers for cells and from 13.46 to 43.25 for stoma in 24 h, but decrease from 39.65 to 24.9 micrometers for cells and from 13.46 to 10.57 for stoma in 72 h, respectively. It is correlated well with the relative flow flux of K^{+} measured by NMT, -96.6 and $+62.2 \text{ pmol}/(\text{cm}^2.\text{s})$ in 24 h and 72 h, respectively. The K^{+} inflow (negative value) leads to the stoma opening, and K^{+} outflow (positive value) causes the stoma close, which agrees well with the K^{+} theory. Nitrogen oxides in the exhaust gas are absorbed completely in 10 h, after 38 h, the total nitrogen content in the peperomia reaches the highest value up to 5.06%. This research work provides a good reference to the plant selection for urban landscaping and air purification.

2014 - EV015

THE EFFECTS OF ETHINYL ESTRADIOL ON DANIO RERIO EMBRYONIC DEVELOPMENT

Maria Cyr Lorenson
Perham High School, Perham, MN, United States of America

According to the Center for Disease Control (CDC), roughly four out of five women will use birth control at some point in their lives. After the main hormone, Ethinyl estradiol, runs its course through the body, it is excreted and becomes part of our water system. This brought me to the question: How does Ethinyl estradiol affect Danio rerio, commonly known as zebrafish, egg development? It was hypothesized that the Ethinyl estradiol will negatively impact the zebrafish embryo development and the more that higher concentrations will have greater affect the embryo. Zebrafish eggs were placed into .1 mg of Ethinyl estradiol in one dish and the .2 mg in another. The third dish acted as a control. Check every two hours for 24 hours, then 6 hours for the next 24 hours, and then twice a day until hatched by placing randomly chosen eggs from the container and and taking pictures through the microscope. The data showed the embryos developed more slowly in the eggs exposed to Ethinyl estradiol, especially in the eyes. The vertebrae in the variable tests were curved in Trial 1, and due to the high mortality rates in Trial 2, it is unknown how the vertebrae were affected. Mortality was measured in Trial 2 after seeing the mortality rates in Trial 1. In both tests, the eyes of the zebrafish developed later when Ethinyl estradiol was present. The controls had a straight vertebrae compared to the curved vertebrae on the embryos where Ethinyl estradiol was present. The embryos exposed to a higher concentration of Ethinyl estradiol had a much higher mortality before hatching.

2014 - EV016

A MYCOREMEDIATION STUDY TO ALLEVIATE EUTROPHICATION IN AGRICULTURAL WATERSHEDS

Dalinh Tran
Southmoore High School, Moore, OK, United States of America

This project exemplifies a form of bioremediation; Mycoremediation study designed to alleviate eutrophication from dissolved phosphorus and nitrogen contamination in agricultural watersheds. The intent of this project is to decrease the amounts of phosphorus and nitrogen content in chicken manure to limit the amount of excessive dissolved P and N contamination in bodies of water, especially lakes. Some success with various species of mushrooms have been used as a form of fungal bioremediation in the past for an Eco-friendly and cost efficient way to remove toxins from the environment. The soil and water runoff analysis were determined by means of a standard testing technique and equipment. Trays inoculated with mushrooms showed a gradual decrease in contents of dissolved phosphorus and nitrogen levels within the soil compared to the controls. The water runoff analysis showed that trays with mushrooms showed a decrease throughout the trial in phosphate, nitrate, and nitrite levels compared to the control. Distinctive species of mushrooms extracted varied quantities of elements and compounds from the soil; for example, the Oyster species flourished overnight while other species emerged within an elongated period of time. The contributions of this project are prodigious. First, the mycelium of the mushrooms has the capability to enhance soil quality, to absorb, and facilitate substances such as litter/manure. Mother Nature has provided us with the key to solving many of humanity's mistakes by providing mushrooms and fungi as its natural decomposer. Secondly, the benefit of a cost-efficient bioassay technique utilizing fungal bioremediation was demonstrated.

2014 - EV017

REMOVAL OF DISSOLVED HEAVY METAL POLLUTANT USING TROPICAL PEAT SOILS OF INDONESIA

Alfy Fathnur Aziza
Al Hikmah Surabaya Senior High School, Surabaya, East Java, Indonesia

Peat soils are natural resources that have high adsorption capacity to remove heavy metal in polluted water. In this work, peat soils from Indonesian tropical forest were used to investigate the removal of lead (II) ion from industrial wastewater. The capability of metal removal from tropical peat soils were characterized at various pH value, amount of adsorbent, metal ion concentration and soaking time. Various amount of humic acid derived from peat soils was added to lead (II) ion aqueous solution. Higher degree of heavy metal removal was obtained at higher amount of adsorbent. Humic acid derived from Indonesian tropical peat soils were soaked with lead (II) ion aqueous solution at various soaking time (1 hour, 5 hours, 24 hours and 168 hours). The highest removal of lead (II) ion was obtained at 24 hours soaking time, pH 6.6 and initial Lead (II) concentration of 100 ppm. The interaction mechanism between humic acid derived from tropical peat soils with lead (II) ion was determined based on the UV-Vis, Fourier-Transformed Infra Red (FTIR) and Nuclear Magnetic Resonance (NMR) spectroscopy.

Keywords: tropical peat soil, humic acid, metal removal, adsorption, wastewater

2014 - EV018
DETERMINATION OF FACTORS THAT IMPACT CLEARANCE OF SUSPENDED PARTICULATE MATTER (DUST) IN AIR

Alanna M. Bram
John Marshall High School, Rochester, MN, United States of America

Environmental dust causes multiple problems, including negative effects on human health, impairment of machinery operation, and production of sensitive electronic components. Multiple types of interventions have been used to reduce amounts of dust, including filtering the air and alteration of local atmospheric conditions. I hypothesized that filtering would provide the most effective decrease in atmospheric dust, while changes in local humidity, temperature, or ionic charges would be less effective.

To test this central hypothesis, I designed and built a portable microprocessor controlled dust meter, with sensors to also measure temperature, humidity, time, and location. Dust levels in different parts of Rochester, MN were determined to identify areas with higher dust concentrations. To analyze effects of atmospheric conditions, dust from smoke was monitored in a controlled environment. Burnt out matches deposited in an airtight aquarium provided a consistent source of suspended particles. Rates of dust decay over time were determined under conditions of varying humidity, temperature, and ionic charge potential. I found that dust levels decayed at exponential rates that were highly reproducible. I also tested the abilities of several materials to filter out dust particles. Surprisingly, one of the most effective conditions that removed suspended particulate matter was the generation of negative ions. Finally, a compact personal dust detector was designed and built, and demonstrated to be able to detect different levels of dust. This methodology may be useful for detecting and ensuring rapid responses to dangerous atmospheric conditions at low cost to improve health and prevent damage to machinery.

Awards won at the 2014 ISEF
Third Award of \$1,000 - Environmental Sciences
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2014 - EV019
TO CHOOSE OR NOT TO CHOOSE?: INVESTIGATING THE TROPHIC EFFECTS OF THIAMETHOXAM ON EUPLECTRUS COMSTOCKII WHEN PARASITIZING TRICHOPLUSIA NI, YEAR TWO

Ashley Suzanne Wyrick
Tuscumbia High School, Tuscumbia, MO, United States of America

1, second generation neonicotinoids were introduced into the insecticide market. Thiamethoxam is the most used of these. It has a unique chemical structure that makes it highly water soluble. Limited information is available on the trophic effects of thiamethoxam on non-target arthropods. Because it's safe for mammals and so closely related to the natural insecticide nicotine, it has been suggested for widespread use in integrated pest management. This second-year research investigated the trophic effects of thiamethoxam on a pest insect – cabbage looper (Trichoplusia ni) and its biological control agent – parasitic wasp (Euplectrus comstockii). The purpose of this study was two-fold: first, to determine the toxicity of the thiamethoxam on the T.ni when fed through a continuous diet beginning at the neonate stage; and secondly, to determine if thiamethoxam would impact the parasitization of the T.ni by the E. comstockii. Toxicity testing was conducted using the following treatments: 10ppm, 100ppm, 1,000ppm, and 10,000ppm. There were two control groups: a negative control (water) and positive control (30% acetone). The neonate loopers were kept on the diet for seven days to determine toxicity based on mortality and effect on development. After 7 days, 30 surviving loopers from each treatment group were separated for the parasitization part of this study. A single parasitic wasp was placed in with each looper. After 24 hours, each looper was checked for the number of wasp eggs laid on its body. The following conclusions were drawn: The pest insect did not show susceptibility to the thiamethoxam, when given in a continuous diet. However, the neonicotinoid, at the concentration of 10,000 ppm, had a negative effect on parasitizing and ovipositing by the parasitic wasp.

Awards won at the 2014 ISEF
Third Award of \$1,000 - Environmental Sciences

2014 - EV020
THE EFFECTS OF HYDRAULIC FRACTURING ON GROUND WATER AND TAP WATER IN THE BAKKEN FORMATION

Gabriella TJ Blatt
Box Elder High School, Box Elder, MT, United States of America

Hydraulic fracturing, or fracking, describes the recovery of natural gas from deep layers inside the earth. In this method, porous rock is fractured by the use of

water, sand, and chemicals in order to release the natural gas. There has been controversy over this method after it was linked to contamination in Texas, New Jersey, New York, and Pennsylvania. This project looks at whether fracking is affecting groundwater resources in the Bakken formation. The water was tested for total dissolved solids, dissolved methane, and oil and grease. It was hypothesized that fracking does have an effect on the ground water and that the tap water was able to be successfully treated at a treatment plant. The results show high levels of total dissolved solids for sites within a one mile radius of a fracking site. The levels of total dissolved solids were significantly lower for the sites that were more than a one mile away radius and for the tap water. The water had more oil and grease in the sites more than a mile radius of a fracking site. The levels show little difference in the sites that were within one mile radius of a fracking site and the tap water. The methane the results were higher in sites within one mile radius of a fracking site and the tap water samples. They significantly lowered in sites that were more than a mile radius away from a fracking site.

2014 - EV021

INVESTIGATING THE EFFICACY OF BIOLUMINESCENT MUSHROOM PANELLUS STIPTICUS AS A BIOSENSOR TO DETECT THE TOXICITY OF WATER CONTAMINANTS

Bridget Ann Oei

East Catholic High School, Manchester, CT, United States of America

Conventional chemical assays of water samples typically target certain chemicals and are difficult to apply to a broad range of water contaminants. An economical and robust bioassay method for determining the toxicity of water contaminants should help improve public health worldwide. This research explored the effect of six common water contaminants - CuSO4, ZnSO4, NaNO3, HgCl2, Atrazine, and Permethrin, on the bioluminescence of the Panellus Stipticus mushroom. Panellus Stipticus was cultivated using two methods; a nutrient culture method and a plug spawn method. The harvested mushrooms were introduced to contaminants that were diluted according to EPA Maximum Contaminant Level values and at other varying concentrations. Decay in Panellus Stipticus bioluminescence intensity was visually monitored as well as measured using a Sper Lux/FC meter. Decay can be visibly observed with bioluminescent intensity reduction of 10%. The bioluminescent intensity of Panellus Stipticus was measured at 4.7 lux. 30 minutes exposure to metal salts, CuSO4, HgCl2, and ZnSO4, reduced the bioluminescent intensity by 68-72%. 90 minutes exposure to alkali metal salt contaminant, NaNO3, showed a reduction of bioluminescence intensity by 15%. Panellus Stipticus subjected to Atrazine and Permethrin contaminants showed a reduction of bioluminescence intensity by 12-13% after 150 minutes. Bioluminescence intensity decay of 10% or greater could be detected within 130 minutes under all contaminant concentrations. This makes Panellus Stipticus a viable qualitative and quantitative biosensor to detect toxicity of water sources.

Awards won at the 2014 ISEF

Second Award of \$1,500 - Environmental Sciences

2014 - EV022

THE EFFECT OF LEMNACEAE ON OVERALL WATER QUALITY PART LL: THE LOSS OF NITRATE NITROGEN THROUGH DECOMPOSITION

Brooke Pieke

Newman Grove Public Schools, Newman Grove, NE, United States of America

I ran a series of tests on water samples testing the overall water quality with an emphasis on high nitrate concentrations. Based on studies I completed, this is continuation research involving tile drainage systems and runoff from agricultural operations and their effects on water quality. As a variable, I harvested and added Lemnaceae to holding tanks with a nitrate concentration of 150 ppm to simulate the amount of nitrates entering watersheds from the tile drainage systems. The holding tanks did include the use of an oxygen aerator to prevent anaerobic bacteria from killing my specimen. My purpose behind my experiment was to reduce the amount of nitrates in local watersheds in an environmentally friendly way, while using the Lemnaceae to study if any other overall water quality components were affected by the plant. With my research, I hypothesized that Lemnaceae, or commonly known as duckweed, would absorb the nitrates from effected watersheds, or in my case, water samples; along with vary the pH, dissolved oxygen, phosphates, and temperature. The Lemnaceae could then be applied to fields for agricultural purposes acting like a residue, preventing soil erosion and naturally placing the nitrates back into the soil once decomposed I tested the water from each tank routinely with a colorimeter and studied the data for any trends that may be developing. My data consist of numerous charts and graphs that support my conclusion. I have concluded that Lemnaceae does reduce the amount of nitrates, dissolved oxygen and phosphates found in water, the pH increases, and the temperature remains consistent. I also concluded that when the Lemnaceae decomposes, nitrate-nitrogen levels increase in soils, making it an effective fertilizer.

2014 - EV023

INVESTIGATING THE USE OF PLANT XYLEM FROM ANGIOSPERM WOOD SPECIES AS ORGANIC WATER FILTERS

Varsha Venkatesh

Jericho Senior High School, Jericho, NY, United States of America

A major global concern pertains to the availability of potable water due to continuous growth in water demand which is not balanced by adequate restoration. Common technologies for water disinfection suffer from high costs, fouling, require pumping power due to low flow rates that prevent their wide implementation in developing countries. Xylem tissue in plants contain pores which not only allow for the passage of water between interconnected vessels, but also protect the plant against the formation of embolisms and spread of pathogens, raising the question of whether or not plant xylem can be used to make inexpensive water filtration devices. This study shows how xylem tissue from Tilia americana, and Ochroma pyramidale, angiosperm wood species were identified as suitable materials for filtration considering their availability, pore size, and resistance to fluid flow. A simple pressure-driven filtration apparatus was designed to contain xylem membranes during the flow and filtration process experimentation. Filtration was examined using soluble ink particles ranging from 10-60um in size. At pressures of 2940Pa, flow rates in the Ochroma pyramidale membrane were approximately 1.8mL/s, while flow rates in the Tilia americana were 0.5mL/s. Low flow rates in the Tilia Americana membrane were due to its uniform interconnected porous structure, yet the Tilia americana xylem membrane exhibited highest

filtration characteristics, having a particle rejection reading of 44.1337%. Plants are readily available as byproducts of the agricultural industry, and if certain wood species could be used to make water filtration devices, then such biodegradable, sustainable materials can be implemented in many resource-limited settings.

Awards won at the 2014 ISEF

Fourth Award of \$500 - Environmental Sciences

2014 - EV024

P.A.H. (POLYCYCLIC AROMATIC HYDROCARBONS) MIXTURES: USING ZEBRAFISH TO ELUCIDATE MECHANISMS OF TOXICITY

Meera Radha Srinivasan

Interlake High School, Bellevue, WA, United States of America

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous non point source aquatic contaminants derived from various combusive and fossil fuel sources, causing sublethal cardiotoxic effects in fish. PAHs' toxic mechanisms, especially in complex mixtures, are poorly understood. To elucidate these and develop diagnostic biomarkers to assess fish populations' health, a simplified model of an environmentally-relevant PAH mixture was examined by combining cardiotoxic Phenanthrene (PHN, three-ringed), and non-toxic Chrysene (CHR, four-ringed). Effects on morphology and metabolism were examined in relation to the cytochrome p450 enzyme detoxification metabolic model. Zebrafish embryos (<52 hpf) were exposed to increasing CHR concentrations in synergism with a stable PHN concentration. Morphological abnormalities were observed with increased doses of CHR and heart-rate measurements decreased dose-dependently (p<0.05). Then, PAH metabolites were analyzed with high performance liquid chromatography(HPLC) with fluorescence detection. Gene expression analysis of both cyp1a and cardiac-specific genes in the PHN+CHR exposures was conducted with qPCR and compared with expression levels from individual PHN and four/five-ringed PAH exposures to find biomarkers of PAH toxicity. Results indicate increased toxicity with the PHN+CHR mixture. HPLC method allowed measurement of PAH metabolites in exposed fish embryos, providing a novel method to examine metabolic interactions; results suggest the existence of an alternative metabolic pathway involved in PHN metabolism with toxic products. Though the examined genes were not bioindicators of non-toxic vs. toxic PAH exposure, some could distinguish between three and the four/five-ringed individual PAH exposure and should be further studied.

Awards won at the 2014 ISEF

Full tuition scholarship - Drexel University

Second Award of \$1,500 - Environmental Sciences

2014 - EV025

EFFECTS OF THE ENVIRONMENTAL POLLUTANT ACRYLIC ALDEHYDE ON RENAL FIBROSIS

Sanjana J. Rane

duPont Manual High School, Louisville, KY, United States of America

Cigarette smoke promotes renal fibrosis but the direct effects of acrolein (acrylic aldehyde), a constituent of cigarette smoke on renal fibrosis had not been determined. Heat shock protein 27 (Hsp27) is known to regulate renal fibrosis. Nuclear Factor Erythroid derived protein-2 (NF-E2) is a novel Hsp27-binding protein. Therefore, the purpose of my study was to determine the effects of acrolein exposure on renal fibrosis by examining NF-E2 expression, pro-fibrotic Connective Tissue Growth Factor (CTGF) expression, and induction of apoptosis in acrolein treated renal epithelial (HK-11) cells. I hypothesized that acrolein will induce renal fibrosis by altering CTGF expression and HK-11 cell apoptosis in a NF-E2 dependent manner. HK-11 cells were exposed to varying concentrations of acrolein (10 microM, 25 microM, 50 microM) for 24 hours and cell lysates were immunoblotted with anti-CTGF, anti-NF-E2, and anti-cleaved caspase-3 antisera. Exposure of HK-11 cells to acrolein significantly induced CTGF expression in a dose dependent manner with a concurrent decrease in NF-E2 expression. Increased NF-E2 expression was detected in acrolein treated HK-11 supernatants. The role of extracellular NF-E2 currently has not been determined. Acrolein also induced caspase-3 cleavage, and Hoechst staining demonstrated nuclear condensation indicative of apoptosis. Increasing acrolein concentration decreased HK-11 cell viability as documented by MTT reduction. Over-expression of NF-E2 inhibited CTGF expression and prevented HK-11 apoptosis by inhibiting caspase-3 cleavage. Thus, my studies identified NF-E2 as novel regulator of acrolein-induced CTGF expression and HK-11 apoptosis. Therefore, inducers of NF-E2 expression may serve a therapeutic role in treating renal fibrosis.

Awards won at the 2014 ISEF

Second Award of \$1,000 - American Physiological Society

Second Award of \$1,500 - Environmental Sciences

2014 - EV026

DIABETICS ARE MORE SUSCEPTIBLE TO AIR POLLUTION: EFFECTS OF URBAN PARTICULATE MATTER WITH HIGH GLUCOSE ON HUMAN MONOCYTES

Yue Zhang

duPont Manual High School, Louisville, KY, United States of America

er of epidemiological studies and animal experiments have shown that individuals with preexisting diseases, such as asthma, chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), and cardiovascular diseases are more susceptible to ambient particulate matter (PM)-related health problems. However, the underlying mechanisms are still unclear. Individuals with DM may be more susceptible to PM because they have preexisting inflammation, pro-oxidant states and endothelial dysfunction. In addition, hyperglycemia has been shown to activate macrophages/monocytes to secrete cytok

ines, which are involved in various hyperglycemia-induced cardiovascular diseases. Therefore, we hypothesized that PM and high glucose combined may cause enhanced effects on activation of monocytes and mitogen-activated protein kinases (MAPKs) through PM-induced oxidative stress, which may further activate matrix metalloproteinases (MMPs). Human monocytes U937 were used to test the effects of urban particulate matter (U-PM) and high glucose. Our results showed that exposure of monocytes to non-toxic doses of U-PM alone caused generation of reactive oxygen species (ROS), increased phosphorylation of Erk1/2 and p38, and up-regulation of MMP-9 mRNA expression and pro-MMP-2 and pro-MMP-9 activity. These effects were enhanced significantly when cells were exposed to U-PM in a high-glucose environment. These results may help us understand the health effects of PM on susceptible populations, such as those with DM. The results may also provide evidence to support policies that reduce particulate matter emissions.

Awards won at the 2014 ISEF

Fourth Award of \$500 - Environmental Sciences

2014 - EV027

ACID RAIN... BAD FOR CORAL REEF

Adrienne Sara Green

Nettleton High School, Jonesboro, AR, United States of America

The purpose of this project is to find the percentage weight loss of limestone, hard coral, and mushroom coral when in carbonic acid and mushroom coral in hydrochloric acid. Carbonic and hydrochloric acid are both acids in the ocean that are bad for the oceanic plants and animals. Limestone is a sedimentary rock when effected with carbonic acid, will deteriorate. Hard coral and mushroom coral are both warm, salt water corals.

In this project, 27 beakers of carbonic acid were filled with the pHs of either 5.5, 5.0, or 4.5. 12 beakers of hydrochloric acid were filled with the pHs of either 4.5, 4.0, 3.5, or 3.0. The limestone and coral were then weighed and results were recorded. Then, the specimens were placed in appropriate beakers. This process continued on for six weeks.

After analyzing data, it was concluded that there is no significant difference among the pH level and the specimen according to ANOVA. However, the mushroom coral lost the most percent in mass, then hard coral, and the limestone lost the least. It was also incorrect to compare the carbonic acid and the hydrochloric acid due to the difference of solution.

2014 - EV028

NOVEL RENEWABLE FILTER FOR HEAVY METAL REMOVAL: A PRACTICAL APPLICATION OF FUNCTIONALIZED MULTI-WALLED CARBON NANOTUBES

Perry Alagappan

Clear Lake High School, Houston, TX, United States of America

Heavy metals pose a huge threat to society by diffusing through water supplies. Many technologies have been developed for removing heavy metals from industrial wastewater and drinking water, but few are efficient, and almost none are renewable. This project's objective is to create an innovative, low-cost renewable multi-walled carbon nanotube (MWNT) filter that can efficiently adsorb heavy metals from contaminated water. MWNTs were deposited on 3.45g of Quartz Wool through Chemical Vapor Deposition, purified through Wet-Air Oxidation and HCl-Sonification, and functionalized with m-CPBA to produce the filter medium. 0.052M, 0.01M, 0.01M, 0.001M, and 100ppm solutions of Cadmium(II) Acetate, Mercuric Chloride, Nickel(II) Nitrate, Cobalt(II) Chloride, and Lead(II) Acetate respectively were poured into 0.5g filter medium samples packed in a burette, for three filtration trials per metal. Then, a 50:50 solution of de-ionized water and acetic acid was poured through the metal-contaminated filter medium, to renew it. Characterization techniques employed were: UV-Vis Spectroscopy for filtration capacities, Scanning Electron Microscopy for MWNT growth-patterns, Raman spectroscopy for changes in nanotube purity, and X-Ray Photoelectron Spectroscopy (XPS) for filter composition after filtration and renewal. UV-Vis revealed filtration capacities of 99.39%, 99.61%, 99.70%, 99.72%, and 99.97% for Cadmium, Mercury, Nickel, Cobalt and Lead respectively. Thus, heavy metal-contaminated sources even as high as 750µg/L can be filtered to meet current EPA MCLGs as low as 1µg/L. Progression of Raman G/D ratios (0.82-1.92-1.59-1.69-2.29), XPS atomic % (19% to 0%), and filtration/renewal times (120s/180s per 50 ml) clearly indicated that the filter is not only efficient, but also renewable.

Awards won at the 2014 ISEF

Intel ISEF Best of Category Award of \$5,000 - Environmental Sciences

2014 - EV029

SUSTAINABLE WATER PURIFICATION SYSTEM WITH UV IRRADIATION

Hans Christian Pande

Woods Cross High School, Woods Cross, UT, United States of America

There are nearly a billion people worldwide who do not have access to clean water and this lack of access has led to nearly 3.4 million deaths annually. This project attempted to determine an economical, effective, and renewable water purification method. UV water purification systems are currently being used in developed nations as a safeguard for water treatment after chlorination. The experimentation was conducted using a novel two-step ultraviolet (UV) water irradiation system. The first UV source purifies incoming contaminated water, while the second UV source pre-treats the transportation vessel the purified water flows into. The sustainable operating system is very economical as solar cells and a backup battery power the device. The apparatus is self-sustaining as it contains no chemicals or filters that need replacing. The device requires little maintenance as it is contained in a closed system and has no moving parts. The prototype apparatus purifies 3 gallons of water per minute as well as sterilizes the vessel that the sample was carried in. Ten water sources were tested from a variety of sources. Several Trypticase Soy Agar (TSA) agar dishes were inoculated with raw samples while others were inoculated with treated samples. After results were gathered and assessed, it was found that the testing apparatus was able to make all sources safe for human consumption with no outlying results.

This apparatus has the potential to save millions of lives by making clean water more accessible to people in an economical, effective, and renewable manner.

Awards won at the 2014 ISEF

Full tuition scholarship - Drexel University

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Fourth Award of \$500 - Environmental Sciences

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2014 - EV030

BENDING GENDERS - THE EFFECTS OF ESTRADIOL ON ARTEMIA FRANCISCANA FROM GREAT SALT LAKE, UTAH

Robert Paul Baskin

Bountiful High School, Bountiful, UT, United States of America

Artemia Franciscana (brine shrimp) are an integral part of the Great Salt Lake ecosystem and are impacted by variations in salinity and chemicals in their environment. Endocrine disruption has been observed in fish that live in waters that receive significant inputs of wastewater effluents. Even in trace amounts, endocrine disruptors, can have adverse effects on humans and aquatic ecosystems. The purpose of this project is to determine the effects of endocrine disruptors, specifically estrogen, on Artemia Franciscana. Six replicate populations of greater than 30 cysts were placed in 0, 2.5, 5, 7.5, 10, and 12.5 ng/L concentrations of estradiol, hatched, and grown to adult stage. One to three replicates were randomly selected for enumeration and determination of sex. Adults were separated from juveniles and the number of males and females determined by microscopic examination. Statistical analysis of the populations included a χ^2 -test of homogeneity and a linear regression T-test to determine if varying concentrations of estradiol impacted the ratio of males and females in the population. Results from the χ^2 -test of homogeneity revealed that differences in the population ratios of females to males was not statistically significant, with $\chi^2=1.7195$ and a p-value of 0.8864. The results of this study show that a single endocrine disruptor may not be the controlling factor in observed endocrine disruption effects in fish. The combination of multiple endocrine disruptors commonly found in wastewater may have an additive or multiplicative effect and require additional study involving T2 populations and additional forms of estrogenic hormones.

2014 - EV031

HAS METHICILLIN-RESISTANT STAPHYLOCOCCUS SUREUS (MRSA) ESCAPED PUBLIC HEALTH FACILITIES AND IS THE GENERAL POPULATION AT RISK?

Kincade Leo Stevenson

Davis High School, Kaysville, UT, United States of America

Methicillin-resistant Staphylococcus aureus (MRSA) has been an increasing health problem, annually killing more than 5,500 people in the USA alone. MRSA is resistant to most antibiotics. As researchers develop stronger antibiotics, strains of MRSA continue to mutate becoming resistant to these antibiotics almost as fast as they are being developed. It is generally accepted that MRSA was found in health facilities, such as hospitals and nursing homes, but whether or not it is found in other public domains is still unknown. MRSA has been detected in influent municipal wastewater, but it is undetermined whether the effluent water is also contaminated with MRSA as it leaves the treatment plant and is released into the public waterways. Earlier testing confirmed that MRSA was present in the influent wastewater at North Davis Sewer District, a treatment plant which serves 200,000 people. Water was tested from 7 different stages of treatment for the presence of MRSA to determine where, if at all, MRSA is eliminated before being released downstream. Tests were run on three different occasions, using two samples from each station. Two controls were present, one containing MRSA and one of a sterile solution. It was found that MRSA is removed during the Effluent 3 phase of treatment, which is where all of the solids in the water are removed indicating that MRSA may be bonding with the solids. This research could be applied to and help other entities effectively remove MRSA from their water sources.

2014 - EV032

EXPLORING THE EFFECT OF HERBICIDES ON ACQUATIC ECOSYSTEMS: THE DENITRIFICATION EFFICACY OF LEMNA MINOR UNDER VARYING ATRAZINE CONCENTRATIONS

Abigail Ella Johnson

Shenandoah Valley Governor's School, Fishersville, VA, United States of America

Aquatic plants that uptake nitrogen are an integral part of most aquatic ecosystems, serving to help prevent eutrophication and hypoxic conditions. Additionally, such plants are sometimes used in the wastewater treatment process. Certain herbicides, such as atrazine, may influence the phytoremediation abilities of these plants. The purpose of this experiment was to determine the percent denitrification efficacy of Lemna minor under varying atrazine concentrations. Tested concentrations, which were chosen with regards to current research and regulations on atrazine within aquatic ecosystems, were 0, 0.4, 4, 40, and 4000 $\mu\text{g/L}$. There were four replications across each concentration group, and each sample contained forty Lemna minor fronds suspended in a modified Steinberg's solution. Initial nitrate levels were measured, and after ten days, final levels were measured for each sample. After the collection of nitrate level data, analysis included a test to determine the correlation between atrazine concentration and percent nitrate removal. Assuming a logarithmic trend, this yielded an R-value of -0.82. Via post hoc analysis, a statistically significant difference in percent denitrification efficacy was found to exist between all except two concentration pairings. Further research is needed in order to affirm these results and to determine specifically why these results were obtained.

Awards won at the 2014 ISEF

Full tuition scholarship - Drexel University

2014 - EV033

THE ENVIRONMENTAL DEPENDENT PASSIVE FLUX METER: A NUMERICAL MODEL ASSISTED DESIGN

Stephen Yao

University High School, Tucson, AZ, United States of America

The degree of deep infiltration in the vadose zone is an important measurement to obtain for many applications and studies in the field of agriculture, containment management, and groundwater recharge. However, a simple and effective technology for direct water flux measurements has been elusive-many are associated with large margins of error. A previous study demonstrated the use of correct materials as well as an added evaporation prevention design that can minimize the instrument errors. In this study, the flux meter design of wick length, divergent pipe length, and pipe diameter were studied systematically with a numerical model. Different flux schemes were applied to the flux meter with various designs under various soil environments. The numerical results demonstrated that the design of the flux meter is dependent on all the parameters described above. A long wick length is particularly useful for fine soil and dry climate while the long divergent pipe can help to stabilize the vertical flow fields, thus preventing convergent and divergent flows. The large diameter of the pipe can also improve the flux measurements. In this study, the use of numerical model to assist the design will greatly increase our success for more accurate flux measurement by taking the local soil type and climate environment into consideration. While the passive flux meter is not able to react to changes in the surrounding environment, its low cost and simple design has the advantage of producing precise and accurate flux measurements with some assistance from numerical models. Three soil types were used in this study to demonstrate the fundamental difference of the flux meter design.

2014 - EV034

IMPROVING BIOINDICATORS: A NEW WEIGHT-LENGTH MODEL FOR FISH TO PROVIDE MORE ACCURATE ECOSYSTEM CONDITION ASSESSMENT

Ya'el Carmel Courtney

Mount Carmel School, Aurora, OH, United States of America

Bioindicators are a widespread and effective tool for evaluating ecosystem condition. Weight-length models are essential to using fish as bioindicators, providing estimates of expected weight for healthy fish of a given length. The traditional model, $W(L)=aL^b$, is widely used and fits many fish taxa. However, the leading coefficient a lacks clear physical meaning and yields error prone parameters, and the model overall yields parameters with undesirably high uncertainties. This study evaluated a proposed improvement, replacing a with scaling parameter L_1 : $W(L)=1000 \left[\frac{L}{L_1} \right]^b$. The primary hypothesis was that the improved model would have lower mean parameter uncertainties than the traditional model and smaller uncertainties in most data sets, yielding more accurate bioindicators. The models were compared for 160 data sets including 94 taxa containing 14,102 data points. Both linear-least squares and non-linear least squares regression techniques were used to produce best-fit parameters. The improved model yielded lower uncertainties for L_1 and similar uncertainties to the traditional model for b . Thus the improved model is empirically better for producing expected weights for use in assessing aquatic ecosystem health. Lower uncertainties enable diagnosis of ecosystem health with fewer samples and earlier problem detection. The secondary hypothesis was supported: L_1 is valuable as a new bioindicator because its value increases when fish are stressed by suboptimal ecosystem conditions. L_1 was sensitive to the effects of the Deepwater Horizon oil spill in Lafourche Parish, Louisiana, oyster overharvesting in Calcasieu Estuary, Louisiana, and invasive species in Blue Mesa Reservoir, Colorado as well as in several other cases.

Awards won at the 2014 ISEF

Fourth Award of \$500 - Environmental Sciences

Award of \$2,000 for best overall project in ocean science and exploration. - Consortium for Ocean Leadership

2014 - EV036

MONITORING OCEAN MICROSCOPIC ORGANIC MATERIAL: ASSESSING LARGE-SCALE ECOLOGICAL DISRUPTION ON ANNUAL CHL-A, POC, AND PIC FLUCTUATION EQUILIBRIUM

Jinsong (Tony) Yan

Cleveland High School, Portland, OR, United States of America

According to the biodiversity theory, the decrease in piscivore population will result in direct, short-term increase in planktivore biomass, reductions in crustacean herbivore biomass, and increase in chlorophyll a concentration and phytoplankton biomass. Put into perspective, when environmental systems are introduced to large-scale disruptions, we can expect a shift of biomass from secondary consumers to primary consumers and producers. This study focuses on the environmental impacts of the Fukushima Earthquake on the lower trophic levels of the Pacific Ocean ecosystem. Through satellite remote sensory (MODIS Aqua-9km), the resulting shifts of chlorophyll a (Chl a) concentration and particulate organic (POC) and inorganic carbons (PIC) will be monitored monthly for 2 years prior and after the earthquake. Chl a , POC, and PIC concentrations will be converted into average annual mass/biomass. The two data groups will be compared and analyzed with respect to modeled seasonal trends. Annual Chl a data shows an overall biomass increase after the earthquake while annual POC and PIC mass decreased. 2-tailed t-tests on datasets from before and after the incident reveals no statistical significance in the numerical difference. Furthermore, only the overall amplitude of the total mass/biomass peaks were noticeably changed. Seasonal distribution and concentration trends were largely unaffected. Given that POC and PIC are most commonly created through fixation of inorganic carbons by organisms of lower trophic levels, the results of this investigation show that the earthquake incident served to slightly increase Chl a while lowering overall biological productivity of microscopic organisms in the affected marine ecosystem.

Awards won at the 2014 ISEF

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2014 - EV037

PERCOLATION VS. HOMOGENIZATION: THE EFFECTS OF PHOSPHATE AMENDMENT ON LEAD CONTAMINATED SOIL, PHASE II

Annika Daniels

Ogden High School, Ogden, UT, United States of America

This experiment builds on further testing of percolation of phosphate through soil rather than homogenization to remediate lead contaminated soil. The experiment tested if percolation of a phosphate amendment would work on a larger scale and greater depth. To test this four 18x3 inch plumbing pipes were filled with 2,200 grams of lead contaminated soil from two different sites, two of these samples had 110 grams of phosphate amendment placed on top of the soil, and the other two samples had the same amount homogenized into the soil. 400 grams of distilled water was distributed to each sampling apparatus over five days allowing the water to percolate through the soil. The samples were then dried for two weeks. Composite samples were taken from each of the homogenized soil apparatuses. Soil samples were taken from four and nine inch depths from each of the percolated apparatuses. Each sample was then submitted to American West Analytical Labs for the Toxicity Characteristic Leachate Procedure analysis. The results from site one showed that both methods had lowered the leachability below the detection limits of the instruments. The results from site two also showed that percolation reduced leachability as effectively as homogenization. Homogenization of the phosphate reduced leachable lead from 80 parts per-million to 1.43 and percolation reduced it to 2.41 ppm at a depth of four inches and 3.74 ppm at a depth of nine inches.

2014 - EV038

INVESTIGATION OF DIFFERENT DEGRADATION TREATMENTS ON PESTICIDE CONTAMINATED WATER WITH TOXICITY BIOASSAY ON DAPHNIA MAGNA

Bovey Rao

Hillcrest High School, Midvale, UT, United States of America

Pesticides help to ensure crop productivity, but they contaminate the surrounding environment with toxic substances that can directly affect a local ecosystem's organisms. Microbial degradation of pesticides occurs naturally, but with today's higher levels of pesticide usage, toxic pesticides persist longer in the environment and can run-off or leach into human water systems. In this experiment, I measured the effectiveness of several degradation techniques at degrading a wide variety of pesticides. Fifteen types of organophosphate pesticides were degraded using UV light (254 nm) photolysis, potassium permanganate, hydrogen peroxide and combined treatments. I applied the UV light photolysis treatment method for six days with measurements being taken on each day using a GC/MS/MS. Concentration levels for nine out of the 15 pesticides dropped to non-detectable amounts, and the other six dropped by over 83%. The other treatments using hydrogen peroxide and potassium permanganate yielded drops of 54-83% and 59-100% for all pesticides, respectively. After combining pesticide degradation treatments, I found that the chromatogram peaks of all pesticides dropped over 93% for the hydrogen peroxide/UV combination and over 94% for the permanganate/UV combination. In addition, a water safety test using Daphnia magna has been conducted for 6-hour durations. The UV treatment and the combined permanganate/UV treatment resulted in a higher surviving Daphnia magna count and thus better water quality. However, the combined hydrogen peroxide/UV treatment resulted in higher toxicity levels for Daphnia magna. These results indicate that pesticide degradation can be achieved through a variety of treatments and combining these treatments greatly improve pesticide degradation.

Awards won at the 2014 ISEF

Full tuition scholarship - Drexel University

2014 - EV039

THE DISTRIBUTION OF ENTEROCOCCI IN SHORELINE SEDIMENT OF LAKE CARROLL

Margaret K. Parrish

Chamberlain High School, TAMPA, FL, United States of America

The purpose of this experiment was to determine the difference of enterococci levels with increasing depths of shoreline sediment beneath aquatic vegetation and sediment clear of vegetation. A preliminary goal of this project was to establish which testing method (shaken, blended or vortex) was best in determining a reliable method for enumeration of fecal indicator bacteria in sediment.

 The hypothesis states due to substantial enterococci in shoreline vegetation, there will be significantly increased enterococci levels in sediment beneath the aquatic vegetation than will be found in sediment clear of, yet adjacent to the vegetation. There will also be decreasing enterococci levels with increasing sediment depth.

 Vegetation and sediment were collected along the vegetation line on the shoreline following standard protocols. Sediment was collected at 0-3 cm, 4-6 cm, 7-9 cm and 10-15 cm under vegetation area and adjacent exposed area. Vegetation samples were blended, sediment hand-shaken. Samples were filtered using Enterococci EPA Method-1604.

 The data collected did not fully support the hypothesis. While higher enterococci levels were observed in the sediment under the vegetation at all levels except for 10-15 cm, decreased levels in the exposed sediment were not found to be statistically different. The data in both the exposed sediment and the sediment under the vegetation supported the trend of decreasing enterococci with depth.

 Future areas of research could focus on the importance of naturally occurring enterococci colonies in the vegetation or sand in relation to enteric viruses, and computer visualizations of enterococci levels in freshwater environments.

2014 - EV040

ASSESSMENT OF THIRDHAND EXPOSURE TO NICOTINE FROM ELECTRONIC CIGARETTES

Lily Wei Lee

Stuyvesant High School, Manhattan, NY, United States of America

Purpose: Electronic cigarettes (e-cigarettes) are new battery-powered devices that resemble tobacco cigarettes and convert nicotine solutions into inhalable vapors. Thirdhand exposure occurs when nicotine particles settle on indoor surfaces and react to form carcinogenic compounds. Exposure can continue long

after smoking has ceased and is a serious health concern. We assessed the possibility of the deposition of nicotine on various surfaces as a marker of thirdhand exposure from e cigarettes.

Methods: Three brands of e-cigarettes were refilled with varying nicotine concentrations and then vaped with a syringe in an exposure chamber in four experiments. Surface wipe samples were taken from several indoor 100 sq. cm surfaces (window, walls, floor, wood and metal). Nicotine was extracted with methanol from the wipes and analyzed using gas chromatography with a selective nitrogen-phosphorus detector (GC-NPD). Blank samples were collected from each surface before the experiments to estimate background exposure. ~

Results: Three out of four experiments showed significant increase in the amount of nicotine on all five surfaces. Nicotine stuck more easily to certain surfaces. The floor and glass windows had the greatest increases in nicotine, on average by a factor of 28 and 4, respectively, whereas wood had the lowest deposition rate of nicotine.

Conclusion: Our work indicates that nonsmokers can be exposed to nicotine released from e-cigarettes and deposited on surfaces. Thirdhand exposure levels differ depending on the surface, creating the potential danger of e-cigarettes exposing people to carcinogens. Future research should explore the risks of thirdhand exposure to carcinogens from e-cigarettes.

Awards won at the 2014 ISEF

Fourth Award of \$500 - Environmental Sciences

First Award of \$2,500 - National Institute on Drug Abuse, National Institutes of Health & the Friends of NIDA

2014 - EV041

MICRO AND MACRO INVERTEBRATES: WHAT'S CRAWLING IN THE WATER?

Tyhendreon Wilson

Noxubee County High School, Macon, MS, United States of America

Ponds and streams are being impacted daily in complex ways. Teems of organisms that inhabit these waters are excreting nitrogenous waste products. Fisherman and farmers may also be adding small amounts of waste to these biotic systems. In addition, natural processes of the water cycle like acid rain and runoff are at issue. There are also agricultural and residential sources that may be suspected of causing pollution. All of these factors contribute to the changes observed in pond and streams. The focus of this year's study was to make visible and quantities observations of these self-contained aquatic ecosystems; thereby providing a multiple measure of their quality. From the field research done this school year the fauna in local streams revealed that even though chemical test showed 90% of these waters could be classified as in good condition, about 50% of this year's water analyzed reveal that there are organism found in them that have been associated with poor water quality. The presence of certain macro invertebrates like black fly larvae and at least one leech indicates that the waters may be changing in a negative way. As shown in the photographs, the general areas that surrounded the streams looked good. In addition, there were no foul smells apparent in any of the waters tested. There were signs that animals have visited these waters by tracks being present. The micro-organisms found in local waters can also be used as a barometer of stream quality they were ciliates, flagellates, and some amoeboid.

2014 - EV042

THE NATURAL DECONTAMINATION OF INDUSTRIAL AND AGRICULTURAL WATER

Gage Connor Metzen

Hankinson Public School, Hankinson, ND, United States of America

e: To anayze the decontamination ability of coontail, sago pondweed, and barley straw. Secondl to determine the decontamination ability of natural wetland s.

cedures: Small Sca e Study & Large Scale Study: Tested watr samples from three different locations (beet plant, ethanol plant, and the Wild Rice River). Placed two different aquatic plants (coontail & sago pondweed) and one cereal straw (barley) in water from each of the locations. Tested water samples for amounts of phosphates, nitrates, ammonia, pH, conductivity, and bacteria growth. Repeated this procedure a total of four repetitions.

Tewaukon Refuge: Collected water samples from four different water sources located at the Tewaukon National Wildlife Refuge. Tested water samples for amounts of dissolved oxygen, carbon dioxide, phosphates, nitrates, ammonia, and bacteria growth. Repeated this procedure a total of four repetitions.

Barley Straw Pump: Built a pump system that flowed water through a collection of barley straw. Determined flow rate to be at 600ml per minute. Allowed it to flow freely for four weeks. Tested water samples for amounts of phosphates, nitrates, ammonia, pH, conductivity, and bacteria growth.

Conclusion: I found that all three decontaminators helped reduce water contamination in both the small scale, large scale, and the practical setting studies. I also noticed that cycling water through the barley straw does help to increase its overall effectiveness. Overall, I feel that even though plants are more effective at decontaminating water, barley straw would still be a suitable choice due its relative low cost and abundance

2014 - EV043

WHAT MATERIAL BEST ENHANCES SOIL MICROBIAL CARBON USE EFFICIENCY TO REDUCE SOIL CO2 EMISSIONS?

Jarek Vincent Kwiecinski

Albuquerque Institute for Mathematics & Science at UNM, Albuquerque, NM, United States of America

This experiment was conducted to determine how the addition of kenaf fiber, granular activated carbon (GAC), and humate affected soil microbial carbon use efficiency (CUE). Upper Sonoran Life Zone soil was collected, homogenized, and a control sample was created. Three samples with 20% one amendment, three samples with 10% each of two amendments, and one sample with 6.7% of each amendment were created. Samples were placed in an environment with minimal temperature and humidity changes. Samples were watered regularly with 500 mL adjusted with environmental variables. CO2 flux data was collected with an LI-6200 CO2 analyzer. Biomass was assayed via ATP luminescence detections and enzyme analyses were performed with fluorescence detection.

Based on respiration data, a decline in CO2 flux throughout the test period was observed. For some amendments such as humate, a greater decline in CO2 flux was observed. Biomass data indicated that samples had significantly different effects on biomass. The GAC sample had much lower biomass, accompanied by higher β-Glucosidase activity. Kenaf and GAC and kenaf samples had higher biomass and lower respiration values and were calculated to have marginally higher CUE. Humate and kenaf samples also had steadily higher biomass values.

To conclude, for each amendment, a significant

decline in soil CO2 flux occurred over the course of the test period. CUE increased for samples containing GAC and kenaf.

2014 - EV044

PROTECTIVE EFFECTS OF TURMERIC ON ULTRAVIOLET-RADIATION EXPOSED FRUIT FLIES (DROSOPHILA MELANOGASTER)

Raveena Aggarwal

St. Andrew's Episcopal School, Ridgeland, MS, United States of America

This investigation studied the effect of various exposures of Ultraviolet radiation on Fruit Flies (*Drosophila melanogaster*) cultivated in Turmeric, a spice that has previously been proven to have some medical benefits. The purpose of this project is to find cost-effective ways to guard or reduce the health risks of UV radiation. Adult fruit flies were placed in tubes containing a medium with Turmeric. The adults would lay larvae and these larvae would consume the Turmeric medium. In order to have a consistent development level of the larvae, third instar larvae were chosen for irradiation. The mediums of Turmeric contained various dilutions. After diluting the serial through a standard diluting process, there were 5 dilutions, 1, .1, .01, .001, .0001. After separating 10 larvae into petri dishes for all the various dilutions, the larvae were then exposed to Ultraviolet radiation on an Ultraviolet transilluminator for different time increments: 180 seconds, 150 seconds, and 90 seconds. Finally, at intervals after the exposure, the fruit flies were observed for whether they had developed any mutations, and data was collected in order to determine the protective effect of the Turmeric on the fruit flies. A previous study had been conducted with blackworms (*Lumbriculus variegatus*) with three different spices: Turmeric, Coriander, and Cumin. After the study was completed, Turmeric was shown to have the most protective affect from Ultraviolet exposure. Therefore, Turmeric was chosen as the spice used for this study.

2014 - EV045

WHITE RIVER QUALITY AND POLLUTION STUDY USING BENTHIC MACROINVERTEBRATE BIOINDICATORS

Muhammed Amir Sankari

Eman Schools, Fishers, IN, United States of America

In 1999, over four million fish and an uncountable number of macroinvertebrates died when the Guide Corporation released a large amount of Sodium Dimethyldithiocarbamate (HMP-2000), a corrosion inhibitor, into the sewers of Anderson, Indiana. The chemical broke down into thiram, a pesticide, which is highly toxic to all organisms in the White River. This toxin spread to over fifty miles of the White River. The purpose of this project is to investigate the effects that this pollution had on the ecology and hydrology of the White River. This study focused on two sites near the original dumping site, one upstream (River Bend Park) and one downstream (Perkinsville). The Kick Seine standardized collection method was used to disturb macroinvertebrates attached to the substrate, thus allowing them to float downstream into the net. Samplings were taken from both riffle and run locations at both sites. Samples were then separated and identified for the name and number of macroinvertebrates using the Pollution Tolerance Index (PTI). PTI numbers were then totaled and multiplied to obtain the PTI rating (PTIR), based on the tolerance group of the various macroinvertebrates. Results were compared with those upstream and downstream of the original contamination site. Results of the study revealed that upstream samplings had a PTIR geometric mean of 53.85 and downstream samplings had a PTIR geometric mean of 46.54. This shows that recovery has occurred between the two sites tested. However, it is also indicated in the study that there are lower numbers of less tolerant species, suggesting that the White River may still be experiencing pollution, in which further research would be warranted.

2014 - EV046

SUN IN . . .WATER OUT!: LIGHT ABSORBING NANOPARTICLES DRAMATICALLY ENHANCE VAPORIZATION IN SOLAR DESALINATION

Reeves Balderson

Moorestown High School, Moorestown, NJ, United States of America

Population growth and climate change will increase global water demand while water supplies diminish. Creating a compact, inexpensive solar desalination device to salt water into drinking water can turn this crisis into an opportunity. This project explored the potential to create solar vaporization by exploiting the photothermal effects of nanoparticles in the desalination prototype. The concept is to create steam without boiling water using the sun and nanoparticles. Increased vaporization resulted in increased water production in the solar desalination device when the particle size was <100 nm. Evaluation of the potential to create a superhydrophobic condenser using hydrophobic polymers to speed condensation and produce more water did not produce the hypothesized results. The hydrophobic materials led to dense droplet formation, but the droplets did not release quickly and grew too large. Droplets must fall away quickly in order form new droplets to speed condensation. Seven different samples were tested, incorporating different particle size carbon black and hydrophobic coatings for the condenser, modifying last year's best desalination device. Temperature measurements were taken over time and water was collected to determine rates of water production and temperature increases. The hypothesis was partially supported. Nanoparticles absorbed light, raising the surface temperature and causing vapor to be formed around the nanoparticle surface. This caused vaporization of the water that was close to the heated nanoparticle. With time, heat was exchanged with the water causing a rise in the bulk water temperature. The greater surface area of the nanoparticles improves reactivity and catalysis, driving improved efficiency of the desalination device.

2014 - EV047

THE EFFECT OF PHOSPHORUS LEVELS ON THE GROWTH OF DUCKWEED

John Joseph Bell

Little Rock Central High School, Little Rock, AR, United States of America

The purpose of this experiment was to determine the effect phosphorus has on the growth of duckweed in an aquatic environment. The hypothesis was that if increased amounts of phosphorus are added to containers of de-ionized water holding the same number of duckweed plants, then the container with the most

phosphorus added will produce the largest increase in the mass of duckweed. The procedure was to set up three sets of containers, each set having: a Control with only de-ionized water; a container with .125 mL of phosphorus solution added; a container with .25 mL of phosphorus solution added; and, a container with .5 mL of phosphorus solution added. The mass of 14 duckweed plants was measured on a special scale, recorded, and the duckweed plants were placed in a container. The same process was followed for the other 11 containers. After 35 days, the duckweed mass in each container was again measured and recorded. The data showed that the more phosphorus that is added, the greater the duckweed growth. Consequently, the hypothesis was supported.

2014 - EV048

WHICH GRASS COULD HELP REDUCE GLOBAL WARMING?

Connor James Henze

Elk Point Jefferson High School, Elk Point, SD, United States of America

Global warming is a real world problem that we each have a responsibility in helping to reduce. My project was to see what type of grass could help reduce global warming. My hypothesis was that if I test different grasses to see which would reduce the temperature the most, then it will be Red Fescue grass. I made twenty terrariums from pop bottles. I planted three different kinds of grasses: Red Fescue, Kentucky Bluegrass, and Rye, in fifteen terrariums and left five with only soil to serve as the control. My carbon dioxide source in each terrarium was a tablespoon of vinegar mixed with one tsp of baking soda. I used a temperature probe and thermometers to measure temperature change in each terrarium. After performing my experiment and recording my data, I found that the control group had an average percent change in temperature of 10.8. Rye grass had an average percent change in temperature of -8.6. The Red Fescue had an average percent change in temperature of -6.6. The Kentucky Bluegrass had an average percent change in temperature of -6.4.

In conclusion, my hypothesis was rejected. My data supports that Rye grass caused the temperature to decrease the most. The Rye grass used more of the carbon dioxide in the container to perform the process of photosynthesis. If people would be willing to plant Rye grass in their community this could potentially help reduce global warming and have a positive impact on our climate.

2014 - EV049

POSSIBLE HUMAN IMPACT ON DEGRADATION OF SURFACE WATER QUALITY: NOVEL BACTERIAL ANALYSIS WITH ONGOING CHEMICAL AND MACROINVERTEBRATE ANALYSES OF WEEKS' BAYOU SUBWATERSHED

Jane Elizabeth Moore

Ocean Springs High School, Ocean Springs, MS, United States of America

Purpose: A series of biomonitoring techniques were used to assess the surface water quality of Weeks Bayou subwatershed using chemical, macroinvertebrate, and bacterial analyses. The aquatic health of estuary waterways affects the health of the Sound and Gulf of Mexico. This project measured the local surface water quality, particularly in areas with high human impact.

Procedures: The reach was defined from a freshwater pond at the top of Weeks Bayou to the inlet into the Mississippi Sound. Four sites were established at equal intervals. Water and macroinvertebrate samples were collected annually. Chemical analyses were performed using LaMotte® Earthforce water monitoring kit. The bacterial classification/quantities were measured using the Coliscan MF biochemical kit protocol. Bioassessment for macroinvertebrates followed the Adopt-A-Stream protocol.

Data: The highest contamination is in the upper portions of the reach, closest to ongoing development. Sites 2 and 3 show dense E. coli growth as well as other coliforms. Site 2 receives not only run-off from the neighborhood at site 1, but also from two other neighborhoods and a farm pond. This creek was recently widened by city backhoes upstream from Site 2, resulting in greater runoff and less natural filtering. Site 3 has new development adjacent to it.

Conclusion: Human development can damage an estuary. Even in the small study area, E. coli contamination and water quality degradation are identified. There are many ways to lessen negative impacts of humans on surface water quality and restore aquatic health of the bayou. Limiting further development and preventing loss of natural/vegetative filtration is highly beneficial but unlikely to occur as city growth continues. Mitigation techniques are required.

2014 - EV050

COMPARATIVE ANALYSIS OF CARBON DIOXIDE SEQUESTRATION AND CALCIUM CARBONATE PRECIPITATION IN TWO SPECIES OF CYANOBACTERIA: TOLYPOTHRIX DISTORTA AND FISCHERELLA MUSCICOLA

Asmaa Mahoui

Eman Schools, Fishers, IN, United States of America

This project focuses on comparing two different species of cyanobacteria, Fischerella muscicola and Tolypothrix distorta, and their ability to sequester carbon dioxide in the form of calcium carbonate precipitate. Cyanobacteria have many advantages towards mitigating excess atmospheric carbon dioxide, which is one of the major causes of global warming. Many species of cyanobacteria have the ability to remove carbon dioxide from the carbon cycle and fix it into inorganic calcium carbonate. I hypothesized Tolypothrix may be a more effective bioagent in sequestering carbon dioxide in the form of calcium carbonate based on its close morphological homology to Calothrix which has been shown to produce visible calcium carbonate deposits. To test how much carbon dioxide was sequestered, each strain was put in an enclosed chamber and placed in a plant growth chamber for 84 hours. The change in carbon dioxide levels was recorded and analyzed. Subsequently, hydrochloric acid was added to the samples to determine how much calcium carbonate was precipitated via an indirect measure of carbon dioxide release. Tolypothrix distorta sequestered the most carbon dioxide over a span of 84 hours. Interestingly, however, Fischerella muscicola precipitated the largest quantity of calcium carbonate. This discovery supports that the two strains disproportionately converted the carbon dioxide into two forms: Fischerella to calcium carbonate and Tolypothrix to organic compounds.

2014 - EV051

ESCHERICHIA COLI DISINFECTION: COMPARING THE EFFECTS OF ULTRAVIOLET LIGHT AND SODIUM HYPOCHLORITE

Akash Sivakumar

South Pacific Academy, Pago Pago, American Samoa

The purpose of this project was to compare the effects these two water purification methods had on E. coli. It was hypothesized that Ultraviolet light sterilization would disinfect and kill more E. coli than the Sodium Hypochlorite disinfection method. Since this was a comparative study there was to be two experiments conducted pertaining to each individual disinfection method. For the Ultraviolet disinfection, the E. coli would be exposed to UV radiation for different lengths of time in different groups so it would be evident what amount of time is required to kill the bacterium as effectively as possible. For the Sodium Hypochlorite it is a similar situation except time wasn't the variable it was the concentration of the Sodium Hypochlorite solution. It will be done through different concentrations of the solution; preferably 1%, 0.5%, 0.7%, 0.2% concentrations of Sodium Hypochlorite mixed with the Bacterium and one control. The results of the UV light experiment showed that the effect of UV exposure time against E. coli decreases its survival rate much faster than the Sodium Hypochlorite experiment.

2014 - EV052

INVESTIGATING RELATIONSHIPS BETWEEN AIR QUALITY AND ENVIRONMENTAL PERSISTENCE OF FECAL INDICATOR BACTERIA AT RECREATIONAL BEACHES: A MOLECULAR MST APPROACH

Kristina Marie Thoren

American Heritage School, Plantation, FL, United States of America

Despite numerous cases of beach bacteria affecting millions of people worldwide the persistence of the bacteria populations in coastal areas is still not well understood. The purpose of this study was to test the levels of persistence of Enterococci, Escherichia Coli, and Human Bacteroidales within the "swash zone" and waist zone in which people commonly bathe and play. In addition, the study sought to determine if the bacterial components in the beach are similar to those found in the air. Solar insolation in relation to bacterial persistence in seaweed was used to determine if sunlight plays a role in modifying concentrations of bacteria. Air quality measured by a solar photometer was compared to varying locations where the beach samples were collected. Results demonstrate that bacteria measured using plate counts and qPCR were indeed higher within the swash zone than in the waist zone. This is in contrast with the way that the EPA currently measures and determines the public safety of beach waters. They commonly measure the waist zone, but disregard the swash zone. This emphasizes the need to collect samples from the entire beach instead of just measuring at an isolated area. It was further identified that the bacteria from both wrack and water matched in quantity to the air measurements. Thus, the data reveals a potential way to identify harmful levels of bacteria and dangerous levels of poor air quality at recreational beaches. These results expound the need for the EPA to measure not only the air quality, but also varying depths of water, which can be extremely beneficial to spare people from microbial contamination risk.

Awards won at the 2014 ISEF

Fourth Award of \$500 - Environmental Sciences

2014 - EV053

H2OH NO: PHARMACEUTICALS CONTAMINATE GROUNDWATER! SULFAMETHAZINE ADSORPTION ISOTHERMS AND KINETICS WITH HYPERCROSSLINKED POLYMER MN250 IN ACID AND ALKALINE ENVIRONMENTS

Maria Elena Grimmer

Oxbridge Academy of the Palm Beaches, West Palm Beach, FL, United States of America

Four hundred tons of sulfamethazine are fed to livestock annually in North America to prevent disease and promote growth, but most of the drug is excreted unmetabolized into the environment. Due to slow degradation and high soil mobility, sulfamethazine contaminates groundwater supplies and causes aquatic ecosystem damage. Current water treatment methods to remove sulfamethazine are not universally effective and have considerable limitations, which necessitate newer remediation techniques. Hypercrosslinked polystyrene adsorbents show promise because of high surface areas, high mechanical strength, and regenerable properties. Using batch adsorption techniques, this study compared the capacity and rate of sulfamethazine adsorption onto Purolite hypercrosslinked adsorbent MN250 in simulated groundwater at pH 5, 7, and 9. The adsorption capacity of MN250 for sulfamethazine (Qe) generally increased with decreasing pH. Over the same range of equilibrium sulfamethazine concentrations, Qe values at pH 5 were 20 to 30% higher than pH 7 and 51 to 62% higher than Qe values at pH 9. At pH 5, the maximum Qe was 128.3 mg/g (Ce = 14.3 mg/L) whereas the maximum capacity at pH 9 was 80.33 mg/g (Ce = 16.7 mg/L). The adsorption kinetics displayed prolonged adsorption over 120 to 144 hours and were best described by Ho's pseudo-second order model. Overall, MN250's adsorption capacity for sulfamethazine is pH dependent because both the ionic distribution of sulfamethazine molecules and the zeta potential of MN250 vary as a function of solution pH. MN250's high capacity for sulfamethazine adsorption across a wide pH range highlights its potential for groundwater remediation.

Awards won at the 2014 ISEF

Third Award of \$1,000 - Environmental Sciences

2014 - EV054

THE SELENOPROTEOME INFLUENCES VULNERABILITY TO ENVIRONMENTAL METHYLMERCURY: THE POTENTIAL PERSPECTIVES IN RELATION TO HUMAN DISEASES

Davarshi Nikhil Patel

Red River High School, Grand Forks, ND, United States of America

A) Purpose of Experiment: Most people understand that mercury inhibits certain enzymes which are essential for health in virtually all organisms. The mechanisms on how it is studied is not very well known and understanding how certain inorganic's such as selenium can prevent mercury toxicity. The research may help provide certain correlations to diseases such as AIDS and how it is important to have selenium.

B) Procedure: The research hypothesis was

to look at organisms (crickets) that do have selenoenzymes versus organisms (beetles) that don't have selenoenzymes. To test the hypothesis 270 beetles and crickets were placed into 9 dietary treatment groups each containing low, moderate, and high amounts of mercury and selenium. The individual weight of each cricket and beetle was recorded and analyzed. The data was graphed in Microsoft Excel.

C) Data: The data collected from crickets showed signs of impaired growth when exposed to high amounts of mercury with low amounts of selenium. The data also showed that high amounts of mercury exposed to high amounts of crickets had negligible growth affects. Beetles when exposed to high amounts of mercury and selenium and no significant change in growth. The data gathered goes along with the original hypothesis.

D) Conclusion: The research gathered from the data helped come up with research which can be used in future studies to tie in the importance of selenium in understanding mercury poisoning. It also gave background to animals that don't have selenium and why they don't require it. The study can also help create possible conjectures in understanding how certain diseases interact with selenium which could help find novel cures in the future.

Awards won at the 2014 ISEF

Fourth Award of \$500 - Environmental Sciences

2014 - EV055

COPPER PAINT: THE BIOCIDES TO MARINE LIFE FORMS

Holly Darlene Merrill

Earl Wooster High School, Reno, NV, United States of America

The purpose of this experiment was to discover if copper paint on boat hulls, used to repel sea life adherence from the bottom of boats, can change the pH of ocean water. To determine if copper is a culprit of increasing acidity levels, seawater samples were taken in the marina area of Oakland, California, the harbor of Seattle, Washington, and the open shore of Malibu, California. These places are not only different in location, but differ in how the water is situated. 50 samples with 5 controls were set up in 125ml (1/2 cup) increments in 225ml receptacles (1cup). 'Boats' were added to water samples for a period of 2 weeks, while pH was determined with a calibrated pH meter. All data concluded and supported my hypothesis of an acidic change in pH. (Seattle, 7.5%; Oakland, 1.5%; and Malibu, 6.3 %). Copper paint does change the pH in seawater to a more acidic and thus toxic level. Barnacles, the target species of copper paint, have existed for millions of years. To easily repel/remove barnacles and other unwanted sea life, a high level of toxicity, which is provided by copper paint, must be used to defy their calcareous water fouling which in turn has a greater effect on more sensitive species. (Even a 2% change in pH can harm the larvae of a keystone species, such as 'Brittlestar Ophiolthirix Fragilis.)

2014 - EV056

CYMBOPOGON AS AN ALTERNATIVE TO REDUCE MOSQUITO POPULATION

Nur Zayani Zamri

SMK Seri Kenangan, SEGAMAT, Malaysia

Citronella is a traditional plant that is abundance source and easy to found in Southern Asia. It is rarely use for medication in modern world and never be a main material for anything. So , the objective of this product is to study the relationship between citronella as main material in reducing the population of mosquito without kill them. Some experiment has been carried out to proving that citronella can be used for this product . It started when the type of plant such as citronella , ‘selasih seeds’ , ‘bunga kantan’ and clove is being choose by put a few of mosquito inside the compartment and test it respectively . It then being continued by test the effectiveness between citronella root or citronella stem with root , hydrosol and essential oil of citronella and lastly the experiment about testing the original product which is Cyombo-Quito with others product nowadays . The oil essential of citronella is produced by distillation process and from that the GCMS result is formed . The GC-MS result showed that major chemical compounds of the citronella oil used were citronella (35.97%),nerol (17.28%), citronellol (10.03%), geranyle acetate (4.44%),elemol (4.38%), limonene (3.98%), and citronellyle acetate(3.51%).As a result , it is been proved that citronella is most effective among the plants which is 96 % the efficiency repellent. The used of root with stem of Cymbopogon Nardus state the best record of efficiency repellent which is 90% , higher than leaves.Cyombo Quito also state the best record as it was 90% efficiency repellent between product that have been made nowadays. As the conclusion , citronella or Cymbopogon Nardus is the most effective in reduce the population of mosquito besides have many benefits when using this product.

2014 - EV057

PREVENTION OF OZONE (O3) BY ENVIRONMENTAL PROTECTION FILTER (EPF)

Sidra Riaz

C.M.A Paradise School, Karachi, Sindh, Pakistan

This research project aimed to prevent O-Zone Layer through at low cost, most efficient and easy to assemble Environmental pollution Filter. Environmental pollution is the biggest menace to the human race on this planet today. It means adding impurity to environment. The environment consists of earth, water, air, plants and animals. One of the biggest sources of this Pollution is generation of CFCs in Industries which spread out in the form of gasses in the environment. That's why I have decided to work on a Filter which absorb and control the main cause CFCs and other causing substances which are damaging and harmful for O-Zone and also before it mix up in air and Polluted air it control at its source of generation. My New filter is based on cooling process and attached with the top of Chimneys of the Industries. Before the polluted gasses enter in the atmosphere my filter cool it at low temperature provided by system attached or heat pump. As the temperature becomes down gasses liquefy and store in the chamber name is collecting chamber. To Utilize the newly introduced material NOTT-202a consists of a tetra-carboxyl ate ligands a honeycomb like structure made of a series of molecules or ions bound to a central metal atom and filled with indium metal centers ,which gas capability of absorption of CO2 and all other gasses.

E% = Absorption power of smoke x 100

 Total power of smoke

My Designed Filter is low cost, easy to assemble and most efficient

2014 - EV301

FRACKING CONTAMINATION

JoLynn Faith Riojas, Roger Garcia

Taft Hlgh School, Taft, TX, United States of America

Based on research done last year, it was decided that an experiment would be completed to observe the contamination that occurs during hydraulic fracturing. In an experiment done in 2013, it was observed that contamination does occur within aquifers, and substances within fracking fluid seep into the drinking water. From these results and further research, a new scientific question was created to have a more exact analysis of the contamination within aquifers, and to compare the extent of contamination to the CDC's chemical exposure limit.

 Using isopropanol and methanol, two fracking fluids were created with each chemical. A more advanced geological model of the Eagle Ford Shale layers were created, and an improved hydraulic fracturing mechanism was created. The aquifer water was extracted following a completion of the hydraulic fracturing process, and was tested. The steps were repeated for six trials with each chemical.

 The data showed that the average amount of contamination from both methanol and isopropanol exceeded the exposure limits provided by the CDC. The average methanol contamination level was 396 PPM, exceeding the limit of 200 PPM. The average isopropanol level was 442 PPM, exceeding the limit of 400 PPM.

 It was concluded that the amount of contamination that occurs within aquifers following hydraulic fracturing surpasses the safe limit for human exposure. The results suggested that the amount of force used is strong enough to create openings in the rock layers, allowing chemicals in the fracking fluid to seep into the water.

2014 - EV302

CO-EERTING SURPLUS: TO COLLECT TO SEPARATE POLLUTION PLANT MATERIALS OF RICE PLANTAE WITH FRESH WATER PERCH FISH (PERCA FLUVIATILIS) OF TRICHDERMA TERRARIUM

Diyari Mawlud Murad, Mohammed Mohammed

Ishik Boys College, ERBIL, Iraq

Fish are often raised on their own. We got the idea to raise them with rice crops. We dig the farm 50cm then raise perch fish there so that less land is wasted less water is polluted and the waste of the fish is good for the rice as well as the nutrition of the rice is good for the fish. The results we got were pretty good, we increased the profit the fish were completly healthy and they even tasted better! After raising a few generations of rice and fish the water gets polutted, so we will clean the polluted water and reuse it. Water purification is normally done by chemicals but they are expensive and often bad for our health and the water purified by chemicmals doesnt taste good. The best method for water purification is boiling the water but this method is usually really expensive. Our plan is to boil water without the use of electricity by the system we came up with that boils water by the sun's heat using some system efficiency, so to sum up, our project saves water land and produces healthier fish and rice. We got the results after 75 days of expirimenting.

2014 - EV303

SUN RIVER CONSERVATION

Sabia Reiche, Serenity Wolfe

Simms High School, Simms, MT, United States of America

In 2004, the State of Montana deemed the lower Sun River between the town of Sun River and the city of Great Falls impaired for conductivity, sedimentation, nitrogen, and phosphorous. The purpose of this research was to determine the source of contamination in the lower Sun River. Three potential sources of contamination were hypothesized. These included the town of Sun River, Muddy Creek, and the village of Sun Prairie. Physical and chemical data was collected from multiple sample locations along the lower Sun River. The standard error was calculated for pH, conductivity, and temperature. All pH values fell outside the estimate of error. All samples except SRP-4 and SRP-5 fell outside the estimate of error for conductivity. Nitrite and sulfate exceeded maximum acceptable values. The data supports the hypothesis that the town of Sun River and Muddy Creek were sources of contamination.

2014 - EV304

BACTERIAL COLONIES GROWTH IN PRESENCE OF: AL, NI, PB, CD, AND ZN

Rocio Taire Vazquez Beltran, Jose Martinez

Colegio Marista, Guaynabo, Puerto Rico

Biogeochemistry is the study of the relationship between the chemical processes of earth, and life. Understanding these chemical processes also provide further information related to environmental problems. Biogeochemical cycles can be impacted by waste in the environment, especially those of the metallic type. Water can be contaminated when these metals are discharged or are in contact with water bodies. This experiment evaluated the effect of specific concentrations of heavy metals in river water allowed by EPA, on the growth of different types of bacterial colonies which are essential in many biogeochemical processes.

 The required conditions for colony growth were recreated transferring a nutrient agar in six independent petri dishes. After solid media preparation, 1.0 ml of river water transferred to a fish-tank was added to each. The petri dish selected as Control was not exposed to any metal solutions. For he remaining five, 0.5 ml of a specific metal solutions (Al 0.2ppm, Ni 0.1ppm, Pb 0.015ppm, Cd 0.005ppm, and Zn 5ppm) were added, respectively. After incubating plates for 48 hours at 37°C, they were inspected under a dissecting microscope, and colonies were classified according to their morphology. With a manual bacterial colony counter, the quantity of species per colony were counted and recorded. This exact procedure was repeated two more times.

 Data was graphically analyzed. Bar charts and Pie charts generated displayed the individual bacterial growth frequency for each category, and were used to show consistency between groups. Box plots were used to show behavior of bacterial growth when compared to the Control. It was determined that the metals have an impact in bacterial colonies growth.

2014 - EV305

EFFICIENCY OF THREE MACROPHYTES IN THE REMEDIATION OF MIGUELETE STREAM WATERS

Melissa Belén Cristóbal, Claudio Lacuesta

Liceo No. 17, Montevideo, Uruguay

Physicochemical and biological monitoring of Miguelete Stream, main fresh water course of Montevideo, capital city of Uruguay, shows deterioration in the water quality. Departing from the idea of phytoremediation as a process based in the use of plants to clean or restore polluted environments, it is set the objective of assessing the impact of the application of a phytoremediation system in the course of the stream. The study is planned in stages and in the first step is pretended to assess the impact of three native macrophytes in the physicochemical variables of Miguelete stream water in laboratory conditions to determine safely the species with the highest efficiency to use in situ. It is used *Eichornia crassipes*, *Pistia stratiotes* and *Typha angustifolia*, species recommended by the scientific advisors. The hypothesis is that *Eichornia crassipes* and *Typha angustifolia* are more efficient in the improvement of the physicochemical variables of the stream than *Pistia stratiotes*. The toxicity analysis, the BDO5, Nitrates and Phosphates measurements show that the three species of macrophytes have a positive impact on these physic-chemical variables, being the *Pistia stratiotes* the least efficient in this aspect, thereby checking the hypothesis established. It is planned to do a study in situ in the stream to evaluate the development of the plants in real environmental conditions since in the laboratory they present important physiological deterioration. In the same way, actions in the community are developed to form a collaborative work network with NGO's, private companies, social, educational, state and neighbor organizations, engaging them in the management of the project.

2014 - EV306

BIOREMEDIATION OF THE ENBRIDGE OIL SPILL THROUGH AUTOCHTHONOUS BIOSTIMULATION

Alexandra Marie Peirce, Katherine Wu

Kalamazoo Area Math and Science Center, Kalamazoo, MI, United States of America

Bioaugmentation is a developing method of remediating the disastrous effects of oil spills. If the existing species of hydrocarbonoclastic bacteria can be augmented through the addition of nutrients, the effects of an oil spill could be vastly reduced. In this experiment, soil samples from the Enbridge Oil Spill along the Kalamazoo River and control soil samples were augmented with various nutrients, and then levels of linear and branched alkanes were assessed after 0, 12 and 21 days using gas chromatography. This provided an indication of the degradation of hydrocarbons within the soil due to the augmented bacteria. In addition, the bacteria from the oil-affected soil and the unadulterated soil were augmented with LB and then serially diluted to assess and compare the quantities of bacteria existing in oil contaminated areas with non-contaminated areas. Quantification and identification of bacteria in contaminated areas allows for the assessment of whether hydrocarbonoclastic bacteria are likely to grow within these regions. Therefore, the possibility of successfully conducting autochthonous bioaugmentation in an oil-contaminated region, such as the Kalamazoo river, to degrade hydrocarbons can be evaluated.

Awards won at the 2014 ISEF

Fourth Award of \$500 - Environmental Sciences

2014 - EV307

SUPER SPIDER SIEVE

Ain Adibah binti Roslaile, Farah Mustapha

Kolej Tunku Kurshiah, Seremban, Negeri Sembilan, Malaysia

Inhaling carbon monoxide can be fatal. This gas is produced whenever fuel is burnt and the level of carbon monoxide exhaled can be life threatening without any visible warning signs. Therefore, The Super Spider Sieve is an invention of air filter that can be part of vehicles exhaust to absorb carbon monoxide from being emitted into the environment. The Super Spider Sieve can effectively absorb poisonous gases because the presence of *Chlorophytum Comosum* (spider plant) which has this natural capability to do so. Hence, this contribute to save the environment. *Chlorophytum Comosum* is grinded to form air filter. The rate of carbon monoxide absorbed by this filter is measured using carbon monoxide detector. From our study, it is identified that 15g of *Chlorophytum Comosum* can absorb 100% of carbon monoxide. As a conclusion, Super Spider Sieve air filter is not only able to reduce the level of carbon monoxide presence in the environment, but it is also an environmental friendly life-saving device. Keywords : *Chlorophytum Comosum*, carbon monoxide, air filter, life threatening, environmental friendly

2014 - EV308

RAINWATER HARVESTING

Karla Judith Estrada Hernandez, Margarita Rebollo Castaneda, Abigail Morales Guerrero

Escuela Preparatoria Oficial No.102, Tlalmanalco, Estado de Mexico, Mexico

One of the problems of the infrastructure of EPO 102, is the scarcity of water. This project will cover 100% of the demand for water in the rainy season and 48% annual, with a significant cost savings and a positive environmental impact. With more funding will have better hygiene in bathrooms and lower incidence of disease. Students could achieve more awareness on the rational use of water and to be able to organize thematic workshops.

2014 - EV309

EFFECTS OF SOLID WASTE ON THE COLONIZATION OF ORGANISMS ASSOCIATED TO COASTAL MANGROVE FORESTS

Jakeline Ku Cen, Javier Ku Cen

Colegio Parroquial San José de Almirante, Almirante, Bocas del Toro, Panama

Mangrove ecosystems play an important role in maintaining marine life, stabilizing coastal environments and sustaining human well-being. However, mangroves are constantly threatened by human activities such as logging, overfishing, and pollution. A less studied type of pollution is the accumulation of solid waste, in particular plastic, which could take hundred of years to decay. This type of waste could accumulate around mangrove roots, affecting the colonization of the species associated with this ecosystem. To test solid waste effects on mangroves, we studied how mangrove colonizing species respond to the accumulation of plastics waste in Almirante Bay, Bocas del Toro, Panama. Specifically, we compared the abundance and diversity of colonizing organisms by placing random quadrants on contaminated and uncontaminated sites. We found that the abundance and diversity of organisms (e.g., crustaceans and mollusks) is ~ 3.4 times higher at sites without plastics (77.5 %) than at sites with obvious accumulation of plastics (22.5 %). These results indicate that the diversity of organisms associated with mangrove ecosystem could be drastically altered by plastic waste pollution. Although more work is needed to better understand the implications of solid waste pollution at larger scales, or study reveal in simple way how human activities affect the function of mangrove ecosystems. These findings might have important implications for managing and conserving mangroves across the tropics.

2014 - EV310
IDENTIFICATION OF BIOINDICATOR ORGANISMS IN THE PARANA COAST THROUGH CORRELATION BETWEEN BIOTIC AND ABIOTIC FACTORS, YEAR III

Nayara Martins Orsi, Flavia Faggiao
Colegio Interativa de Londrina, Londrina, PR, Brazil

The coast of Paraná in Southern Brazil presents increasing pollution levels and incipient monitoring systems. To overcome this deficit, we sought to identify relationships between phytoplankton and abiotic factors, to verify the usefulness of these organisms as bioindicators. Our aim was to establish relationships between the faecal coliforms, inorganic nutrients and phytoplankton. Four collections were conducted at six points of the Paraná coast, one for each season. A planktonic 45cm diameter net with a 200µm mesh size was used. Two hauls of 2 minutes were employed and samples were fixed in 3% formal. Temperature, salinity and pH were also measured at the sampling points. Two 100ml water samples removed from the surface to be used for inorganic nutrients analysis, which was performed using colorimetric tests. Faecal coliform analysis which is conducted in the Univali laboratory by Coli-Count method. The qualification and quantification of the organisms found was using an optical microscope. Analysis of similarity between the sample points and Canonical Correspondence was applied. Similarity analysis showed high cohesion between sampling points and seasons. A correlation analysis between the diversity of microalgae and the physicochemical parameters obtained. Specific relationship between Acanthostomella, Leptocylindrus, Chaetoceros and Bacteriatrum algae with increasing temperature and salinity. Furthermore, a population explosion of dinoflagellates from the Ceratium genus seems to be correlated with the concentration of nitrate, an important factor because of the toxicity of these organisms. Was found a positive relationship between the levels of phosphate and Asterionella, Peridinium and Triceratium indicates that these organisms can be used as bathing indicators.

2014 - EV311
NEW DISCOVERY OF ECO PLYFIBRE VIA PINEAPPLE LEAF AND RECYCLABLE PLASTIC FOR FUTURE SUSTAINABILITY

Nurul Najihah Binti Mohd Roslan, Nur Hanis Suriani Mohd Zaini
Mara Junior Science College Terengganu, MALACCA, Malaysia

Fibre-reinforced polymeric composites have received widespread attention for the past decades because of their high specific strength and modulus. Pineapple leaf fibre is rich in cellulose, relatively inexpensive and abundantly available has the potential for polymer reinforcement. Pineapple leaf fibre at present are a waste product of pineapple cultivation. HDPE is the most recognized recyclable plastic and is used to make detergent bottles, shampoo and conditioner bottles, and many other non-food items. According to U.S. National Park Service; Mote Marine Lab, Sarasota, FL, these plastics take around 450 years to decompose in the environment which will contribute to the earth's waste disposal problem. The initial idea was to recycle waste materials into a green project which can increase the environmental friendliness. This project is designed as an alternative to replace the role of wood in industry. The process of designing this project began with detailed on related fields and a prototype was designed and later constructed. This project was started by extracting the pineapple leaves fibres and collecting the HDPE bottles from houseware waste. Internal mixer machine was used to mix the materials well at 180 °C for 10 minutes. The mixture was compressed in the hot and cooling compressor machine. Specimens with same sizes were produced and cut into specific measurement for tests. The result shows that it resist water, anti-termite, high flexibility, strong yet flawlessly shiny surface. Furthermore, with its simple design and durable structure which contribute to its cost effectiveness and environmental friendliness, it can be applied in other industries of wood-based manufactured, board production and furniture.

Awards won at the 2014 ISEF
Third Award of \$1,000 - Environmental Sciences
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2014 - EV312
WATER INTEGRATED DESALINATION SYSTEM USING GRAPHENE SHEETS AND SILVER NANO PARTICLES

Mayar Mossad Allam, Marwa Ibrahim, Demiana Abdelmalak
Maadi STEM School for Girls, Cairo, Egypt

Our country "Egypt" is susceptible to droughts and could possibly run out of water by 2025. Providing new source of pure water is challenging. The solution is inspired from our natural, God-given unconsumed seawater. Advanced research is made upon previous solutions in seawater desalination. Nano-Technology seems revolutionizing and effective. Efforts are exerted to make integrated system that produces pure water. It was found that the nano pores requires water without macro bacteria that clog the bores, so pretreatment stage is made. It is BSF (Bio-Sand Filter) that can reduce bacteria, protozoa, and viruses by the percentages of 81-100% 99.98-100% and 90% respectively. After desalination stage water will be more likely to distilled water without essential

minerals to human health, so post-treatment stage is made. It reinserts the minerals to maintain the TDS (total dissolved solids) around the fixed values 150-900 PPM (part per million), according to the standards of the (WHO) World Health Organization.

 The project in its present form produces high quality of potable water. The activated carbon in the BSF can remove odors, tastes, colors by 88.2%. The system desalinates water with 99% less energy due to hydrophilic edges of graphene sheets. Increasing the period of availability of the membrane is required, so anti-scaling stage is added to destroy the locked salt molecules.

 The factories that overuse and pollute fresh water can apply this integrated system. This system can be applied in the villages that suffer from water shortage or polluted water drinking to provide them healthy water.

2014 - EV313

USE OF LICHENS AS INDICATORS OF AIR QUALITY IN JEJU ISLAND, KOREA

Minseong Go, Hyeon Woo Song, Jeongin Kang

Namnyeong High School, Jeju-si, South Korea

Lichens have been used as biological indicators of environmental pollution. As lichens show high sensitivity to air quality, hundreds of studies have linked lichen communities to air quality. In the present study, attempts were made to correlate air quality and lichen diversity in Jeju island, one of the new seven wonders of nature, and to find out whether lichens can be used as a bio-indicator for air quality assessment.

The study was conducted on 3 broadleaf and 3 pine trees in each 17 survey places. On each trees, the transparency lichen grid was installed on the trunk of a tree to identify lichens and record areas on the grid. After, the data were analyzed by Shannon index values(SDI), Index of atmosphere purity(IAP) and compared sensitivity of the lichens to SO₂ according to Hawksworth&Roses scale.

In the results, both SDI and IAP values were higher in broadleaf trees than in pine trees. Since pine trees are disadvantageous for lichens to inhabit, broadleaf trees showed more accurate values. In most survey places, SDI and IAP values showed similar except for 2 pollutant emission areas. Mountain areas showed the highest IAP values and coastal&populated areas showed the smallest values. Also, the number of lichens classified sensitive to SO₂ pollution by Hawksworth&Roses scale coincided more with SDI values than IAP values. Compared to European criteria of IAP values, Jeju has a clean air quality in all areas, mostly over 40.

Conclusively, these results strongly suggest that lichen's diversity has direct connection with the clean atmospheric environment of Jeju. Thus, lichens can be used as a biological indicator for long term monitoring for air.

2014 - EV314

INVESTIGATING THE FERMENTATION AND DISTILLATION OF ETHANOL FROM AN INVASIVE SPECIES

Jasmin Corpuz Valera, Irene Kuikahi

Waipahu High School, Waipahu, HI, United States of America

The question addressed was, are we human beings contributing to future disasters of our environment, such as global warming, air pollution, climate change and even invasive species? If so, then can we still prevent it?" From our perspective overall, yes we do believe we humans contribute to the world-threatening effects of many environmental problems we face today. Since the main source of contribution comes from human activities such as introducing animal and plant species to areas outside of their natural range, there are ways to adapt to a new way of life. A solution that we found to be upmost adaptable was creating ethanol, a bio-fuel source from an invasive specie. To perform this experiment we had to schedule four days to ferment the leaves from our invasive specie source named the Molucanna Falcataria, and then distilling the leaves for approximately 30 minutes. We then compared the results we received from fermenting and distilling the cane sugar. Results did support our hypothesis from both perspectives as the Molucanna Falcataria being a possible bio-fuel crop and as a natural source that created more ethanol than the cane sugar. We then took a step further by exploring the effects of creating ethanol from other possible invasive plants we could use, if we were to ignore today's environmental problems.

2014 - EV315

DISPOSE WASTE LUBRICANT IN SOIL AND FRESH WATER BY STRAINS OF MICROORGANISMS ISOLATED IN NATURE

Uyen To Tran, Anh Nhu, Hong Minh Duong

Tran Dai Nghia High School for the Gifted, Ho Chi Minh, Viet Nam

Currently, the use of transportation is blooming in every nation, which leads to the rise of waste lubricant emission. Waste lubricant not only does harm to human's health but also causes environmental pollution. Simultaneously, many researches show that microorganisms are able to dispose mineral oil, solve oil spills on sea quite effectively. The purpose of this project is to use microorganisms in waste lubricant treatment.

After isolating, purifying and selecting the most effective strains of microorganisms from soil containing waste lubricant in Ho Chi Minh city, Viet Nam, a survey was taken to examine some conditions affecting the strains ability to dispose waste lubricant such as disposing time, waste lubricant concentration. The survey showed that the time of 48 to 96 hours and the waste lubricant from 3% to 5% were the best for the strains growth and their ability to dispose waste lubricant. According to the test reports, the chosen strains reduced waste lubricant and lead amount in contaminated soil and fresh water in a short time.

Plants grown on the soil and fresh water containing waste lubricant disposed by chosen strains were better than those on environment having waste lubricant without microorganisms.

With this project, the bacteria, yeasts and fungi from nature in Viet Nam can dispose waste lubricant in soil and fresh water in an economical, feasible and time-saving way.

2014 - EV316

GRAINS OF GOLD

Hayat Abdulredha Abu Alhassan, Shamma Al Bastaki

Al Ittihad Private School-Jumeira, Dubai, United Arab Emirates

Throughout our research project, we will be analyzing the properties of a relatively new yet potentially pivotal scientific breakthrough, which is Hydrophobic

Sand, occasionally recognized as “Magic Sand” or “Nano Sand”. We will be examining its effectiveness in battling certain global environmental issues threatening not just mankind, but also the entirety of life on Earth. The predicaments we will be focusing on include: Oil spills, water scarcity, ground-water contamination, soil aeration, flood and coastal protection, weak foundations due to high salinity, and digging objects stuck in frozen ground. We will be doing so by conducting controlled experiments based on our background research to test our hypotheses, recording our observations through informative graphic organizers, drawing conclusions, and determining whether our hypotheses were valid or false. All the while, The Scientific Method will be thoroughly implemented. The general aim of conducting this research is to give its readers a deeper insight into the valuable potential Hydrophobic Sand possesses and the ways it can be essentially beneficial in saving our planet as well as preserving precious resources

Awards won at the 2014 ISEF

Second Award of \$1,500 - Environmental Sciences

2014 - EV317

THE ESQUILMO WHEY OF NATURAL CHEESE AN ALTERNATIVE TO PREVENT FIRES AT HOME

Clara Gomez Quintana, Jesus Benitez Serrano

Colegio de Estudios Cientificos y tecnologicos del Estado de Mexico Plantel Aculco, Aculco, Estado de México, Mexico

is a cheese village; processing about 100,000 liters of milk daily, which obtains 10,000 kg of cheese and 85.000 liters of whey. The whey or cheese whey is the liquid that is separated from milk when it is coagulated to obtain the cheese. this is a very important problem in the regional dairy industry and it has a high ecological and economic impact. Ecological because when the whey is pulled down into the drainage, lactose is converted to lactic acid, acidified water causing a decrease in pH of the tributaries of the Cofradia's lake causing a serious damage in the aquatic wildlife due to an economic impact on agricultural production reducing the yield per hectare.

General Purpose: Experience and value the reaction of formaldehyde lacto whey and other chelating additives on the design and construction of thermal plates for electrical contacts, resistance to fracture, good condition, aesthetics to prevent the spread of fire, as an alternative to reduce the availability of whey on the ecological impact in Aculcote of Mexico. To sum up, Mixing whey with formalin and chelating substances react favorably producing a malleable slurry with high mechanical properties tolerant fracture, sharp blue flame resistant, withstands extreme temperatures moderately muffle, with good physical appearance and can be used for the electrical contacts manufacture at the level of avoiding electric shocks. Impact 1: The conversion of whey into whey paste allows BOD, COD, TSS of wastewater, due to the minor presence of solids amounts suspended and this makes a body of water increases the ability to support aquatic diversity. Impact 2: When the whey glycoproteins are retained in the lacto serumate, has a direct impact on the reduction of lactic acid formation

2014 - EV318

MENTH-RID-RAT

Imran Bin Miswan, Nur Arifah Mohamad Jamil

SMK Seri Kenangan, SEGAMAT, Malaysia

Recent study showed that peppermint oil is capable to repel rats. The main purpose is to reduce the spread of contagious disease caused by rats. It is eco-friendly because it was made from natural substances and less harmful chemical contain. Steam distillation method was used to obtain the peppermint essential oil and the peppermint extract. The analysed data of the Gas Chromatography Mass Spectrometry (GCMS) reveals that Mentha Piperita are mainly comprised of R-(-)-carvone. The experiment was done by using a three compartment experimental box, A,B and C. The average reading for 10 replicate was taken to get the data of repelling efficiency. The highest yield percentage between different portion of the plants product is the powder ,90%. The results in the 1st treatment shows that comparisons of effectiveness between the type of materials results in the highest percentage of repelling efficiency for the peppermint, 86%, Plus, the 2nd treatment for the different parts of the plant, established the highest percentage of repelling efficiency for the peppermint's essential oil by 86%.The result conducted in our 3rd treatment focused on the effectiveness of the oil dissolved in different volume of ethanol, shows the highest percentage on 60% of the volume of ethanol dissolved, which is 92%.Our 4th treatment shows that the neutral pH form of the oil is the most suitable to use. On our 5th treatment, the product was tested in a palm oil farm to test its effectiveness in a larger scale. It reveals that the estimated population size of the rats decrease.

2014 - EV319

PREVENTION OF ACID RAIN EFFECTS WITH SACRIFICIAL METALS AND DEVELOPMENT OF A DETECTION SYSTEM

Queila Bouza Peteiro, Jorge Cordero Bermudez,Miguel Gomez Cid

Aulas Tecnopole, Ourense, Spain

The effects of acid rain on plants and soil have been carefully studied. By using sacrificial metals, like magnesium, these negative effects of acid rain can be offset. Both mortality rate among vegetation and alterations in the physical and chemical characteristics of the soil have been reduced, which can affect its richness considerably. A system has been designed to enable the detection of acid rain since the very first moment. As a consequence of this, it would be possible to apply immediate and effective measures to stop its effects.

From this project, it can be concluded that, by applying powdered magnesium on plants, their death can be prevented when they are sprinkled with an acid dissolution. In the same way, soil acidification can be stopped by adding powdered magnesium and, as a result, the reduction of soil fertility is prevented when plants are exposed to acid rain.

Through conventional electronic devices such as LEGO MINDSTORMS EV3 and arduino, and their components, it is possible to detect acid rain very quickly and to be able to diminish its effects in an immediate way.

Keywords: acid rain, pH gauges, sacrificial metals, magnesium, acid.

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