2014 ABSTRACTS – PALOS VERDES PENINSULA USD SCIENCE & ENGINEERING FAIR – MARCH 2014

MISSING ABSTRACTS IN RED FONT – WILL BE ADDED AS RECEIVED

BEHAVIORAL & SOCIAL SCIENCES

1

EKANAYAKE, Ruwanthi
Behavioral and Social Sciences

EFFICACY OF PERCEPTUAL MODALITY TEST PREPARATION IN COMPARISON TO UNIVERSAL DESIGN FOR LEARNING

The purpose of the current study was to investigate the effectiveness of Perceptual-Modality based test preparation in comparison to that of the Universal Design for Learning (UDL) test preparation process. In addition, the study tested the accuracy of students when self-identifying perceptual modality.

Over 180 high school student subjects were given a test to determine their perceptual modality and then placed into one of four perceptual modality divisions: auditory, kinesthetic, print, or visual. Each division first received a basic history lesson and then prepared for an exam with strategies utilizing their own perceptual modality, and was tested on this information. Subsequently, each division received another basic history lesson and prepared with the UDL test preparation process, and was then tested on this knowledge. In addition, each subject was instructed to identify his or her own perceptual modality.

Over 87% of subjects tested displayed a clear sway towards the perceptual modality test preparation process of most effective. The high statistical significance of these results were confirmed by the t-test, with a two-tailed P value was less than 0.0001. In addition, over 56% of subjects correctly identified their own perceptual modality. This difference was not particularly statistically significant, with a two-tailed P value of 0.8159.

This study provides crucial information regarding effective test taking for students: if able to identify their perceptual modality, they can contour their study strategies to maximize their comprehension and test performance. These results can also be taken further, into the education system itself. The study supports the idea of learning styles; thus educators can use these results to better suit their teaching programs to benefit the greatest number of students. Furthermore, the study displayed the students themselves are not the best predictors of their own perceptual modality. Thus, the current study provides significant information to the field of cognitive science and learning, supporting the idea that perceptual modality plays a vital role in education and learning.

2

LEE, June
Behavior and Social Studies
2013/2014

THE EFFECT MENTAL PRACTICE HAS ON REACTION TIME

The objective of this project was to analyze how to improve reaction test in teenagers, both male and female. The main purpose of this experimentation was to discover the effect mental practice has on reaction time, a mental process that holds an effect on physical performance.

In order to test this, thirty teenagers from Palos Verdes Peninsula high were needed to volunteer as participants. The participants were given a reaction test to take. Then, they were given about three minutes to mentally practice taking the reaction test. After the three minutes were over, they took the reaction test again. The results were anonymous. After the experiment, the percentage of people who improved and the averages of both the first test and second test were found.

The data collected showed that 60% of the people who participated improved their reaction time by mentally practicing. Therefore, people are more likely to improve by mentally practicing than not improve.

The conclusion of this study is that mental practice more often benefits reaction time than not. The results of this study generally agrees with other studies done on the broad topic of mental practice, which tend to state that mental practice does positively affect activity performance.

3

OEHLER, Jacqueline
BEHAVIORAL AND SOCIAL SCIENCES
2013/2014

THE RESPONSES OF CATS TO VARIOUS SOUNDS

Cats have a knack for always hearing the smallest, most minute noises when someone or something is creeping up on them, so why do they outright ignore their owners when they call out their cats' names, because obviously the cats can hear them. The purpose of this experiment was to figure out which sounds cats are most likely to acknowledge.

Three cats were tested four times each. There were six different sounds played for each cat at a duration of 20 seconds. The sounds were from the following animals: a crow, a thrush, a pigeon, a cat, a seagull, and a squirrel. The time it took for the cat to respond to each of the noises was then recorded. The cats' reactions were then ranked on a scale of zero through ten (zero being the least) based on their interest displayed in each sound.

The results showed that on average, the cats were most responsive to the cat sound and least responsive to the squirrel sound. Also, it was discovered that the first time the recordings were played for the cats, they showed a significantly higher response than they did to the later three trials. This could be because they recognized the noises as fake after hearing them a second, third, and forth time.

This leads to the conclusion that cats are most likely to respond to sounds that are familiar, but only if they are hearing the particular version of the sound for the first time. This could be because to them it could be real food or a real threat since they know that an actual animal made that noise, but once it is repeated it becomes obvious to them that it is only a phony recording. Also, cats must have a decent memory to be able to recognize a sound they have already heard.

4

SHIM, Kaitlyn
BEHAVIORAL AND SOCIAL SCIENCES
2013/2014

CONFORMITY ON STUDENTS IN ACCELERATED AND REGULAR CLASSES

The objective of this experiment was to test and analyze the ability of fifteen to eighteen year old adolescents in accelerated level and regular level classes to resist conforming to their peers and the social norms. The purpose of testing in two different leveled high school classes was to dictate whether or not students in higher level classes would be able to conform less or more than those in lower leveled classes.

Students in both Regular and Advanced Placement Physics B were gathered as participants. They were given a simple five question perception test. After everybody had taken the test, they were allowed to discuss their answers with each other for one minute. The two-quarters of the participants, whose data would not be regarded were given specific instructions to choose the incorrect answers and asked to give their reasoning behind their choices while deliberating. Their responses were then individually stated one by one and recorded.

It was found that, collectively, the Physics B AP classes received 95% on the perception test and the regular Physics B classes received an 87%. Each individual score, from students in advanced or regular classes, was recorded and then added up. The higher score in the advanced placement class proved the hypothesis stated that the students in the regular course would have more incorrect answers than the students in the advanced placement course would, indicating that the former conforms more to the opinions of others.

The level of difficulty of the class seemed to correlate with the results. The resulting conclusion from this data is that students with a more advanced level of thinking in math and science may have a higher chance at resisting peer pressure and therefore show stronger individual thinking than those in regular courses. In addition, the procedural task of having the answers read aloud could have likely resulted in an increase in pressure among the participants.

BIOCHEMISTRY

5

DOKKO, Rachel
Biochemistry
2014

Expression and Identification of N-acetylglucosamine-6-sulfatase (GNS): A Potential ERT Drug for Sanfilippo Syndrome D – Year 2

Mucopolysaccharidosis IIID (MPS IIID), also known as Sanfilippo Syndrome D, is a genetic lysosomal storage disorder caused by an absent lysosomal enzyme, N-acetylglucosamine-6-sulfatase (GNS). GNS normally breaks down sugar chains called glycosaminoglycans (GAGs), which, when accumulated, cause symptoms such as cognitive impairment, skeletal deformities, and respiratory abnormalities. There is currently no cure or treatment for MPS IIID, but an enzyme replacement therapy (ERT) may be a way to attenuate symptoms for Sanfilippo patients.

The human *GNS* gene was transfected into a Chinese hamster ovary (CHO) cell line, and sulfatase and GNS activity assays were used to isolate the highest expressing clone, A-D3. The protein was then purified from the A-D3 medium through myc-affinity chromatography. Through immunoblotting, it was confirmed that the CHO cells were able to produce rhGNS (~94kDa) comparable to native GNS, which was confirmed through deglycosylation (~60kDa). MPS IIID fibroblasts were incubated with the rhGNS and tested for uptake. After incubation with the fibroblasts, rhGNS was detected through immunoblotting within the lysed cells.

Because it has been confirmed that a functioning GNS protein is being secreted by the CHO cells, we can now optimize enzyme stability, purification, and activity. The subsequent step in our research will be to incubate MPS IIID fibroblasts with the rhGNS and successfully detect cellular uptake through immunoblotting and confocal microscopy. Additionally, enzyme purification methods will be improved to increase rhGNS activity. Upon optimization, the rhGNS may be used in ERT to treat patients with Sanfilippo Syndrome D.

6

HUANG, Christina
BIOCHEMISTRY
2014

BIOLOGICAL PROPERTIES OF A NOVEL 3D SCAFFOLD FOR USE IN TRANSPLANTATION TO TREAT STROKE

New advances in stem cell therapies have promising implications for victims of many diseases, especially post stroke patients who suffer from physical, cognitive, and emotional impairments due to the death of brain cells during stroke. Transplanting neural stem cells into stroke infarct cavities to facilitate neurogenesis following injury may be achieved with the aid of 3D matrices that would help deliver necessary cells to the site of injury and protect them during the transplant. A novel combination hyaluronic acid and fibrin gel is proposed here as a 3D scaffold for use in transplantation therapies that would resist degradation *in vivo* while stimulating the proliferation and differentiation of neural stem cells.

The viability of cells was measured using a LIVE/DEAD Viability/Cytotoxicity Assay from Invitrogen, degradation was determined by measuring the presence of fibrinolytic factors with absorbance, and proliferation was observed using an EdU assay, and these values were contrasted with those of the commonly used fibrin gel.

The combination gels fared comparatively better in all of these tests. Neural stem cells cultured in these gels were shown to have higher levels of survival, and a 1.5 fold higher level of proliferation. The combination gels were especially resistant to degradation, lasting up to three times longer than the fibrin gels.

This result suggests that this novel gel would be beneficial to recover motor skills affected by neuronal loss during stroke in the future.

7

KEE, Dustin
BIOCHEMISTRY
2014

THE EFFECT OF NOTCH PATHWAY MODULATION ON HEMOGENIC ENDOTHELIUM

Hematopoietic stem cells are generated from a specialized subset of endothelial cells, hemogenic endothelium, which can differentiate into blood. What controls the commitment of hemogenic endothelium to blood is largely unexplored, but evidence for the roles of paracrine and juxtacrine signals in blood development (hematopoiesis) has been published. The Notch pathway is a cell-to-cell signaling pathway that has been shown to be important for blood development. However, how Notch pathway activation or inhibition impacts hematopoiesis is largely unknown and is the focus of this research.

To study the effect of the Notch pathway on blood development, embryonic stem (ES) cells were utilized as a general system to model hematopoiesis *in vitro*. These cells were differentiated into embryonic endothelial cells and the Notch pathway was activated or repressed.

Upon Notch pathway activation, a higher frequency of hematopoietic cells, lower percentage of endothelial cells, and greater number of blood progenitor colonies was measured. This suggests that Notch activation promotes endothelial cells differentiation into blood cells. On the contrary, when the Notch pathway was repressed by a chemical inhibitor (DAPT), a lower frequency of hematopoietic cells, higher percentage of endothelial cells and fewer number of blood progenitor colonies was observed.

Taken together, these results demonstrate that the Notch pathway is both sufficient and essential for blood development. These findings provide a new method to optimize blood formation from ES cells.

8

KIM, EMILY
BIOCHEMISTRY
2013/2014

GENE KNOCKDOWN IN *DROSOPHILA* MELANOGASTER TO STUDY THE EFFECTS OF GENES IN THE HEMATOPOIETIC SYSTEM

There are many genetic blood disorders such as acute myeloid leukemia which have very little information of the exact mutations of the genes of these disorders. Thus, in this experiment genes were studied by gene knockdown to see whether they have a role in the development of the hematopoietic system.

Various stocks were crossed against the main line, Hand Hemolectin Lineage Tracing (HHLT), which marked the dorsal vessel, lymph gland, and hemocytes of the hematopoietic system. The 3rd instar larvae from these crosses were then prepared to be photographed by placing them in a cold environment which prevented movement. Then by using a fluorescent microscope, three pictures of each larva were taken. In addition to doing the actual experiment, research online was utilized to hypothesis the function of the targeted gene.

After experimentation was completed, results showed that three of the HHLTxRNA interference lines (102871-KK, 100058-KK, and 101369-KK) had phenotypes which altered the hematopoietic system once compared against the HHLTx5905, the control. In the HHLTx102871-KK cross, certain larvae did not develop any blood phenotype while in the HHLTx100588-KK and HHLTx101369-KK crosses, there was very little dorsal vessel development.

Thus this experiment supported my hypothesis that genes involved in the hematopoietic system would have a different phenotype than that of the control. Additionally, a future potential experiment could be overexpressing the genes and then observing the effects on the blood system as well as directly observing the effects of knockdown in a dissected lymph gland and/or dorsal vessel.

9

MCCLOUD, Amaya
BIOCHEMISTRY
2014

BIOINFORMATICS: THE HUMAN GENOME OF 5-HYDROXYTRYPTAMINE RECEPTOR 2A; HTR2A

The purpose of this project is to find out why a persons DNA blueprint is very important to health and disease. This project enables a person to use methods that bioinformatics and biotech scientists perform on a daily basis to decipher the human genome in their efforts to diagnose and treat genetic diseases. The idea of this project was see what effect does the single-nucleotide polymorphism have on serotonin 5-HT-2A receptor in epilepsy.

From the OMIM website, the gene HTR2A, was chosen. Next, a missense SNP, rs6304, was chosen from the exon, which results from a change in an amino acid, was then chosen. Once picked, it was studied to see if that SNP had any impact on the protein structure or function. If the SNP was red in the model that SNP was predicted to have a damaging effect on the protein. If SNP was yellow it was not predicted to be damaging, the SNP would be harmless. Then a sequence-structure-function relationship for the SNP was established. Next the P link (Protein) was followed and a copy of the protein sequence was made. Finally the domain was found where the mutation was located; in this case, it was the first AAA domain.

It was found that the effect of the single-nucleotide polymorphisms on Serotonin 5-HT-2A Receptor causes damage to the myelin in the brain. The SNP causes the myelin in the brain to deteriorate which is one of the factors in epilepsy. The SNP, over time, causes destruction to 50% of the myelin in the brain; this could be one of the reasons for epilepsy.

After a month and a half of research, it was determined that the hypothesis that was predicted was correctklfg2]\sw. The myelin in the brain is affected in a harmful way by the SNPs. Because of this research, a person can now better understand the process of the human genome in their efforts to understanding, diagnosing, and treating genetic diseases.

10

REN, Emily
BIOCHEMISTRY
2014

The Effect of Humanin on B16 Mouse Melanoma Proliferation and Apoptosis

This project is in its present form a study on how the cytoprotective protein humanin affects B16 mouse melanoma cells, in vitro, because humanin has been proven to protect normal body cells from the harmful effects of chemotherapy drugs; however, humanin must not have a significant effect on the proliferation or apoptosis of cancer cells treated with the chemotherapy drug Doxorubicin.

The mouse melanoma cells were revived from a frozen state and cultured using standard cell culture procedures. They were lifted and allocated to six-well plates, 50 000 cells per well for the proliferation procedure and 500 000 cells per well for apoptosis. Both proliferation and apoptosis received treatments of 10 µg/mL humanin, 10 µM Doxorubicin, and a combination of the humanin and Doxorubicin. The proliferation plates were incubated for periods of 48, 72, and 96 hours after treatment. The proliferation cells were lifted and counted manually using a hemocytometer. The apoptosis cells were stained with fluorescent markers for flow cytometry to measure the amount of apoptotic cells.

Upon running data collected from the proliferation procedure in a one way UNOVA test, all three incubation treatment periods failed to pass either the Normality or Equal Variance Test ($p < 0.05$); however, the standard deviation for the three did not deviate far beyond the mean. In the end, humanin did not have a significant effect on the proliferation of cancer cells when used with Doxorubicin. Under the apoptosis procedure, humanin also did not show a significant effect on cancer cell apoptosis when used with Doxorubicin.

Humanin did not have a significant effect on either proliferation or apoptosis of mouse melanoma cells. If in vivo studies on live mice demonstrate the same results, it could be considered for development into a viable treatment for patients undergoing chemotherapy.

11

SMITH, Caleb
BIOCHEMISTRY
2014

BOTANY

12

ANAND, Sahill
BOTANY
2014

13

EL-MAGHARBEL, Yousef
BOTANY
2014

THE EFFECT OF ULTRASONIC RADIATION ON THE *MYRIOPHYLLUM SPICATUM*

There is has always been the question; how can things grow faster. The purpose of this experiment is to see if ultrasound can make the Myriophyllum Spicatum grow faster. The hypothesis is that the plant receiving the ultrasonic frequency of 12 megahertz will grow the fastest because it will be stimulated more by the faster frequencies.

Four containers were filled half way with water, and three Myriophyllum Spicatum stems were placed in each container. After placing each container of plants under its assigned ultrasonic frequency every night for a week, the results showed that the container that received no radiation had the highest growing plants with an averaged measurement of 6.5 cm. The highest growing plan that was put under the ultrasound was the container receiving 8 megahertz, and its measurements averaged 6.26 cm. The container receiving 5 megahertz, which was the lowest frequency being tested, grew the slowest with an averaged measurement of 6.13 cm, which was expected. The results did not exactly support the idea that the highest frequency tested would make the plants grow the fastest, because the container receiving 12 megahertz had an averaged measurement of 6.23 cm.

Although the data obtained by this experiment does not have a significant difference in its measurements, it still shows that the ultrasonic frequencies might have stunted the growth of the plants. In the future, to find out if freshwater is a worse conductor of ultrasound than salt-water; the same procedure will be tested with salt-water plants and salt-water.

14

LEE, Hangil Paul
BOTANY
2014

HUMAN URINE FERTILIZER

Many third world countries are in dire need of nutritious soil but cannot afford the typical fertilizer; therefore, human urine can be used as an inexpensive, abundant substitute. The purpose of this research is testing the effects of urine as a fertilizer in order to substitute the traditional, manure or chemical form of fertilizer.

The level of growth was determined by the height of the stem itself. *Solanum lycopersicum* was used as the test subjects. A control group of no fertilizer and an experimental group with human urine distributed in the soil were used with a sample size of n=3. After three weeks of growth, measurements of the stems to the apex are made. Measurements are recorded daily for two weeks.

The principal findings from the data are that the experimental group of size n = 3 had a slight increase in growth compared to the control group of size n = 3. These results, however, were hindered due to the minimal amount of control in the experiment. There were also many factors that could have altered the data given. Some examples include weather, temperature, and insufficient sunlight.

The contributions of this project are minimal. Although the results show that human urine used as a fertilizer has indeed some effects in aiding plant's growth, many factors has hindered these results and rendered the research as inconclusive. Another experiment and collection of data must take place in order to confirm the results.

15

GAO, Jenny
BOTANY
2014

16

MCCLOUD. Kaelyn
BOTANY
2013- 2014

THE EFFECTS OF ZAE MAYS IN A HYDROPONIC VERSUS FERTILIZER ENVIRONMENT

Can a plant be grown in water? The answer is yes. In the process called hydroponics, plants are grown in systems that have nutrient rich water. These nutrients provided in the water are the same that would be in a soil setting. So what is the purpose to planting plants in nutrient rich water? By using hydroponics, less water is used and it is easier for plants to get the required nutrients. It may seem that hydroponics requires a lot of water, but really it doesn't because of the reuse of nutrient waters. This type of growth setting is easier on plants because the plant can exert less energy. While in soil settings the plant has to stretch its roots to the nutrients or water, in hydroponics the roots of the plant float in the water, allowing the roots to easily obtain the required nutrients. This project tested the growth of Zae Mays in two different environments.

Two experiments were set up, one in a iron deficient hydroponic chamber, containing Ca (No) 3, KNO3, MgSO4 & KH2PO4, and one in a fertilizer environment. Six Zae Mays seeds were placed in germinating plugs that were inserted a germinating float then placed in the chamber, while ten fertilizer pots were made. For seven weeks the fertilizer plants were watered, the hydroponic chamber was pumped twice a day, both experiments were placed outside in the sun, and the growth of the Zae Mays was collected.

The Zae Mays had a different effect in each system of growing. In the hydroponic system the roots grew two weeks into the experiment, and in the fertilizer setting there was a plant four weeks into the experiment.

The hydroponic system was more efficient in growing the Zae Mays because the roots grew faster than the fertilizer system. Hydroponic planting can be used to preserve water and to preserve plants energy. Growing Zae Mays in a hydroponic setting is a sufficient and is better for the plant.

17

SATO, Kevin
BOTANY,
2013/2014

STOMATAL RESPONSES TO CONTROLLED ENVIRONMENTAL CONDITIONS

Stomata, the small pores on the surfaces of leaves and stalks, are the major pathway for the movement of CO_2 from the atmosphere into the mesophyll of leaves and water loss from the hydrated surfaces within leaves to the atmosphere. It is commonly assumed that they therefore provide the main short-term control of both photosynthesis and transpiration. Given the knowledge of the tradeoffs plant leaves face between CO_2 uptake and evaporative water loss, it was my target in this experiment to speculate upon stomatal features which can be expected to evolve in plants adapted to dry environments with variable and unpredictable heat stress.

This paper first explains the main method available for quantifying the control exerted by stomata over transpiration. The discussion is then extended by analysis of data obtained in this experiment to investigate the role and function of stomata in the control of heat stress.

Major conclusions include that an early response to heat stress was a reduction of transpiration to increase water use efficiencies, the number of stomata on the bottom of a leaf was higher than on the top, and there was a correlation between leaf surface transpiration rate and the number/density of stomata but the response was characteristic of a parabola rather than a linear relationship.

18

YAMAUCHI, Mia
BOTANY
2014

CHEMISTRY

19

Chang, Julia
CHEMISTRY
2014

EFFECTS OF CARBON DIOXIDE LEVELS DURING FERMENTATION IN VARYING ENVIRONMENTS

Fermentation is an essential chemical process that aids in alcohol production, preservation of food, and enrichment of diet. The objective of this project was to determine which temperature condition will increase the rate of fermentation to the greatest degree. Three different food samples were tested under varying temperature conditions to ferment and measure the level of Carbon Dioxide.

The ingredients to make Kimchi, Rice Wine Makgeoli, and Dwaenjang Soybean Paste were gathered and made. An important ingredient that was essential to the production of Rice Wine Makgeoli was *nuruk*, an enzymatic microbiological culture. Each of the three samples were placed in a room temperature of 20.5C, hot temperature of 43.3C, and cold temperature environment of 1.2C with the help of an electronic heater, an enclosed room, and a refrigerator respectively. This set a total of nine samples, three in each environment. The samples were left to ferment for 1-2 months. The level of Carbon Dioxide and temperature were measured with a CO2 meter before and after the experiment.

The levels of Carbon Dioxide produced varied significantly among the tested results. In average, the hot temperature samples produced the highest average amount of Carbon Dioxide of 5310.66ppm. The room temperature samples had an average of 1846.33ppm, and the cold temperature samples produced the least average amount of Carbon Dioxide of 946.00ppm. Rice Wine Makgeoli proved to have the fastest rate of fermentation in the hot temperature environments compared to the other samples.

Unfortunately, my hypothesis that the rate of fermentation will be fastest in cooler temperatures was not supported. Thus, it can also be concluded that the lactic acid bacteria in fermentation thrives best in hot temperatures. Measuring the amount of carbon dioxide produced by each of the three food products under varying temperature conditions will produce useful information to find the best possible route to a successful fermentation.

20

HU, Celeen
CHEMISTRY
2013/2014

THE EFFECT OF DIFFERENT PH ON SUGAR CONVERSION RATE

This project concerns the conversion of sugar in acidic conditions. Sucrose, or table sugar, is converted to glucose and fructose by an enzyme in the human body. This enzyme is called sucrase, and is an essential part of digestion and metabolism. For the purposes of this experiment, invertase was used instead of sucrase. However, both behave the same way. Sugar must first go through the stomach before reaching the small intestine to be digested. As such, the pH of the sugar will change drastically. The purpose of this experiment was to determine the changes in sugar conversion rate when the pH level has changed.

As mentioned before, this experiment uses the enzyme invertase to convert sucrose to glucose and fructose. Glucose test strips were used to determine the rate at which the sugar was converted. Citric acid was used in various quantities to change the pH of the sugar solution. Invertase was added to solutions of different pH. The percentage of glucose in the solution was measured with the glucose strips over a period of time.

The results indicated that the hypothesis was not completely correct. Although the lowering of the acidity did increase the rate of sugar conversion, notably at a pH of 5, not all of the solutions quickened the rate of sugar conversion (normally at pH of 7). Some of the solutions showed no change in glucose levels at all, while others showed a lower rate of reaction than normal.

In conclusion, the hypothesis was not fully supported by the experiment. This may have occurred because enzymes can denature at a very low pH and thus do not work.

21

KAHSAI, Yasmine
CHEMISTRY
2014

CALCIUM CARBONATE DISSOLUTION IN OCEAN WATER DEPENDENT ON PH, CARBON DIOXIDE, AND TEMPERATURE

This experiment is a product of ocean acidification's affect on marine life. It compares the value of temperature in addition to carbon dioxide's effect on seashell masses. The rate in which the shells change mass will be examined and compared to specific water conditions.

Four shells of roughly similar size, after being massed initially, were each placed in a separate 2L clear plastic container full of seawater. One container had a standard aquarium heater in the water to maintain 25.6℃ and a carbon dioxide diffuser for a steady supply to dissolve. Two other containers had either piece of equipment, but neither contained both. The last container, the control, contained only seawater. These were measured foe pH, temperature, and dry masses of shells once a week for 5 weeks. A pH meter, aquarium thermometer, and electronic scale were used to achieve this.

In comparison to the rate of shell dissolution in the double variable sample at 0.12 grams/day, the carbon dioxide sample shell dissolved at 0.17 grams/day and the heated sample increased at 2.57 $x10^{-3}$ grams/day. Thus the heat reversed the trend of dissolution rather than supported it. The pH displayed similar differences between the gas concentrated seawater and the water without carbon dioxide. Basicity of the control and heated water gradually increased, while the carbon dioxide concentrated and dual variable water had a relatively steady pH. Initial pH of the seawater was 7.74; the control reached a final of 8.36 and the heated water 8.51, in comparison to 6.98 for the carbon dioxide water and 7.27 for the water with both variables.

The results from the data indicate that carbon dioxide concentrations in the seawater had the greatest effect on the rate of shell dissolution. Temperature had the opposite result, as it demonstrated a rate of appearance and resulted in a slower rate in the double variable sample than the sample with gas alone. In terms of pH, the data displays that the carbon dioxide concentration in water directly correlates to a lower pH.

22

LEE, Anissa
CHEMISTRY

The Efficacy of Fire Retardants on Pine Wood Framing,

Builders and constructions workers use different fire retardants on wood framing when building houses and buildings. Fire retardants are a major form of protection against fires. Therefore, this research could provide information on which fire retardant is the most effective out of others.

To start off with, eco friendly fire retardants (Flamex, Fire'z Off, Master Flame), non-eco-friendly (No Burn and Fire Block) fire retardants and a homemade fire retardant (Borax) were gathered. Then each fire retardant was sprayed on the pine wood (except the control). Next, under the fume hood, a Bunsen burner was lit and a jack held up each piece of wood over the flame for 2 minutes, and then a transparency was done to calculate the burnt area.

No Burn fire retardant was the most effective with a burnt area of 88 cm. The second best fire retardant was Master Flame with an area of 89 cm, and the third best was Borax with an area of 90 cm. Fire'z Off came in fourth place having an area of 94 cm, and in fifth place was Flamex with a burnt area of 98 cm. In last place was Fire Block with a burnt area of 108 cm. All the fire retardants were more effective than the control, which had a burnt area of 121 cm.

All the fire retardants had similar burnt areas. Between the most effective fire retardant, No Burn, and the second best, Master Flame, there was a one cm square difference. However, they are both effective compared to the control. Master Flame is eco friendly and No Burn is not, so this can have an influence on people choosing which one to use if they care for the environment.

23

Lee, Christopher
CHEMISTRY
2014

PHYTOREMEDIATION RATES OF BRASSICA JUNCEA IN THE PRESENCE OF FOREIGN IONS

Phytoremediation has been the subject of much recent scientific speculation. There is much ongoing research to test the ability of certain plants, such as Brassica juncea, to remove deleterious ions from soil and water sources to secure a cheap, efficient way of maintaining public health. To test the real-life applicability and efficiency of these phytoremediators, it is important to know how the presence of many ions/heavy metals, rather than the effect on the phytoremediative rate of only one, effects the rate at which certain ions can be translocated.

In several aquariums were placed carefully calculated amounts of copper sulfate and zinc sulfate. Water, and equal amounts of copper sulfate but differing amounts of zinc sulfate were placed in each tank. The rate of copper intake of equal numbers of Brassica juncea plants was measured daily for 4 days.

The differing concentrations of zinc sulfate in each phytoremediative sample initially had no significant effect on the rate of copper uptake by the Brassica juncea plants. However, it was found that in high concentrations of zinc sulfate, the Brassica juncea plants perished more quickly, and thus phytoremediative rates slowed down.

While phytoremediation does hold promise for future application, it is important to note that plants are limited by how much poison they can reasonably sustain. Beyond this threshold they will lose their initial efficiency.

24

NASRALLAH, Leane
CHEMISTRY
2014

25

RAMAYYA, Shreya
CHEMISTRY
2014

BUILDING A LIBRARY OF DIFLUORO- AND TRIFLUORO- ARTEMISININS: YEAR TWO

In recent years fluorine has become increasingly important to the pharmaceutical industry. Coupled with already-potent drugs, fluorine has allowed common therapies to become even more effective in treating many diseases. One disease that could particularly benefit from the development of a more effective treatment method is malaria. For centuries malaria has been treated with artemisinin, but drug resistance has drastically reduced the effectiveness of artemisinin combination therapies, preventing successful treatment of patients in many cases. For this reason, this study was begun to develop new approaches to solve the malaria question in a novel way.

Recognizing the benefits of adding fluorine to pharmaceuticals, this study focused on developing the methodology required to successfully incorporate fluorine into molecules of biological importance. Initial success with trifluoromethylation of artemisinin paved the way for experimentation with difluoromethylation, a process that has not been studied in great detail before. The primary goal of this study was to utilize both nucleophillic and electrophilic fluorination methods to develop compounds of potential biological value.

The first step in the study involved nucleophilic trifluoromethylation of artemisinin using the Ruppert-Prakash (TMS-CF_3) reagent. This process was successful, and high yields were achieved in the process. Difluoromethylation was the logical next step to this study. Given the unique and delicate structure of artemisinin, initial difluoromethylation is underway on simple molecules to assist in the development of a procedure that could work for artemisinin. NMR analysis revealed that although the reaction may have worked successfully, side products were formed in the process, indicating that further optimization and purification is necessary.

In conclusion, while we have deduced that the addition of fluorine to various compounds is beneficial and possible, the procedures involved in adding fluorine to biologically active molecules must be refined and perfected. NMR Spectra will confirm the purity of the desired product at which point biological testing can be performed to test the potency of the newly synthesized library of compounds to treat malaria.

COMPUTER SCIENCE

26

HA, Chang Hun
COMPUTER SCIENCE
2014

ENHANCEMENT OF THE EXECUTION OF JAVA CODES

The project was initiated in order to assist the non-programmers to understand the basics of Java-based programs' execution process and to illustrate the function of individual lines within the source code. The program would create an analyzer, which would produce a copy of the programming source code in comprehendible English to assist the novice programmers in understanding the process of execution of the java programming language.

The project was constructed with a Java program compiler with several sample programs, each with different commonly used methods such as loops, conditional statements, and simple variable assignments along with the possible mathematical calculations. The program analyzer would interpret the program, execute the process, and produce an output which would display its overall running process.

The analyzer allowed a third-person viewer to learn the execution of the sample programming code, allowing that individual to understand the basic syntactical rules along with the grammar and structure of the Java codes. As a result, the program analyzer would further allow the programmers to utilize the program as a debugging tool while compiling their own codes for individual purposes.

27

HU, Richard
COMPUTER SCIENCE
2014

COMBINATIONLIST: A HYBRID OF ARRAYLIST AND LINKEDLIST TO MAXIMIZE EFFICIENCY

Modern day life has become increasingly digitized, and as a result, the mass storage and retrieval of data has become an essential technique to survival. The efficiency of such a process is a key issue that throttles the progress of technological development. ComboList was created with the intent to create a method of data storage and retrieval that would accelerate the data storage process. Incorporating a combination of techniques from the two classes currently in use in the Java library, ArrayList and LinkedList, ComboList is a class that performs a similar function but achieves better results.

Data was collected by comparing ComboList with the two similar existing structures, ArrayList and LinkedList. Each class was instantiated with a sample of random integers from 1 to 100 of varying sizes. Then, each class added or retrieved data from initial, final, and random indexes for a number of trials. The times were totalled and compared for each function.

ComboList achieved results much more quickly than its counterparts for most functions. ComboList excelled especially in retrieval of data, proving itself up to hundreds of times faster than the next best alternative in data retrieval while sacrificing little to no speed in storage.

ComboList is a successful data structure, serving most of the functions of ArrayList and LinkedList at a higher efficiency, and thus is a suitable replacement and considerable upgrade from existing methods.

28

IM, Cheolmin
COMPUTER SCIENCE
2013-2014

BEZIER CURVE BASED AIRFOIL SHAPE DESIGN PROGRAM DEVELOPMENT USING JAVA

The main objective of this project is to create an Airfoil Shape Design Program using algorithmic approaches with implementation of Graphical-User-Interface components that allow for the development of a visual applet with use of JAVA Language. The parameters necessary for thorough design of an airfoil profile shape using Bézier Curves will also be coded through functions in trying to design airfoil shapes.

The GUI components and the rudimentary program coding for Bézier Curve values along “sections” of the surfaces were incorporated together to show the airfoil shape in a defined boundary of the tool. Parameters applied within the program are connected to corresponding buttons shown in the tool to be expressed when needed.

The upper and lower surfaces of the airfoils are successfully generated on the tool, and free surface manipulation is also achieved. The parameters are also effectively expressed when called for, and in turn, allowed a smooth interaction between the user and airfoils in designing an airfoil shape. An unexpected goal achieved is the use of Bézier Curves themselves in creating a continuous leading edge instead of implementing quadratic functions or equation of ellipses.

The trials of the program show the ability to design a highly aerodynamic shape of airfoil with shock free, high lift, and low drag. The present work is regarded as a move towards a construction of an overarching program that allows for design, analysis, and optimization of airfoils.

29

JIANG, Zirui
Computer Science
2013/2014

THE PROOF OF PAPPUS CHAIN THEOREM THROUGH CIRCLE INVERSION

This project in its present form is the result of the proof of Pappus Cain Theorem, which states that the height of nth inscribed circle is 2n times the radius of that circle, under the help of circle inversion. The initial ides was to determine the validity of the theorem and explore its derivations. The project will help developing the theorem by deriving the new equations from the theorem.

The Pappus Chain was constructed by using computer software GeoGebra. After the construction of the chain, the properties of circle inversion were applied to the graph. The relationship between line segments were determined and were used to proof the theorem. The derivations — the radius of nth inscribed circle and the coordinate of the center of nth inscribed circle — were found under the help of theorem.

The theorem was proved and the equation for the nth inscribed circle's radius was found. The expression for the coordinate of nth inscribed circle was also found.

The result of this project contributes to the development of the theorem.The theorem has been proved to be valid: h (n) = 2n * r(n). The equation for r (n) is r (n) = $\frac{R(1-r)r}{2n^2(2n-r^2)}$ (r =$\frac{AC}{AB}$, R= AB, r (n) is the radius of nth inscribed circle). The coordinate of the center of nth inscribed circle is ($\frac{R(r^2+r)}{2n^2(2n-r^2)}$, $\frac{R(1-r)r}{n^2(2n-r^2)}$).

30

Kim, Kijung
Computer Science
2014

DEVELOPING A JAVA CLASS AUTOMATER THAT CAN BE DERIVED FROM OTHER CLASSES

The project was designed to develop a Java program that can automate class definitions for created classes that can be derived from existing classes.

Ten samples were made using different targeted classes to be created by the parent classes. Then, the two other pivotal programs were made: the correcter, which will go back to the sample and edit the unchanged classes names, and the creator, which will create the class definitions for the targeted classes. Their different runtimes were also measured to see if this program will be detrimental to the total runtime.

Out of all the samples that were processed, all of them compiled through the Java SE 7 without a problem. It was found, on average, that the program affects the runtime by adding around 1.73 seconds to the total runtime. It was also found that there was no need to edit the compiler itself; the program can do everything without further edits.

After reviewing the results, it was found that this has supported my hypothesis greatly, as my hypothesis was that by creating only three main classes (the sample class, the corrector class, and the creator class), this program will be able to execute perfectly. For further research, it would have been interesting if it was possible to compare runtimes of these samples with a compiler-based project that was made with this purpose in mind.

31

KIM, Taehyun
COMPUTER SCIENCE
2013-2014

JavaScript program to check Sudoku solution and verify that it is correct

Sudoku comes from Japan and consists of Japanese characters which mean Number Place. The number of classic 9×9 Sudoku solution grids is 6,670,903,752,021,072,936,960 or approximately 6.67×1021. This is roughly 1.2×10−6 times the number of 9×9 Latin squares. This project's main purpose was to create a JavaScript program to check a Sudoku puzzle's answer by manipulating several fundamental java statements.

However, algorithm to solve this puzzle is rather simple. First, the number can appear only once on each row. Second, number can appear only once on each column. Third, number can appear only once on each 3×3 sub-grid. This java program was programmed on the BlueJ, a free java development environment. This Sudoku program adequately used nested for loop, which means a for loop within a for loop, one dimensional array, two dimensional array, and if else statement to verify the solution of the Sudoku puzzle.

This project used the nested for loop, a for loop within a for loop, not only to read rows and columns but also to check specific area like sub-grid out of the whole grid by modifying the limits of for loops. It also used one dimensional array to store the data instead of going through each rows and columns nine times to check duplicate number. Lastly if else statement was properly used to verify if the input that program received is correct answer. This java program shows that the program can become more powerful and fast by using several fundamental java statements within logic.

32

MARMARELIS, Myrl
Computer Science
2014

A Novel Approach to Time Series Forecasting with Artificial Neural Networks

Predictive modeling techniques are immensely valuable throughout science. Artificial neural networks have been shown to have great potential in time series forecasting, with traditional networks consisting of a single type of neuron and being typically trained individually or in small numbers. This project introduced three new varieties of artificial neural networks, each of which is composed of a different combination of multiple types of neurons. The four types of networks (the three new and one "traditional") were all trained using a new evolutionary algorithm that utilizes simulated annealing, which starts with a very large number of networks that gradually decreases. The hypothesis was that the new types of neurons would improve the accuracy of a network.

The four types of networks were all trained to forecast a yearly global temperature time series. Different configurations of the networks (varying number of neurons, connections, etc.) were also tested. In the training procedure of a single network, a very large population of candidates were randomly generated at first. The candidates repeatedly reproduced, mutated, and were selected based on their overall predictive accuracy. The number of networks and the mutation size were gradually reduced until only one fine-tuned network remained.

In the end, the new types of networks did show an improvement in their prediction accuracies when compared to the traditional networks. All the networks also performed over five times better than the control network.

This experiment demonstrated that this new predictive model could be viable for real-world usage.

33

MARMARELIS, Zissis
COMPUTER SCIENCE
2014

DYNAMIC MODELING IN OPERATIONS RESEARCH WITH APPLICATION TO FERRY SCHEDULING

Tourism is one of the most important industries in many countries around the world, which relies heavily on effective transportation and management of tourists and goods. In Greece, traveling with a ferryboat is one the most common means of transportation due to its numerous popular islands among tourists, and the optimization of ferryboat scheduling and routing is crucial for its economy. Greece, like many other countries, depends on tourism as its main source of income. This study aims to seek an efficient method of determining ferryboat schedules through the comparison of two different algorithms (dynamic and fixed) based on different criteria.

The experiment was virtually conducted by creating and implementing two different computer algorithms (a dynamic-schedule algorithm and a fixed-schedule algorithm) for the determination of the ferryboat route. Five major islands in the Aegean Sea situated with different distances from the main port of Athens were considered, though both algorithms are adaptable to the consideration of different island locations. The expenses and attributes of a realistic ferryboat were employed in the algorithms. Passenger lists were created with the use of a random number generator, which determined where each passenger wanted to go. The main criterion on the dynamic-schedule algorithm required that the ferryboat traveled to the island that the majority of passengers from the starting island wanted to go to, and then continued the same process from the subsequent island and so on. The fixed-schedule algorithm took the same parameters into account as the dynamic algorithm but its difference lay in the determination of the next island. The fixed-schedule algorithm determined each subsequent island based on the minimum distance the ferryboat could travel, without repeating any islands. Ergo, this algorithm was fixed because the distances do not change, but the passenger lists did, which is why there is different data for each trial. The amount of passengers traveled and the profit earned for each algorithm were recorded after 100 trials, with the goal to maximize those numbers.

It was found that the fixed-schedule algorithm was more efficient than the dynamic-schedule algorithm in that it served more passengers, and thus also generated more profit. The primary reason that it served more passengers was that it always traveled to the nearest island, exchanging passengers who desired to depart with those who wished to board, while the dynamic-scheduled algorithm often traveled to farther islands with the same passengers as determined by the algorithm's criterion which was to satisfy the majority of the passengers. Hence, while the fixed-scheduled algorithm may have served more passengers, the dynamic-schedule catered to the desired of the majority of the passengers, likely leading to greater passenger satisfaction.

The fixed route, which is primarily used today, was proven to be more efficient than the dynamic route in both passenger servicing and in terms of profit. However, in an effort to boost tourism and thus the country's economy, it may be beneficial during certain times (i.e., tourist season) to have a dynamic route as a supplement to the fixed route.

34

STEINBERG, David
COMPUTER SCIENCE
2014

EXAMINING THE ROLE OF GENDER IN AUTHORSHIP OF *NEW YORK TIMES* CROSSWORD PUZZLES

Computer science is a field in which women are noticeably underrepresented. Crossword puzzle construction, which now heavily involves computer software, is an area in which gender differences have not previously been investigated.

This study used the Pre-Shortzian Puzzle Project and XWord Info databases of *New York Times* crossword puzzles and authors to test whether there was a significant difference in the proportions of puzzles published by male and female constructors.

Principal findings were that more puzzles were published by men than women from 1942 to 2013, the proportion of puzzles published by women was greater in the pre-Shortz than Shortz era, editor gender did not affect this pattern, and the proportion of puzzles constructed by women from 1942 through 1999 was greater than from 2000 through 2013. In the Shortz era, the proportion of puzzles constructed by women from 1993 through 1999 was not greater than from 2000 through 2013 using a complete data set but was greater using a Sunday puzzle data set. A Shortz-era test using a different time period—1993–2003 vs. 2003–2013)—revealed that the proportion of puzzles constructed by women was less in the later time period.

The results suggest that the advent of computer software may have contributed to the decline in the proportion of crosswords published by women in *The New York Times*, analogous to women's underrepresentation in computer science. They further suggest that more efforts should be made to incorporate women into technological fields, including nontraditional ones such as crossword construction.

35

TAMBE, Arjun
COMPUTER SCIENCE
2014

36

TAMBE, Raam
COMPUTER SCIENCE
2014

COMPARING COMPUTER BASED METHODS TO PREDICT HUMAN BEHAVIOR

The purpose of this experiment is to determine which method of predicting human behavior is more accurate, between a logit model, a logit model with added frequency and a subjective utility quantal response model (SUQR).

The SUQR model uses attacker utility to determine the best target, while logistic regression is focused on past behavior. Frequency is the amount of times an event re occurs, and was added to logistic regression. The comparison was conducted in an eight-target game, each target with its own defender reward and penalty, attacker reward and penalty, and coverage. The predictions were made based on 39 separate attacks, conducted by real players

The subjective utility quantal response model outperformed both models of logistic regression by an average of forty four percent. However logistic regression out performed SUQR at points where no attacks occurred. Logistic regression with frequency outperformed logistic regression by 7.53429E-05 percent on average. It was found that increased frequency leads to a trend of more accurate predictions, however the rate at which it affects accuracy is not determined. Similarly, the data indicates that an increase in sample size lowers the difference between logistic regression and SUQR, but the rate is undetermined.

It is concluded that the subjective utility quantal response model is by far the most effective method for forming predictions in, but is far from a perfect method of prediction. Logistic regression with frequency is more accurate the logistic regression without frequency, and will get exponentially more accurate as a data set increases.

EARTH & SPACE SCIENCE

37

KIM, Jongmin
EARTH & SPACE SCIENCE
2014

38

KURUPPU, Praveen
Earth and Space Science
2014

EFFECTS OF PHOSPHATE LEVELS ON DEERVETCH

At the Madrona Marsh preserve, it was determined that phosphate soil levels are high, 1500 ppm in some places. One native plant, Deervetch, a staple of biodiversity, was chosen to determine the effect of high soil phosphate on it. The purpose of this project was to determine if the stunting of plants was due to high phosphate levels.

The procedure started out by setting aside 15 Deervetch plants. Five surface soil samples were taken from separate sites to determine phosphate levels and were found to be between 200 and 1500 ppm. One Deervetch plant was then placed in each of 15 one-gallon pots containing soil of known phosphate content. The first plant was a Control; the rest were dosed between 200 and 1500 ppm dissolved phosphate. The experiment was done outdoors. We measured the heights and watered the plants with Sump Water, weekly.

It was found that the test plants from 800 ppm and higher grew less in height compared to the Control and the lower dosed plants did not look as healthy throughout the entire study. The results support our hypothesis: high soil phosphate levels are responsible for the stunted growth of the Deervetch. This explains why several native plants are slow growing and subnormal in height. This is the first time an explanation has been offered for the abnormal growth of plants on the Preserve. Of equal importance is the fact that this study revealed for the first time that surface soils contain very high phosphate concentrations.

39

YONG, Stephany
EARTH & SPACE SCIENCE
2014

ENGINEERING

40

CHEN, Dennis
Engineering
2013-2014

ELIMINATING TRANSFORMER STANDBY POWER

Fewer than 15% of electric appliances in a common household can directly use the electricity provided by an electric company. A set of transformers or power adapters is used to circumvent these limitations, but the method in which the power is converted leaves unwanted power draw even when the appliance is turned completely off, composing about 20% of the total household power usage.

This project examined many of those devices and proposed solutions, and attempts to create a new apparatus that will be efficient and effective in its handling of unwanted power draw. After detailed analysis of each application and apparatus, several concepts were generated by combining aspects of the various approaches and methods.

The decided best result was prototyped and demonstrated success in its application as a USB power adapter. Although the device is still in prototype stage and a few minor errors have occurred, the device has completely eliminated excess power draw from an adapter.

After analyzing and comparing the various costs of production and usage, the device proves to be a cost-effective and efficient method in removing standby electrify draw. The successful creation of this apparatus shows progress to exceed standards set by regional legislation and creates an initiative for the recognition of power conservation.

41

Chen, Shannon
Engineering
2014

A NEW AND PRACTICAL APPROACH FOR MINI-AIRSHIP DESIGN

This project aimed at developing an approach for the design and fabrication of mini-airships that are minimal in size and capable of carrying usable payloads. A new and practical hull architecture was proposed and investigated.

The proposed mini-airship architecture uses flexible films expanded by a skeleton frame to form a super lightweight streamline hull and unpressurized gas cells to provide buoyant lift and partial support to the hull. This approach allows the construction of mini-airships with shapes that are difficult to implement with non-rigid or semi-rigid hulls. It also allows size minimization that is not achievable by rigid hulls. Rigorous design procedures were followed to calculate the drag, weight, and structural parameters, and a mini-airship was constructed for demonstration.

The mini-airship was 2.5m long with a maximum diameter of 1.0m and a volume of only 1.12 cubic meters. The hull streamline was scaled from Model-111 in NACA Technical Report TN-614 for low drag at low speed. Two unpressurized gas cells were used to prevent buoyancy center shifting when they are partially inflated. Two propellers with 12” diameter and 6” pitch were installed in the front to generate differential thrust. A micro servo was used to adjust pitch moment. An onboard wireless radio received operation signals from a remote controller. The entire airship excluding the battery (0.29kg) weighed only 0.45kg. The payload capacity was 0.3 kg with additional 0.16kg margin.

In conclusion, this project demonstrated a viable approach for designing mini-airships with advanced streamline shapes, minimal sizes, and practical payload capacity.

42

INAGAKI, Yosuke
GOLD, Ethan
ENGINEERING
2014

USING BODY HEAT TO GENERATE POWER FROM THE SEEBECK EFFECT

The purpose of this project was to determine if thermoelectric tiles currently have the capability to produce significant amounts of power from the human body.

In this experiment, specific power was defined as the power needed to charge a AA battery over the course of 13 hours which requires 1.3V and 0.2A. It was predicted that 50 in^2 of thermoelectric material was needed to satisfy these requirements. The particular tile with surface area of 2.13in^2 used in this experiment therefore had to produce 59.8mV and 9.2mA.

On the first trial, the thermoelectric tile produced decreasing amounts of power until the tenth minute where it stabilized. For the first subject, after the tenth minute an average of 173.93 mV, 13.06 mA, and 2.27mW was produced. For the second subject, after the tenth minute, 191.14mV, 14.64mA, and 2.81mW was produced. In the second trial for both subjects, the thermoelectric tile produced decreasing amounts of power until it stabilized after the sixth minute. The first subject, after the sixth minute produced on average 285.48mV, 23.76mA, and 6.79mW. The second subject, after the sixth minute produced on average 256.33mV, 21.60mA, and 5.57mW.

After the experiment was performed, it was determined that a total surface area over the human body of about 45 in^2 was needed in order to charge a single AA battery in the time between 13 and 15 hours.

43

LEE, Regina
ENGINEERING
2014

THE EXTRACTION OF FUEL OIL FROM USED COFFEE GROUNDS BY HEATING IT WITH SOLAR ENERGY

Society today is based around fossil fuels, a source of energy that is depleting quickly. Biofuels are another source of energy and can help the environment by reducing the additional amount of carbon dioxide put back in the air. Many organic materials can be used for biofuels, one of which are used coffee grounds. Coffee grounds prior to being boiled satisfy the early morning needs of many human beings have a lipid content around 10-15%, which can be made into biodiesel. But, using fresh coffee grounds for fuel is often frowned upon. However, used coffee grounds can be a potential resource. In addition, the production of biofuels are not popular because it takes additional fuel and energy. In this experiment, no fossil fuels will be used, instead solar energy from a parabolic solar mirror will be used to heat the used coffee grounds.

To prepare for the experiment, the used coffee grounds were collected. Then they were dried in a pot using the solar mirror. Next, a sealed pot was selected to cook the dried used coffee grounds. The first vessel was a cookie tin in which 2 holes were drilled into its lid, one held a thermocouple, the other held a pressure fitting fixture that connects to a 3/8 inch copper pipe. The copper pipe lead to a copper coil, which acted as a condenser, which then lead to a collection jar. Because of problems encountered when using the cookie tin, a suitable pressure cooker was purchased and modified for the experiment. The dried coffee grounds were heated in the pressure cooker using the solar mirror. The liquid substances that were extracted were sent for analysis using the Fourier Transform Infrared Spectroscopy/Attenuated total reflectance (FTIR/ATR) and Fourier Transform-Near Infrared Spectroscopy (FT-NIR) instrumentation.

When extracted liquid was tested with the FT-NIR, it was shown that they both had the double bond at wave number 966. The FTIR showed various carbon-carbon or carbon-hydrogen groups that indicate the presence of a lipid compound. To summarize, it was shown that 1.74% of the used coffee grounds that were converted were unsaturated lipids from the first batch. From the second batch, 3.24% of the used coffee grounds that were converted were unsaturated lipids.

In conclusion, the project was successful because of the presence of suitable lipids that can be possibly converted to biofuel. However, the experiment shows the process is was not efficient because of the low yield.

44

WU, Juliana
ENGINEERING

APPLICATIONS OF THERMOELECTRICITY AT A HOUSEHOLD LEVEL: YEAR TWO:

For the past few decades, people have opted to use solar cell panels, which only use the light component of solar energy. Not only is heat energy from the sun not fully utilized, but heat also impairs the efficiency of solar panels. Thermoelectricity, which uses a temperature gradient to generate electric power via semiconductor technology, provides an alternative method to collect the solar thermal energy. Ideally, thermoelectric generators should be designed to be used at a household level in addition with solar panels to take advantage of the heat energy present.

The purpose of this project was to discover the most optimum building material for the thermal insulation, to choose the most suitable thermal interface medium for maximize the thermoelectric generator efficiency, and to develop a thermoelectric battery charger to collect the generated electricity.

The Wonder board, a cement based building material, yielded the best insulation results. As for the better medium that works with the thermoelectric, water, which had higher thermal conductivity and higher thermal capacity, had higher results. The battery that collected power generated by the thermoelectric generator was successful in that it was able to store energy and could work about 60% the power a solar powered battery could.

Based on this research data, solar thermal systems embedded with a thermoelectric generator is feasible and can further advance our green energy applications. The data did not show any indication of what material within the Wonder board that improved the thermoelectric module's performance, so this field is something that can be looked into in the future. Also, since true household applications need much more than the one thermoelectric chip used in this research project, discovering a way to successfully connect multiple thermoelectric devices is crucial.

ENVIRONMENTAL SCIENCE

45

Dojiri, Stacey and Woo, Kelly
ENVIRONMENTAL SCIENCE
2014

THE POTENTIAL IMPACT OF HYPERION TREATMENT PLANT'S EFFLUENT ON THE COASTAL ENVIRONMENT: SCIENCE INFLUENCING MANAGEMENT

For decades, phytoplankton blooms caused by eutrophication have concerned the global community. In 2015, Hyperion Treatment Plant will divert its effluent, or treated sewage, from the 5-mile outfall to the 1-mile outfall, which may increase phytoplankton growth and bacteria levels.

Our experiment tests whether HTP should divert in the spring or fall to minimize negative effects of this diversion. It also tests amount of chlorine and contact time needed to effectively kill bacteria in the effluent and the effect of both non-chlorinated and chlorinated effluent on larval abalone development.

In our June, October, and April phytoplankton trials, seawater was collected and different seawater-effluent dilutions were made. After 6 days, samples were taken for chlorophyll and domoic acid analysis. Our chlorine test involved dosing effluent with different amounts of Cl_2 and using a chromogenic substrate test to determine bacterial counts after dosage. Our abalone tests involved exposing red abalone eggs to effluent and effluent dosed with Cl_2 and counting the number of larvae that developed smooth, opaque shells.

We hypothesized that a certain harmful species, *Pseudo-nitzschia seriata*, would be more prevalent in the spring. Our results showed that this species was most abundant in April and June. Based on these results, we concluded that diversion in October is best. Our chlorine test showed that 3ppm Cl_2 at a 25 minute contact time was most effective in killing bacteria, while statistical tests on the abalone data showed chlorinated and non-chlorinated effluent had no effect on the larvae.

46

KAUFMAN, Delaney
ENVIRONMENTAL SCIENCE
2014

PHYTOREMEDIATION OF CADMIUM USING EICHHORNIA CRASSIPES

Cadmium is a heavy metal found in both natural and anthropogenic sources. Cadmium contamination can have significant toxic effects on aquatic organisms and higher species up the food chain. The purpose of this research project was to determine the efficacy of the Eichhornia crassipes, water hyacinth, as a phytoremediator of cadmium in an aquatic environment.

Eichhornia crassipes plants were added to samples of water to which anhydrous cadmium chloride had been added. An additional sample of water with anhydrous cadmium chloride was kept without Eichhornia crassipes plants as a control. Over a 10 day period, the cadmium concentrations were measured using a photometer and the concentration of the samples with Eichhornia crassipes were compared to those from the control samples.

Throughout the 10 days of the experiment the cadmium concentration in the control sample remained constant. During this same period, the cadmium concentration in the samples with the Eichhornia crassipes decreased by a total of 63%. The concentration reduction was more rapid during the first 2 days then slowed as the experiment continued.

This project confirmed the ability of Eichhornia crassipes to phytoremediate cadmium in an aquatic environment. In this limited study the plants did not reduce the cadmium to the level deemed acceptable by the United States Environmental Protection Agency.

47

LANDSBERGER, Huws
ENVIRONMENTAL SCIENCE
2014

THE EFFECT OF AN AQUAPONICS SYSTEM ON THE TOXICITY OF WATER

This experiment tested the sustainability and viability of an aquaponics system. An aquaponics system is a system in which plants and fish are grown in a closed environment, which is claimed to be a less toxic and more sustainable system than standard aquaculture and hydroponic systems. By setting up this experiment, the goal was to determine whether the concentration of toxins of water in an aquaponics system is lower than those of stand-alone, separate aquaculture and hydroponics systems.

To test the hypothesis, one tank for each of the different types of systems was created. Over the course of thirty-three days, each system was tested for levels of toxins. Using testing kits from Aquarium Pharmaceuticals Inc., concentrations levels of pH, ammonia, nitrate, nitrite, and phosphates were recorded daily.

At the conclusion of the experiment, significant differences in toxin levels were evident between the aquaponics and aquaculture tanks. The aquaponics eco-system was less toxic than the hydroponic tank by margins as large as 2 ppm. When results were compared to the hydroponic tank, there were variations in the differences, with some results favoring the aquaponics and some the hydroponics system.

A final analysis of data supported the statement that an aquaponics system is less toxic than an aquaculture system. No evidence was found to support the claim that an aquaponics system is superior in toxicity to a hydroponics system, even with the added toxins due to fish waste.

48

LEE, Amanda
Environmental Science

EFFECTS OF OILS ON *DELFTIA ACIDOVORANS*

Oil-eating bacteria are ubiquitous both in freshwater lakes, ponds and streams, and the ocean. Until this study, no one has studied such bacteria at Madrona Marsh. The purpose of this project is to determine if oil-consuming bacteria exist within oily, soil/water in contact with surface oil seeps on the Madrona Marsh Preserve.

This study began by collection of a Sump water sample from the Preserve. Next, a Pre-Test was conducted to determine the presence of oil-eating bacteria. Three of the substances tested were natural, commercially available cooking oils. The fourth and fifth were motor oil and petroleum jelly. The sixth was the oil soil mixture from the Preserve. Tests were conducted in Sump water and were dosed with phosphate and nitrate-concentration varied from 0.05mg/L-10.0mg/L. Five out of six tested positive (turned pink), using a 2.0% Tetrazolium indicator solution. The oily soil mixture did not test positive. At the conclusion of the test (5 weeks), the beaker containing 1.0mg/L phosphate/nitrate (each) was sent to Bio-Screen Laboratory (in Torrance) for identification of the dominant bacterium present in the solution. (This concentration turned the brightest pink). The dominant bacterium was determined to be *Delftia acidovorans*.

Dr. David Crowley (UCR), an expert on oil-eating bacteria at La Brea Tar Pits was consulted (e-mail) throughout my project. He acknowledged my work, agreeing that it represents presumptive evidence that *Delftia acidovorans* is digesting oil as an energy source at Madrona Marsh. Further study is needed to verify this hypothesis. A possible way to accomplish this is to repeat the experiment, this time testing for alkane consumption.

49

Wang, Annie
Environmental Science
2013/2014

THE EFFECTS OF CALCIUM ON GROWTH AND DEVELOPMENT OF ADULT *LYSMATA CALIFORNICA*

The ocean pH is slowly decreasing as more carbon dioxide and other pollutants are released into the atmosphere. When pH decreases, many organic compounds, such as calcium carbonate, are dissolved. Calcifying organisms cannot obtain calcium they need to build shells. I was interested in whether they use excess calcium to increase growth or carapace length. A study by Peter Greenaway, “Calcium balance and moulting in the Crustacea”, showed that marine crustaceans obtain most of the calcium needed to grow from the marine environment. Because Crustaceans require sufficient amount of calcium to grow and develop properly, I hypothesized that an increase in the amount of the calcium in sea water will cause the development and growth of *Lysmata californica* to increase.

In this experiment, forty adult *Lysmata californica* were used in four 10-gallon tanks, with ten adults in each tank. Three tanks received different concentrations of calcium hydroxide dissolved in sea water (5 mM, 10 mM, and 15 mM respectively), while the fourth tank served as control. The powder calcium hydroxide was dissolved in sea water, then dosed into the tanks every hour. Once a week, mass and length of five random shrimp from each treatment were measured.

The results showed that the control group grew more when compared to the treatment groups. While the 15 mM group did grow heavier than the other experimental group, the percent mass growth of the experimental groups did not show any patterns.

Because the control group received no extra calcium, yet grew the fastest, I assume that the experimental groups were overdosed and the water was oversaturated with calcium. The data shows that adult *L. californica* grow best in un-treated sea water compared to water saturated with calcium..

50
WILLIAMS, Holly
ENVIRONMENTAL SCIENCE
2014

51
WONG, Kriya
Environmental Sciences
2014

The Effects of Sorting Refuse on Methane Generation in Landfills

The need for alternative energy sources grows as it becomes more and more apparent that our fossil fuel supply cannot sustain us indefinitely. A technique that has recently gained fame is the use of landfill gas, or more specifically, the methane in landfill gas, to power homes and equipment. Because paper waste in landfills is credited with the generation of a large percentage of total generated gas, it follows that if paper waste were mixed only with organic waste and not included in the huge assorted refuse that constitutes our landfills today, there would be a major increase in methane production and therefore energy production.

Four "bioreactors" were created, one with paper and organic waste, one with plastic and organic waste, one with only organic waste and one with assorted waste collected from my own home, and the reactors were placed in a waterbath (cooler) at a temperature around 80-90 degrees Fahrenheit and attached to individual Flexfoil bags. The bags inflated as gas was generated and recorded.

After a time period of 42 days, the organics only reactor produced the most gas and therefore methane, as expected, followed by the paper waste and organics mixed reactor which produced 60% more methane than did the plastic and organics reactor. The plastics and organics reactor produced the same amount of methane as the assorted reactor; in normal circumstances, this would not occur because while the assorted refuse was taken from my own house and may have had unequal amounts of organic waste, the plastics and organics reactor was exactly half organic waste by weight, which accounts for its unusually high methane output.

The results of this experiment show that it would be beneficial to separate waste into categories in the interest of producing more methane. Now that we know that landfills can generate useful energy, we must enhance it by sorting refuse and singling paper waste out to be combined only with organics. Future studies should investigate what percentage of this produced gas is actually methane that can be used.

52
ZHANG, Brian
ENVIRONMENTAL SCIENCE
2014

MEDICINE & HEALTH

53
BENEDICT, Braeden
MEDICINE & HEALTH
2014

Development of an Electroencephalography (EEG) Device for Evaluation of Mild Traumatic Brain Injury (Year 2)

This project aimed to further develop and test a low-cost device potentially capable of detecting concussions based upon brain wave data collected from a simple electroencephalography (EEG) headset, and to correlate this data with the results of C3 Logix iPad concussion testing.

An upgraded version of the device was built by integrating a Mindflex game EEG headset with an Arduino microcontroller. Bluetooth functionality and a touch screen were added. Data for eight brain wave frequencies was collected and analyzed. Ninety-four healthy baseline subjects were tested to serve as a control group. For each subject, brain wave activity was recorded both while the subject was in a state of attention and in a state of relaxation/meditation. Some subjects were also monitored while performing a cognitive test on the iPad. The recoveries of sixteen recently concussed subjects were tracked using EEG and C3 Logix testing. In a second phase of this project, twenty-five baseline subjects and four concussed subjects were tested with the Emotiv EPOC, a 16-electrode EEG headset.

Experimental results showed that concussions did influence brain wave activity. The brain wave patterns for concussed subjects while relaxing/meditating were significantly altered compared to when the same subjects did not have concussions. In addition, the amplitudes of several brain wave frequencies were altered as a result of a concussion. As subjects recovered, these approached normal levels. An additional finding was that baseline subjects who had previously sustained a concussion displayed similar changes, on average, as those who had recently sustained concussions.

Further development of this technology may ultimately provide a simple, affordable, and rapid sideline concussion diagnosis. Research also suggested that concussions have long-term effects in children, even after clinical symptoms have subsided.

54

CHATURVEDI, Deeksha
MEDICINE & HEALTH
2014

THE EFFECT OF BODY MASS INDEX ON FRUCTOSE METABOLISM

This investigation used the body mass index (BMI) of an individual as a marker of insulin resistance to determine its effect on the individual's glycemic response to fructose and the subsequent metabolism of fructose in the form of High Fructose Corn Syrup (HFCS). This study measured the difference in blood glucose levels taken before and two hours after the ingestion of a solution containing 13 grams of fructose, and compared the results to a subset of individuals ingesting a similar amount of glucose. Because BMI is known to be correlated with insulin resistance, and defects in hexokinase are present in insulin resistant individuals, it was hypothesized that if an individual has a greater BMI, then the individual will have a lesser increase in blood glucose levels after ingesting fructose.

A sample of 30 non-pregnant, non-diabetic adolescents participated in the study, 20 of whom made up the fructose group and 10 of whom made up the glucose control group. The BMI for each subject was calculated by inputting values into the Center for Disease Control's BMI calculator and Δ, which represented the change in blood glucose, was found by subtracting the postprandial glucose measurement from the preprandial measurement.

Results for both the fructose ($P= 4.62 \times 10^{-14}$; $r= -0.12$) and glucose ($P= 0.0024$; $r= -0.32$) groups were statistically significant and demonstrated weak, negative correlations. Regardless of BMI, participants displayed a negative Δ to fructose; the average Δ for the fructose group was far lower at -7.7mg/dL compared to that of the glucose group, -0.5mg/dL.

Contrary to what was hypothesized, a higher BMI produced a vigorous decline, not a "lesser increase," in blood glucose in the fructose group. From the negative average Δ in the fructose group, it can be concluded that fructose provoked a greater level of insulin hence the decrease in blood sugar, and created a greater level of insulin resistance in both low and high BMIs. Because the sample was fairly homogenous and fairly healthy, the insulin resistance is not likely to have been caused by fluctuations in weight, and more likely to have been caused by changes in sugar type. However, further experimentation is needed to confirm the accuracy of these results.

55

KIM, Jeanwon
MEDICINE & HEALTH
2014

WHICH INGREDIENT CAN MOISTURIZE THE BEST

This project was conducted in order to isolate which ingredient in moisturizers is the best at its job. Dryness of skin, although not an extreme malady, is common to many people and can cause quite a lot of pain. In stores, many lotions and ointments are available to those who wish to tend to their dry skin; but which one can serve the best, is the question.

JELL-O – being made up of mostly water – was used as a model of skin to see how much of that water would evaporate when using different moisturizers, all having different ingredients. In ten separate, gelatin-fill, petri dishes, four pairs were topped off with different moisturizers, and the last pair was bare, acting as the control. Each day for ten days, the height and weight of the JELL-O was measured to see how much water had been able to escape.

The petroleum-based moisturizer had retained an average of 89.9% of its initial weight and 66.8% its initial height; the mineral oil-based moisturizer retained 91.1% weight and 77.2% height; the butter-based moisturizer retained 66.3% weight and 65.6% height; and the aloe-based moisturizer retained 20.3% weight and 8.5% height.

Looking at the data, it is obvious that the mineral oil-based moisturizer was the best. Between the petroleum-based and butter-based moisturizers, however, the data must not be looked at without further thought. The petroleum-based and butter-based both retained around the same percent of initial height, but the percent of initial weight was noticeably different. This is because nearing the end of the experiment, the moisture in the butter-based moisturizer itself – not the gelatin – was evaporating, while the petroleum-based moisturizer was staying the same. If the butter-based moisturizer had not been losing weight of its own along with the weight of the gelatin itself, it would have resulted in similar, if not better, results as the petroleum-based moisturizer. Therefore, petroleum-based moisturizers should not be thought of as much better than butter-based ones. However, the best choice between all four of the moisturizers would be the mineral oil-based, seeing as though both its height and weight percentages were greatly noticeable.

56

KISSEL, Kendall
Medicine and Health Sciences
2014

THE EFFECTS OF EXERCISE ON SEROTONIN LEVELS

The purpose of this project was to observe the short-term effects of exercise on serotonin levels. Serotonin is a neurotransmitter commonly associated with Obsessive-Compulsive Disorder and depression. Various

prescription drugs are used to control serotonin levels. These drugs have dangerous side effects; therefore, finding a natural way to control serotonin levels would be beneficial.

The serotonin levels were measured through urine sampling. The female teenage subjects took an initial urine test to see their base line serotonin levels. They then walked one mile and took another urinary serotonin test. The sample information was filled out and sent to a lab for analyzing. Within a few days, the results were sent back and the results were analyzed.

The results showed a very strong positive correlation between exercise and serotonin levels. The serotonin levels increased by an average of 53.25 percent from the initial urinary test to the test after exercises (The levels nearly doubled). These levels were very high compared to the normal ranges of serotonin for females under the age of eighteen.

These results hold the ability to aid people who have a family history of depression. They can prevent depression with exercise instead of using medicines, which have the ability to alter personality and various other elements of lifestyle. The results may also be able to help depressed people overcome their depression in a natural way.

57

LEE, Grace
MEDICINE AND HEALTH
2014

MOLECULAR EFFECT OF ALCOHOL ON THE POTENCY OF DENTAL PULP STEM CELLS(DPSCS)

Since a large percent of adult population of the US encounters alcohol everyday, I wanted to see if alcohol affects molecular changes when the tooth structure comes into contact with alcohol. The objective of this research project was to study the dental pulp stem cells' potential in regenerating itself or different aspects of tooth structure and study the effects of alcohol(EtOH) on the stem cells' capability.

In order to carry out this experiment, the human Dental pulp stem cells, obtained from the school of UCLA, were grown in tissue culture. These cells were fed with media containing alcohol with concentration of 20mM and 50mM. These cells were exposed to alcohol for up to ten days. The cell samples were permeabilized in IF staining solution for fifteen minutes. Processed were mounted on a glass slide, with mounting medium with DAPI, which indicates the location of nuclei of stem cells, and were visualized through an inverted microscope. To understand the basic levels of Dental pulp stem cells, stem cell markers, such as OCT4 and TRA 1-60, were used.

When we performed Immunoflourescence of DPSCs with two stem cell markers, we found that alcohol increases the level of TRA 1-60 and OCT4 in dosage dependent manner.

In conclusion, the increased level of the stem cell markers shows that alcohol increases the potency of Dental pulp stem cells. Thus, DPSCs can be utilized as a great therapeutic regenerative tool. In future research, I can study the genomic transcriptions and epigenetic analyses to study the detailed effects of alcohol in DPSCs potency.

58

LIU, Christine
MEDICINE & HEALTH
2014

59

LORE, Jozsef
MEDICINE & HEALTH
2014

CREATING A WORKING REPLACEMENT DEVICE FOR A BI-PAP MASK

The focus of this project was to determine if an alternative Bi-Pap mask could be created for a child patient with sleep apnea. The current mask in use by the patient has been detrimental to her facial bone structure, as it applies excess force due to the elastic straps that keep it restrained to the face.

To reduce the amount of force applied to the patient's facial region, the surface area that the mask covered was reduced. A mouthpiece was constructed and was attached by wire prongs to a nasal pillow which would insert into the nostrils. The force of the new device was measured by holding it at 90 degrees and allowing it to oscillate into a force gauge when the Bi-Pap machine was activated. The patient was also asked for her opinion on the experimental model in comparison with the one she currently uses.

The resistive force of the experimental model was found to be 0.0224 lbs, much smaller than the 0.4844 lbs produced by the current mask. The mouthpiece was an effective retaining force in place of the straps and kept the mask securely attached. The patient, however, preferred the old mask instead of the experimental model due to not being used to having tubes go up her nostrils or wearing a mouthpiece.

Quantitatively, the new device both decreases and moves the resistive force away from the impacted area of the patient's face. The patient predictably preferred the current model as it takes several nights of use for users to become accustomed to new appliances.

60

MURTY, Nikhil
Medicine and Health Sciences
2013-2014

THE EFFECT OF NEBULIZED VITAMIN D IN NEONATAL LUNG DEVELOPMENT

Vitamin D (1α,25(OH)2D3) is an effector of fetal lung maturation. It stimulates key alveolar epithelial-mesenchymal interactions, causing growth of the lung. However, systemic administration of vitamin D can lead to toxicity and increased chances of hypercalcemia.

Using a nebulized agent instead of a systemic form, this study tested for an increase in prenatal lung development after administration of vitamin D. Sprauge-Dawley rat pups were either administered a placebo, 25D (100 ng/kg/day), or 1,25D (10 ng/kg/day) over a 14 day period. After the 14th day, the lungs were harvested and tissue samples were collected for analysis. Western blot analyses were conducted for mesenchymal (PPARγ) and epithelial (surfactant protein B) markers.

The results showed that the protein levels of both the lungs administered with 25D and 1,25D increased with 1,25D having a having higher levels than 25D. It can be concluded that the administration of nebulized vitamin D can enhance lung maturation without the complications caused by systemic administration of vitamin D. The results of this study would mainly be useful to prenatal children who are many times born with underdeveloped lungs and therefore have trouble breathing.

61

SUNG, Mina
MEDICINE & HEALTH
2014

A STUDY OF MULTIPLE SCLEROSIS AND ITS RELATIONSHIP TO STROKE

The purpose of this study is to examine the possibility of a role for inflammatory processes in the development of ischemic stroke by examining an association with multiple sclerosis (MS) prevalence and ischemic stroke (IS) versus intracerebral hemorrhage (ICH) versus subarachnoid hemorrhage (SAH). MS is a chronic inflammatory condition of the central nervous system and recent evidence suggests that systemic inflammation may enhance atherogenesis, the most frequent mechanism for ischemic stroke. However, atherogenesis is not a mechanism for ICH or SAH and so no association with MS would be expected in these stroke types.

Data analysis was conducted with a super computer at the University of Southern California, Keck School of Medicine using the very large Nationwide Inpatient Sample with data on approximately 20 million patients per year of inpatient hospital data. MS prevalence was examined in patients with different stroke type or no stroke. SAS® 9.2 (proc surveymeans) was used to estimate the yearly disease incidence rate; which is reported by10,000 person per year.

The prevalence of MS in ICH and SAH was significantly lower than in ischemic stroke or in non-stroke patients. The prevalence of MS in ischemic stroke patients was significantly higher in the younger patients 20-29, 30-39 and 40-49 compared to ICH, SAH and non-stroke patients. In later age categories, MS

prevalence continued to be higher in IS patients than in ICH and SAH patients, but not in non-stroke patients.

The data clearly reveal an association with MS and ischemic stroke and no association with intracerebral hemorrhage or subarachnoid hemorrhage as was hypothesized. The effect became less prominent in older patients, which may also be expected, since the more common risk factors for stroke such as hypertension, hyperlipidemia and diabetes become more prominent with age.

62

WONG, Ryan
MEDICINE & HEALTH
2014

ACTIVE TREMOR STABILIZATION FOR PARKINSON'S DISEASE AND ESSENTIAL TREMOR

Tremor affects more than 1 million Americans in the form of diseases such as Parkinson's Disease and Essential Tremor. These diseases increase the difficulty in performing fine motor movements, causing some patients to be completely reliant on others throughout the day. The purpose of this project was to develop a wearable tremor-reducing glove that could eventually help these people to become more independent. Though the glove was not tested on humans, it is a theoretical approach, and in the future could be designed for human experimentation.

The device consists of an accelerometer that measures the excursion of the hand. This data is transmitted real time to the microcontroller through its 8-bit analog to digital converter, and a Fast Fourier Transform (FFT) algorithm is used to determine the fundamental frequency of the tremor. A vibration motor then oscillates at the same frequency, and an algorithm changes the phase of the motor in 10-degree increments until the motor is oscillating at an opposing phase from the hand tremor and the amplitude of the tremor is at a minimum. The motor continues to adjust such that the forces of the actuator and the tremor are continuously in opposite directions and cancel.

This device was tested on robotic arm to determine its accuracy. A second vibration motor attached to the end of the arm was used to simulate the hand tremor. After some time, the glove turned on, autonomously determined the resultant frequency of the hand, and attempted to reduce the tremor. It was determined after many trials that the amplitude of oscillation in the hand was reduced by an average of 26 percent due to the tremor-reducing glove.

MICROBIOLOGY

63

BAI, Ruipeng
Microbiology
2014

Immunization Against NDM1-expressing Bacteria

This project is to detect the amount of antibodies against KPC (K. pneumonia**)** follow up case series described isolates of both *E. coli* and *K. pneumoniae* expressing NDM-1 found throughout India by the use of ELISA (**E**nzyme-**L**inked **I**mmuno**S**orbent **A**ssay: test that uses antibodies and color change to identify a substance). For this experiment, three types of buffer are needed to be prepared. From TBS-1Liter, we created TBS 3% BSA, and TBS 0.05% Tween 2 0. In order to test NDM-1 vaccine, a 96-well plate was coated with NDM-1 protein and added the control, NDM-1, and IgG1 isotype (Immunoglobulin G). The experiment shows that the NDM-1 titer (a measurement that shows how much antibody an organism has produced) is higher than the control group which means that the vaccine was successful in producing antibody. Infection caused by KPC-producing *K. pneumoniae* is independently associated with in-hospital mortality (≥50%) it has follow up cases with *E. coli* and *K. pneumoniae* expressing NDM-1 \. Developing a NDM-1 vaccine have great beneficial. This vaccine has the potential to

synergize with carbapenem antibacterial therapy (restoring antibacterial effectiveness by antibody-based blockage of carbapenemase activity), which can prolong the useful lives of some of the post powerful antibiotics that have ever been developed. NDM-1 vaccine have a tremendously beneficial impact on public health.

64

CHANG, Angela
MICROBIOLOGY
2014

DEVELOPMENT OF THE COPROPHILOUS FUNGUS, *PILOBOLUS CRYSTALLINUS BY LIGHT*

This experiment was designed to test the influence of light on the effect of the life cycle of the fastest accelerator in our planet, *Pilobolus* crystallinus var. crystallinus (or cannon fungus). Four different light conditions were used to experiment its effect on the number of developing sporangiophore, developed sporangiophore, and sporangium shot.

First, a cube of agar containing at least one sporangium was cut and transferred to a new agar dish from the agar dish inoculated with *Pilobolus,* using a sterile scalpel. This procedure was repeated eight times, two dishes for each light condition. The incandescent light treatment were wrapped using saran wrap, the no light group with foil, the blue treatment with blue filter , and the red treatment with red filter. They were then placed beside each other 24 inches under a incandescent light source on a 12h:12h light/dark cycle. After two consecutive weeks, all dishes were observed using a magnifier and the sporangiophores and sporangium were calculated for each condition.

As a result, the two agar dishes absorbing blue light proved in possessing the most significant averages in the number of developing and developed sporangiophore and sporangium shot. The agar dishes under incandescent light received higher averages compared to red light. Lastly, the averages were lowest in the absence of light.

Through this conduction, my hypothesis was successfully supported due to the indication of blue light's positive results on effecting growth and asexual reproduction. This experiment helped expand knowledge on this coprophilous fungus and other fungi as well.

65

FILLER, Elan
MICROBIOLOGY
2014

TRANSCRIPTION FACTORS THAT REGULATE ANTIMICROBIAL RESISTANCE IN *CANDIDA GLABRATA*

The fungus *Candida glabrata* is part of the normal human flora. In hospitalized patients with weakened immune systems, the fungus can enter the bloodstream from the GI tract and cause a serious, frequently fatal infection. Both white blood cells and cells lining the GI tract contain antimicrobial peptides that kill *C. glabrata* and prevent infection. Patients infected with *C. glabrata* are treated with the antifungal drug, caspofungin, but some strains are resistant. My hypothesis is that *C. glabrata* has specific transcription factors that enable it to resist antimicrobial peptides and caspofungin. To identify these transcription factors, a collection of *C. glabrata* mutants, each of which lack a different transcription factor, was screened for increased susceptibility to the antimicrobial peptide, protamine, or caspofungin. The ability of each mutant to grow on agar plates containing either protamine or caspofungin was compared to the control, wild-type strain. Mutants that were hypersusceptibile to either compound, as compared to the control strain, were retested to verify the results. Of the 90 *C. glabrata* transcription factor mutants that were tested, 7 were hypersusceptible to both protamine and caspofungin. Notably, 3 of these mutants lacked Spt8, Ada2, or Gcn5. In other organisms, these proteins form part of the SAGA histone acetyltransferase

complex, which acetylates histones, exposing DNA and leads to the transcription of downstream genes that are responsible for resistance. Therefore, the Spt8-Ada2-Gcn5 complex governs the ability of *C. glabrata* to resist both antimicrobial peptides and caspofungin, and is a promising target for new antifungal drugs.

66

JOO. Leea
MICROBIOLOGY
2014

The Effects of Antibacterial Detergents on the resistance of E. coli

The purpose of this project was to determine the effectiveness of two different types of dish detergent in killing *Escherichia coli.* In addition, another purpose was to determine if Escherichia coli possessed a specific type of resistance against a specific detergent.

First, populations of E. coli were grown on a test tube and transported onto 20 petri dishes and left to incubate for 24 hours. Then, on five petri dishes, 3mL of Dawn regular dish detergent were generously applied and spread. On the other five, Dawn antibacterial dish detergent was applied in the same manner. The same procedure followed for regular Palmolive and antibacterial Palmolive dish detergent. After, all of the agar plates were incubated for another 24 hours. The exponential decay of the E. coli bacterial colonies were carefully analyzed and counted under a microscope.

The results of this experiment showed that Dawn antibacterial dish detergent were far more effective than any other dish detergent used in this experiment. There was only one colony remaining proving that E. coli possess the least amount of resistance against this dish detergent. There were many more colonies left in the other 3 dish detergent applied plates when compared.

It can be concluded from this experiment that Dawn antibacterial dish detergent is the most effective solution in eradicating E. coli. Possible resistance factors may be from a less vulnerable capsule of the bacteria.

67

KIM, Anthony
MICROBIOLOGY
2014

THE INHIBITION OF GROWTH OF ESCHERICHIA COLI USING NATURAL ANTIBIOTICS

Essential oils have always been valued for their antiseptic and medicinal characteristics. This project's purpose was trying to determine if thyme oil, oregano oil, and black pepper oil were effective against bacteria, Escherichia coli to be specific. From there, the optimal concentration (within 1%-3%) for the most inhibition of bacterial growth was experimented for.

Antibiotic efficacy was tested for using the "Kirby-Bauer" disk diffusion method. 100% pure essential oil stocks were diluted to 1%, 2%, or 3% using pure jojoba oil as a carrier. A broth culture of Escherichia coli was grown to form a bacterial lawn and disks with the tested essential oils as well as two controls (disks with just jojoba oil, just water) were placed in the petri dishes, and the plates were incubated at 37 degrees Celsius, inverted.

Due to some complications with the procedure and possible errors, there no valid results in this experiment. Other than observations of a slight cloudy layer on top of the nutrient agar and very faint lines around the diffusion disks, not much could be seen from the plates and there was not much difference between the before and after.

Although there were no actual results, there are still conclusions that were made. It is possible that the oil did not mix well with the water, so did not diffuse out of the disks properly. The timing of the placement of

diffusion disks could have been a factor, as well as the fact that the bacteria broth was not incubated with shaking, which could explain the light and scattered growth of bacteria in the results.

68

KIM, Caroline
MICROBIOLOGY
2014

ADAPTATION OF *R. LEGUMINOSARUM* TO METHANE

Bacteria called methanotrophs use methane as for energy, so the harmful impacts of methane are lessened. The purpose of this experiment was to force *R. leguminosarum*, to use methane as energy.

The rhizobia were cultured in test tubes with mannitol yeast extract broth or agar. Methane was introduced into tubes prior to incubation. Carbon dioxide was a potential byproduct, so the pH of the broth was measured because dissolved carbon dioxide lowers the pH of a solution. Cotton balls with drops of potassium hydroxide were put at the top of each tube to see if carbon dioxide reacted with the potassium hydroxide. These methods did not work, so the pressures of each tube were measured. Growth of cultures was measured in the spectrophotometer.

The rhizobia grew well until the fourteenth generation, when the growth declined quickly. The control groups' pressures normally stabilized or increased slightly as time passed, but the experimental groups' pressures declined more quickly. The average pressures varied.

Pressure and growth data show that the rhizobia were not able to adapt to methane. Instead of using the methane, the rhizobia were probably using the limited supply of air that had been trapped inside the tubes with the methane.

69

KUMAR, Divya
Microbiology
2013/2014

DETERMINING THE CAUSE OF VARIATION IN VIRULENCE IN *ACINETOBACTER BAUMANNII* STRAINS

Acinetobacter contains a wide variety of strains with varying virulence. While some strains such as HUMC1 and LAC-4 are recognized as hyper-virulent, others such as ATCC17978 are avirulent, causing much speculation about the cause of such dramatic variation. Possible factors include the incubation period, the complement kill system, and macrophage phagocytosis.

Each factor was tested using a different method. The incubation period was tested by incubating each strain normally for the same amount of time at the same temperature and comparing the number of colony forming units. The complement kill system was tested by using both complement active and heat inactivated serum to incubate each strain and comparing the number of colony forming units. Macrophage phagocytosis was tested by incubating each strain with lab created macrophages comparing the number of macrophages infected with each strain.

While ATCC 17978 did not have a significant disadvantage during normal incubation, both complement killing and macrophage phagocytosis had a detrimental effect on its growth. In order to prove that these two factors do account for the large drop in colony forming units, another test was performed using liposomal clodronate and cobra venom factor. This experiment proved that although both contribute to the decline, the combined effect was the cause for the majority of the sharp decrease.

With HUMC1 and LAC-4 remaining in high quantities, these results suggest that ATCC 17978 is substantially susceptible to the above factors while HUMC1 and LAC-4 retain some kind of resistance that contributes to their high virulence.

70

KUMAR, Raya
MICROBIOLOGY
2014

THE SOURCE OF BACTERIA AT CABRILLO BEACH: WHY IS IT AN F BEACH?

For years Inner Cabrillo Beach has been graded as an F beach by the environmental group Heal the Bay based on single-sample, water quality limits for *Enterococcus*, despite the millions of dollars that have been invested into projects to improve quality. In my previous project, it was discovered that water consistently had higher levels of Enterococcus than sand did, especially in station CB2. However, contrary to a majority of research previously done on Enterococcus that all disregarded sand as an inhospitable environment to the bacteria, my results clearly displayed that sand could actually contribute a significant amount to the Enterococcus levels.

This year, a qPCR analysis of the bacteria was carried out from sand samples collected along a perpendicular transect from the bathroom to the waters edge to see if the source is Bacterioides, which indicates a human source. Water samples were collected 50 and 100 ft on either side of CB2 to determine the geographic extent of any exceedances using the chromogenic substrate method. A 24-hour rhodamine dye study was conducted to determine if the source of bacterial contamination is a leaky bathroom sewer pipe.

Results from the qPCR analysis showed that the samples contained human traces in them. Like last year, there were also Enterococcus exceedances in the water samples taken from the 5 main water stations. Finally, many of the rhodamine dye samples contained traces of dye.

The human traces in the samples as well as the dye that was flushed down the toilet being present in the ocean suggests that there possibly is a leak in the sewage pipe running from the bathroom at Inner Cabrillo Beach into the ocean.

71

SHABBIR, Uswah
MICROBIOLOGY

DETERMINING ARCHETYPAL BACTERIA PRESENT IN A HIGH SCHOOL CAFETERIA: A YEAR TWO STUDY

My project's objective was to sample various areas of a hospital cafeteria and identify the bacteria that were found in order to determine if there were any potentially dangerous bacteria present.

Five areas in a hospital cafeteria were tested for bacteria: the napkin container, the cutlery dispenser, an eating area table, a plate, and the tray railway. Three trials were done. Each area was tested with a sterile swab onto a prepared nutrient agar plate. After being incubated for twenty-four hours at 37 degrees Celsius, each plate were gram stained and observed using an oil microscope.

After observing each bacteria colony from each specific area, it was found that although each colony contained either bacteria or yeast, none of them were pathogenic. Any bacteria that were found to be potentially

dangerous pertained only to those who have a compromised immune system, but they are exposed to such bacteria everywhere. All other bacteria were very common strains that are present when there is a lot of contact in one area.

The results from my project ultimately contradicted my project's hypothesis, concluding the lack of pathogenic bacteria in the cafeteria in the five tested areas.

PHYSICS

72

EDWARDS, Eric
Physics

COEFFICIENT OF RESTITUTION OF ALUMINUM AND WOODEN BASEBALL BATS Year 2

This project was designed to discover the effects of hitting baseballs on an aluminum BBCOR bat and a wooden bat's coefficient of restitution.

I used 38 feet of ¾" PVC pipe to build a structure capable of holding a baseball in place while a bat swung down to hit it. Before each swing, the bats was held perfectly horizontal to let gravity pull the bat to the baseball. The bat rotated on a pivot point six inches from the knob-end of the bat before making contact with the ball on the barrel of the bat. Each collision and flight of the ball was recorded at 60 frames per second in front of a scaled background consisting of 1" vertical stripes. Analyzing each recording for the inches traveled over frames elapsed gave the horizontal speed of the ball after the collision. This process was repeated multiple times for each bat after it had been exposed to certain levels of usage.

The coefficient of restitution of the aluminum bat stayed similar after hitting 0, 200, and 1000 baseballs until tests with 5,000 and 10,000+ balls yielded a much lower value. The wooden baseball bat surprisingly maintained a similar coefficient of restitution throughout the entire experiment.

My findings confirmed my hypothesis that the coefficient of restitution of the aluminum bat would decrease as the bat is exposed to more usage. I also found that the inexpensive wooden bats possessed a lower coefficient of restitution but maintained its liveliness through its lifespan. With thousands of high school and college athletes in America, this study will be a valuable source for helping buyers come to an educated decision when purchasing a BBCOR or wooden baseball bat.

73

LIN, Aaron Jer-Ping
PHYSICS
2014

CONSTRUCTING A SELF-SUSTAINABLE FUEL CELL FOR REAL WORLD APPLICATION

Fuel cells are currently sixty-four percent efficient. The reason being is the energy and pollution needed to purify and produce hydrogen and oxygen. My project is the find a way to make fuel cells more efficient by means of generating the fuels alongside the fuel cell to produce electricity.

This experiment was done with two fuel cells and two thermoelectric generators. These generators provided the energy to separate water. A multimeter was used to measure voltage. A temperature reader was also used, recording temperature at the beginning and during the trials. These pieces if data were collected for five minutes for every trial. There are ten trials total. Five with a load and five without a load. The data eventually is used to determine efficiency by dividing delta G by delta H, and times one hundred.

From the results, one can see that both the normal setup and the experimental setup differ. The control fuel cell setup performed better than then experimental setup. However, the experimental fared decently, close to one volt and in some cases, able to climb in voltage. However, when both setups are connected to a load, their voltage drops dramatically. Also, by using the equation derived from thermodynamic laws, the control cell turned out to be the most efficient at 95%. The experimental setup lagged behind by around 30%.

This experiment shows that using fuels from storage is better than producing on site. However, the control cell's efficiency is not literally 95%, due to the pollution produced by the process of extracting the fuels.

74

NGUYEN, Ryan
PHYSICS
2014

THE EFFECT OF DC-DC CONVERTERS ON SUPERCAPACITOR OUTPUT EFFICIENCY

My experiment's objective is to improve extraction of useful power from supercapacitors. In this experiment, I constructed a circuit consisting of both a step up DC-DC converter and a step down DC-DC converter. With both topologies of converters in one circuit, it was expected that the amount of useful power extracted from the supercapacitors should be increased.

The supercapacitor stack was assembled on a circuit card using eight supercapacitors capable of storing 35 farads and 2.5 volts. The supercapacitors were arranged such that the capacitor bank would be capable of handling 60 farads at 5.0 volts . A switch was used so that the circuit could first use the step down converter and then the step up converter. The set up consisted of the supercapacitor set, two DC-DC converters(one step up and one step down), a switch, and an LED load.

The converter output was connected across the LED load, and the converter was run for 60 minutes with measurements being taken every minute. For each test run, the voltage and current were measured at the output of the supercapacitor and at the input of the load, which allows the efficiency of the converter to be calculated.

When compared to the performance of a step up DC-DC converter alone or a step down DC-DC converter alone, the combined circuit does last for a longer amount of time. However, due to the limitations of the switch, the capacitor bank cannot be charged up to 10 volts. To further improve energy efficiency, one could use a different switch that would allow for higher voltages during circuit operation.

75

WATHUGALA, Samantha
PHYSICS
2014

DEPENDENCE OF SILICA SOL-GEL THIN FILM MATERIAL PROPERTIES ON FABRICATION METHODS

High refractive index (n) thin film coatings are widely used in the field of optics, which touches many aspects of our lives. One application of thin film coatings is in optical biosensors, where increasing n and decreasing film thickness can increase the sensitivity of the biosensors, thus allowing detection of diseases in their early stages.

Thin films from synthesized sol-gel silica are one promising avenue of research. Currently, researchers often settle for doping their films to modify the refractive index. This is not always optimal, as it could degrade other properties, such as increasing the absorption of the film. However, there are no continuous quantitative models researchers can follow to manipulate the parameters of the synthesis process without adding dopants to get the best film for their purposes. This study seeks to fill that need by testing the dependence of n and thickness on easily varied synthesis parameters both in isolation and interaction with each other.

In this work, 175 thin films were synthesized varying the amount of water, aging time, spin speeds, temperature, and annealing times, with both axis terms, varying one parameter at a time, and interaction terms, using a full factorial (2^5) design of experiments. These were characterized for thickness and n at three wavelengths of light using ellipsometry.

Models were developed for some of the parameters varied. For others, however, the relationships were too complicated to model accurately without more data, and some of the parameter values chosen were too extreme to offer meaningful results.

76

WONG, Janeline
PHYSICS
2014

ZOOLOGY

77

BENEDICT, Annie
ZOOLOGY
2014

EFFECT OF VARYING HYPERSALINITY LEVELS ON TORPOR AND RECOVERY OF T. CALIFORNICUS

The harpacticoid copepod *Tigriopus californicus* is found in supralittoral splashpools along the Pacific coast, where it is subject to highly varying environmental factors, including salinity levels. *T. californicus* is a euryhaline osmoconformer, and can tolerate a wide range of salinities through osmoregulation. At high enough salinities, the organism enters a state of torpor due to inability to osmoregulate. This project studied hypersalinity levels and exposure times which sent *T. californicus* into torpor. Behavior when reintroduced into normal salinity seawater was also studied.

Copepods were separated into groups of 10 organisms, placed in 1.5 mL of exposure solution, and allowed to sit for a given exposure time. Salinity levels were 60, 90, 120, and 175 ppt; long-term exposure times were 3, 5, 7, and 18 hr and short-term were 5, 10, and 15 min. After hypersalinity exposure, number of copepods in torpor was counted and all copepods were then introduced into a 35 ppt recovery solution, and were observed every 5 min over a 20-30 min period.

Copepods were able to withstand up to 60 ppt for any length without any changes in behavior. Long-term tests indicated higher salinities yielded higher percentage in torpor. Those able to acclimatize increased over time until the 18 hr point, where copepods re-entered torpor. Short-term tests again indicated higher salinity effectiveness for torpor. However, more copepods entered torpor as time increased. When short-term and long-term tests were compared, number of copepods torpid at 15 min was greater than those torpid at 3 hr due to the ability of the organism to acclimatize. Recovery was more rapid and more copepods survived during the short-term test.

The data suggests *T. californicus* enters torpor prior to acclimatization to hypersalinities and after prolonged exposure, which causes the osmoregulation mechanism to fail. In addition, copepods are more likely to recover from torpor when exposed to hypersalinities for shorter periods of time.

78

KOUCHI, Arisa
Zoology
2014

THE BEHAVIOR OF CAMPYLORHYNCHUS BRUNNEICAPILLUS PREDATORS

Due to the decrease in population of the Campylorhynchus brunneicapillus, otherwise known as the Cactus Wren, the causes of its population decline have been explored. A major factor has been found to be the presence of its predators. In order to protect the Cactus Wren, the behavior of their predators, including but not limited to Red Tail Hawks, Cooper's hawks, and American Crows, have been observed.

Avian predator behavior was observed by a weekly survey during the evening and the morning at the Alta Vicente Reserve. Along the trail, flags were marked as observation points and the surveyor recorded any sighting of predators. The duration of the surveyed was a total of 36 minutes, with three minutes at each of the twelve observation points.

Through the surveys, it has been found that predators lacked in presence and activity. The presence of predators also was affected by environmental conditions. On days of warm temperatures, predators tended to appear, but on days of high wind speed, there lacked a presence of predators, even with other avian activity. Also, the predators generally remained on top of telephone poles to observe the reserve for a long period of time, but minimal action took place.

From these observations, it can be concluded that a more prominent factor could be contributing to the Cactus Wren's population decline. However, other variables such as the environmental conditions and location should be tested.

79

FURUTA, Anna & CHA, Katie
ZOOLOGY
2014

THE SURVIVABILITY OF COPEPODS WITH THE EXPOSURE OF FLORFENICOL

Recent studies have shown that researchers have had great difficulty with rearing abalone larvae as a result of the unknown bacterial infection in diatoms, their common food source. Because of the infection, the larvae cannot settle and die before reaching maturity. Similarly, copepods, which also have the same food source, are exposed to similar bacterial infections. In order to test the effects of florfenicol on survivability of the copepods, tanks were lined with diatoms as the food source for the copepods and one tank was be exposed in 2ppm of florfenicol solution while the other in remained untreated. Once the diatoms had been treated with the antibiotics, the 50 copepods were put in the tanks. Although the initial number of copepods that were placed in the tanks was the same, the data collected shows that the significantly higher mortality rate in the untreated tank compared to the tanks exposed to antibiotics.

This may be due to the fact during the developmental stage of abalone settlement, the larvae cannot settle onto the substrate due to bacterial intervention and thus die before ever becoming a juvenile, making larval development in captivity very difficult. However, exposure to antibiotics can create a loss of essential bacteria in the

small intestine. Because the diatoms were treated with the florfenicol and the copepods were not directly exposed to the antibiotics, essential small intestine bacteria were not lost and subsequently, the copepods were able to occupy a healthier living environment, and thus the treated tank had a better survivability.

80

KAN, Carina
ZOOLOGY
2014

BEHAVIORAL PATTERNS AND ECOLOGICAL IMPACT OF OUTDOOR CATS AT WHITE POINT

Recent studies have indicated that the effects of outdoor cats (Felis catus) on bird populations are far more devastating than previously assumed. Abandoned cats often become part of larger cat colonies with varying levels of care and support from humans. The subsidization of these colonies often cause outdoor cats to exist at much higher densities than their natural predators, leading cats to predate many common and endangered species at an unsustainable rate. Unable to extract nutrients from plants and possessing a short digestive tract, cats are obligate carnivores and are adapted to a predatory lifestyle typified by several small meals a day. As opportunistic hunters which survive off a generalist diet, cats are extremely effective mesopredators.

Sustained by volunteer feeders, the colony of cats at Royal Palms Beach Park most likely exists at an abnormally high density relative to predator and prey populations, and may continue to hunt native birds and mammals even when fed and maintained properly. To determine the ecological impact of the colony on the park and the neighboring White Point Preserve, the cats were visually observed using an ethogram, and a camera trap study was conducted using Bushnell trail cameras to investigate the presence and activity of the cats in the area over a course of 4 months.

Locomotion was the single most reported behavior suggesting that these cats were frequently on the move, displaying much higher levels of activity than pet cats. Out of all the cats in the park area, only three were observed actively hunting birds, and only one bird kill was recorded during the entire study.

The several documented instances of predatory behavior support the fact that even well-fed cats instinctively hunt live prey. However, the low predation rate provides more evidence indicating that the more care provided to cats, the less likely they are to predate native species. In conclusion, the cats did have a significant ecological impact on the preserve, but exhibited a much lower level of predation than hypothesized.

81

LEE, Lauren
ZOOLOGY

THE SURVIVORSHIP OF HALIOTIS RUFESCENS ON VARIOUS FECAL MATTER SUBSTRATES

Although broodstock have provided sufficient amounts of gametes, larval and post-larval survival varies, affecting larval performance and causing high mortality rates. *Haliotis* rufescens, commonly known as red abalone, are herbivores; feeding on mainly various types of macroalgae.

The primary goal of experimentation was to conclude whether present bacteria in the fecal matter of several species of adult abalone would maximize the survivorship rate of red abalone larvae hatched from gametes produced by live broodstock. If proven successful, the same techniques can be applied to the endangered *Haliotis sorenseni,* or white abalone, larvae.

It was hypothesized that the bacteria from the red abalone fecal matter would deem most successful in maximizing larval growth at an early age. Bacteria in feces was hypothesized to maximize survivorship because of its ability to inoculate herbivores with suitable bacteria in their gut to properly digest the food sources introduced to the larvae at an early age. Thus, allowing larvae to digest foods and receive necessary nutrients to grow and survive.

Several types of fecal matter were used for experimentation including adult red abalone, white abalone and green abalone fecal matter; for conspecific purposes. For each trial, 800 red abalone larvae were counted and placed into 8 crystallizing dishes; 2 with one type of fecal matter and diatoms, with the exception of the control, which included only diatoms. At 168 hours, the settled red abalone larvae were counted individually. At 336 hours, the same settled larvae were counted to measure survivorship over a longer course of time. Each trial lasted one month and four trials were completed throughout the course of experimentation. Slight alterations were made after two trials, including the isolation of fecal matter in the center of the crystallizing dish to obtain conclusive results about abalone settlement patterns and survivorship rates.

The data collected shows no significance in terms of the correlation between time and survivorship of red abalone larvae. However, there was a very significant correlation between settlement patterns of larvae and the different substrates they were exposed to. Many of them appear to be settling in the crevices of the crystallizing dishes significantly more than any other location within the dish.

The results appear to be trending, however, more trials will be necessary to conclude whether a correlation between location of settlement and survivorship is significant.

82

MORI, RYAN
ZOOLOGY
2014

CORRELATING TIDE POOL HERMIT CRAB POPULATIONS WITH THE AMOUNT OF RAINFALL

This project was designed to determine if any correlation exists between *Pagurus sp.* in the tide pools, and the amount of rainfall. The project was founded from the initial question: How do tide pool animals that can travel over land react to rainfall? Hermit crabs were selected for observation because they can traverse land and are plentiful in the tide pools. Samplings provided a broader understanding of hermit crab behavior.

In order to obtain quantifiable data, a rain gauge was set up at the tide pools. A transect tape and random number generator were then used to create a random sampling of tide pools. The number of hermit crabs found in those tide pools was then recorded.

Observations showed that the total number of hermit crabs found in the tide pools increased or stayed the same in response to rain. The average number of crabs per pool was also higher in the post-rainfall trials. Also, in post-rain trials, hermit crabs were found in clusters in the deeper sections of the tide pools. This may have resulted from an uneven mixing of salt water and fresh water. The data indicates that hermit crabs prefer to remain in the tide pools, even when it is raining.

The knowledge gained from this project not only establishes a correlation between the hermit crab population and rainfall, but also helps to determine tide pool hermit crab behavior.

83

UETRECHT, Ethan
ZOOLOGY

PREY STRIKING LOCATION OF HEMISQUILLA ENSIGERA CALIFORNIENSIS

The mantis shrimp is well known for its ability to strike prey with devastating force. Repeated hits can break the shell or exoskeleton of snails and crabs, and although it strikes with so much force, its club does not break from the impact. This resilience has inspired researchers to apply the structure of the club to body armor for military applications. While the structure of the mantis shrimp's club-like appendage has been studied often, little research has been conducted on where the mantis shrimp targets its victim. The purpose of this project was to test whether the Mantis shrimp consistently targets the same location on its prey. This experiment is important because it could show that the mantis shrimp has an instinctive or learned ability to attack the weakest parts of an animal to prevent damage to itself while efficiently disabling that animal.

In this project, live shore crabs were introduced to the mantis shrimp *Hemisquilla ensigera californiensis*. A harness was designed to keep the crab within range of the mantis shrimp. Each session was recorded with a high speed video camera. The recordings were viewed frame-by-frame and each strike was analyzed to determine striking claw (left or right), and crab impact point (claw, body, or leg).

The experiment was conducted over the course of 9 sessions, each session lasting about one hour. The data shows that out of a total of 52 recorded hits, 50% of the hits were to the crab's claws. Handedness was also recorded and showed that the mantis shrimp struck with its right club twice as often as with its left.

These interesting results suggest that the mantis shrimp may have a preference for striking its prey in a specific location. The mantis shrimp may be selectively targeting its prey in certain locations to optimize the power of the strike, disable its prey, and prevent damage to itself. Studying handedness in the mantis shrimp could possibly provide additional insight into the organization of its brain. More studies should be conducted to further contribute to understanding this intriguing animal.

84

UETRECHT, Madison
ZOOLOGY
2014

The Effects of Melanin on Resistance to Bleaching in Anthopleura elegantissima

Global warming is causing ocean temperatures to rise. This temperature increase can cause anthozoans such as anemones to expel their endosymbiotic algae in a process called bleaching, which is detrimental to their health. Melanin plays an important role in anthozoan immune systems and may limit bleaching. Melanin is a major component of squid ink. The purpose of this project was to test whether consumption of melanin-rich squid ink affects bleaching resistance in anemones.

This project compares two groups of the anemone Anthopleura elegantissima. The experimental group was fed brine shrimp that were enriched with squid ink. This group was compared to the control group, which was fed unenriched brine shrimp. In the middle of the experiment, temperatures in one tank from each group were increased to simulate rising ocean temperatures. Analyses of chlorophyll content in the anemones' tentacles were used to determine the amounts of symbiotic algae in their tissues, an indicator of bleaching.

The results show that there was no significant difference in chlorophyll content between the control and experimental groups. However, the anemones in the warmer tanks had significantly more chlorophyll than those in the colder tanks. These unexpected results may be due to the very small sample sizes. This experiment should be repeated with larger sample sizes to increase accuracy of the results.

Continuing this project could provide information about anthozoan immune systems, help scientists better understand coral reef ecology, and contribute to finding a potential solution to the widespread problem of thermal coral bleaching.

85

WANG, Lucy
ZOOLOGY
2014

The Effect of Theobromine on Drosophila Melanogaster Lifespan

Theobromine (C7H8N4O2) is an alkaloid extracted from the cacao plant. Like caffeine, Theobromine has diuretic and stimulant properties. The objective of this experiment was to investigate the effect of Theobromine on Drosophila Melanogaster's lifespan. Because there are many biological properties shared by Drosophila M. and humans, Theobromine may affect the human lifespan the same way it affects that of fruit flies.

In experimentation, five different concentrations of Theobromine were mixed into the *4-24 Instant Drosophila Medium*. Two vials were made for each concentration; one for males, and the other for females. Five fruit flies of the same gender were put into each vial the day that they reached adult stage. The controlled group consisted of fruit flies which consumed the medium alone. In total, 12 vials were used. Dates and observations were then recorded for the purpose of finding a possible trend for the lifespan of fruit flies that consumed medium with varying amounts of Theobromine.

The average lifespan of Drosophila M. inside the vial which contained a 0.05% Theobromine solution was found to have lower mortality rate than the controlled group. For the other vials, the lifespan of Drosophila M. decreased as the concentration of Theobromine increased.

The results of experimentation show that Theobromine reduces the lifespan of Drosophila Melanogaster. The only exception was the 0.05% Theobromine concentration, which was beneficial to Drosophila M. in terms of lifespan. In conclusion, the amount of Theobromine consumption has an inverse relationship with the lifespan of Drosophila M.

86

WILL, Isabella
Zoology
2014

Effects of Disrupting Surface Tension on *Melibe Leonina* Hatching Rates

The *Melibe leonina*, a member of the nudibranch family and often referred to by its less glamorous name the sea slug, forms a vital part of the kelp bed ecosystem on the west coast of North America. The *Melibe leonina* is often studied to better understand the neural sciences. Yet attempts to reproduce the *Melibe leonina* has been challenging due to a variety of reasons including hydrophobia and surface tension. Developing consistent procedures for reproducing *Melibe leonina* is an important first step to performing studies of these invertebrates in a laboratory environment. This project will investigate the effects of different methods to disrupt surface tension on *Melibe leonina* hatching rates. The hypothesis is that using a paddle method to disrupt the surface tension would maximize the hatch rate.

Egg masses were collected from the Nudibranch Exhibit at Cabrillo Marine Aquarium. The egg masses were flushed with micro-filtered water, examined for fertilization, and placed into sanitized beakers containing micro-filtered water. The methods used to affect surface tension in the beakers were the rack system (paddle group), airlift-droplet stirrer (drip group), and air group. The control group consisted of beakers in which the surface remained undisturbed. To determine the hatch rate of the Melibe leonina, 3 random samples were taken from each beaker and hatched shells were counted under a dissecting microscope then averaged.

An analysis of the results revealed that the data was not statistically significant. However the averages of the raw data would suggest that the paddle group and the air group had the highest hatch rates while the drip and the controlled had the lowest. But as mentioned, the variability of the data was extreme in all the methods studied.

In conclusion, the results do not reject nor support the hypothesis. Although one can conclude that surface tension statistically does not affect the hatch rate, the extreme variability of the data would suggest that other factors

were violating the stability of the environment. Namely, numerous parasites were observed consuming the remaining egg masses while under examination. Future experiments should evaluate the removal of the parasitic threat, or eliminate the magnitude of its effect to arrive at more stable results.

87

WU, Tiffany
ZOOLOGY
2014

The Effect of Changing Wavelengths of Light on Pigeon Cognition

Pigeons are one of the smartest birds—if not creatures—on the entire planet. What truly sets them apart from the rest of the animal kingdom is their ability to find their way home from hundreds, sometimes thousands of miles away. They also are pentachromatic, meaning that they have five color receptors in their retinas, compared to three for humans. The two extra receptors that allow them to see unique hues are hypothesized to play a role in their internal navigation. This project attempts to determine whether altering the interior color of a maze has any effect on a pigeon's ability to navigate it.

In this study, an eight-armed radial maze was used to test three pigeons. Four different LED lights were tested—red light (650 nm), indigo light (445 nm), green light (510 nm) and indoor lighting (560 nm) as the control. The overall maze completion time for each pigeon/variable was then averaged and compared. From start to finish, the total experimentation time lasted about six weeks.

Results showed that red light had the most significant effect on the pigeons' run times, slowing them down by approximately 33% compared to the control. This was followed by indigo and green light, both which slowed the birds' times by around 12%.

The data illustrates how different wavelengths of light may produce an adverse effect on the speed at which the pigeons can navigate a maze. By demonstrating to what extent sounds affect the cognitive ability of pigeons, more awareness can be gained on how pigeons capitalize on their environment to travel.

88

Zhu, Andrew
ZOOLOGY
2014

MOSQUITO FISH EFFICIENCY AT REGULATING MOSQUITO POPULATION GROWTH

Mosquitoes have become a major problem for many countries worldwide, causing numerous diseases, that all have the potential to kill. In this lab report, the problem tested was "how efficient are mosquito fish at regulating mosquito larvae population growth compared to other hardy freshwater fish". Based on given facts, mosquito fish have a specialized jaw, perfect for consuming mosquito larvae, thus, allowing the hypothesis that mosquito fish would be more efficient in the regulation of mosquito larvae in comparison to other fish.

To begin experimentation, five minnows and five mosquito fish were placed in two separate tanks, and each given five mosquito larvae. Every ten minutes, the remaining larvae were accounted for and recorded.

Findings from this experiment showed that mosquito fish were slightly more efficient compared to the red rosy minnows. However, the mosquito fish's and minnow's efficiency outcome were very similar, with a relatively small difference.

After analyzing the data, there was a small difference between the efficiency of the two types of fish, but not enough to properly conclude the hypothesis because of possible errors included within the environment. However, because mosquito fish were found to have a slightly higher efficiency, the hypothesis is accepted, though further testing is needed.