ABSTRACTS 2009/2010

BEHAVIORAL AND SOCIAL SCIENCES

5
HUANG, Eva
Behavioral & Social Sciences
2009/2010

HOW MUCH TRUST DO PEOPLE PLACE IN OTHERS?

People who are trusting place confidence in others. This project aims to determine if people will let trust, an essential feature of social life, consume all other feelings and emotions and subsequently let their guard down. In order to find out the amount of trust people will initially and instantaneously place in others, sixty random people ranging from grade levels 9 to 12 were instructed to take a test consisting of twenty various pictures, symbols, or questions. Without being able to see any of the pictures, symbols, or questions beforehand, the test takers were instructed to say the first thing that came to their minds when the picture was flashed before their eyes. The test takers were encouraged not to think about the picture in front of them and to voice their initial reactions out loud. A total of four sets of five pictures, each set was supposed to grow progressively controversial as the first set contained generalized and easily recognizable pictures and the fourth set contained private and personal questions. After the test, test takers were then asked to take a short answer survey asking them to reflect back on the experiment. Interestingly, the hypothesis was disproved. People hesitated longer in answering thought-provoking questions rather than to controversial pictures. It can be concluded that people do tend to place confidence in others although how much is dependent on several factors, such as who administered the test and who was listening in.

10-2
TAVAKOL, Delana
Behavioral Science, 2009/2010

EFFECTS OF DIFFERENT TYPES OF MUSIC ON ATTENTION TO TASK

A popular side-task with doing homework for many modern-day students is listening to music. This experiment tested common favorites to determine the effect of music from different time periods and genres on focus to task and accuracy of male and female students.

A 9th grade biology honors class in Palos Verdes Peninsula High School was given two quizzes. Each quiz contained fifteen questions covering almost identical topics. The first quiz was taken with one jazz and one rock piece both from the 20th century. The number of times an individual from the male or female group lost focus, a tally would be marked by one of the two people keeping tally. After completion of the quizzes and songs, the students were given a fifteen-minute break to return to the mindset of when they began the first quiz. After the break, a second quiz was taken with one rock piece and one jazz piece both from the 21st century. The same procedure that was used with the first quiz was applied to the second.

It was originally hypothesized that the male and female results would be equal, and that the century that the song was made in would not be an important factor. The results, however, discovered that females have a far greater ability to concentrate than males. Male students responded with greater distractions to rock music than jazz, but the century of the piece did not affect them. Female students responded equally to both of the jazz selections, but had far greater a number of distractions with the 21st century rock piece than the 20th century rock piece. In terms of accuracy, both genders responded equally. The accuracy when played 20th century music was far higher than the accuracy when played 21st century.

The final results proved that gender, genre, and time period are all strong factors when a student works and listens to music simultaneously.

BIOCHEMISTRY

11
Michele Chan
Biochemistry 2009/2010

FABRICATION OF A BIODEGRADABLE MEMBRANEFOR WOUND REPAIR

The main concern of a medical membrane is whether or not it can help and enhance the healing of the damaged tissue, preventing inflammation, and easy removal and disposal if the membrane is not biodegradable. A biodegradable membrane can fulfill all the needs mentioned above. However, forming an ideal device for an internal wound can be difficult, as the membrane with the desired properties cannot be formed easily. Many combinations of different chemical and biological materials can be used in the trial to see which would form an effective membrane. Indeed, there are many potential experiments and applications around the capabilities of synthetic biodegradable polymers and the effect they might have on the designs and functions of implanted devices.

The basic research question is which biological and chemical substance will form the most ideal membrane? In the experiment, the materials are separately grouped into biologically derived substances and synthetic chemical substances. Then these materials were studied according to their ratio with a second material in forming a blend of the mixtures. The different mixtures are then casted into thin membranes by utilizing a Doctor's blade. Afterwards, different film preparations were carried out multiple times and the end products studied.

It was concluded that the most successful membrane formed in these trials was the one prepared with the combination of the natural substance, Aloe Vera, and the synthetic polymer, polyvinyl alcohol because the film was smooth, uniform and also was able to withstand mechanical force like tearing. Therefore, this membrane would have both healing properties, just like the natural Aloe Vera and also effective as a membrane. We conclude that the polyvinyl alcohol mixture with the plant material Aloe Vera would form the most ideal biodegradable membrane in this study.

The current trend indicates that degradable devices will replace some permanent implants in the near future. Therefore, the study and research of the synthetic degradable polymers is an important task in the medical device field to allow the wide use of synthetic degradable polymers to impact on the performance of a range of existing medical implants. Incorporation of Aloe Vera can enhance the healing effects if integrated into the device. Eventually, synthetic degradable polymers may become the sole material for the manufacture of certain medical implants, and the fabrication of a medical device for wound repair and surgery becomes beneficial to save human life.

15
KIM, Hyunjean
BIOCHEMISTRY 2009/2010

UNVEILING THE SECRET OF THE MEIBOMIAN GLAND BY RAMAN MICROSPECTROSCOPY

The purpose of this project was to determine the chemical composition of the Meibomian gland by Raman Microspectroscopy. Meibomian glands, located in the eyelid, are responsible for secreting a lipid that forms the outermost layer of the eyeball and keeps it moist. However, as the gland ages, it tends to dysfunction, causing the annoyance of dry eyes. In order to determine why people get dry eyes, it is essential to understand the structure of the Meibomian gland. Raman spectroscopy is used to obtain more detailed and direct information about the chemical functional groups and structure of the compound, unique to this method.

The Raman spectra of 2-month and 24-month old Meibomian glands of mice were taken. Then the spectra of various chemical esters were taken. Finally, the spectra of the chemicals were compared with those of the glands to determine the ratio of wax to cholesteryl.

It was found that the glands have a higher percentage of wax esters (about 70%) than cholesteryl esters (about 30%) due a peak around the 2860 cm-1 Raman shift region. Also, the spectra of the duct remained the same between 2 months and 24 months, while the intensity of the acini increased, which showed an increase in cholesteryl esters.

The aging effect was not quite ascertained by Raman Spectroscopy, but the ratio of wax to choletseryl esters was found. The increase in cholesteryl esters of the acini with age may indicate a possible reason for the dysfunction of the gland.

16
Lyberger, Kelsey
Biochemistry 2009/2010

MECHANISM OF PEROXISOME PROLIFERATOR-ACTIVATED RECEPTOR GAMMA (PPAR-g)- MEDIATED APOPTOSIS IN PLACENTA OF UNDERNOURISHED DAMS

Maternal food restriction (MFR) during pregnancy leads to intrauterine growth restricted (IUGR) fetuses that have a higher risk of adult obesity, hypertension and diabetes. Notably, increased placental apoptosis has been associated with IUGR. The mechanism may involve peroxisome proliferator-activated receptor gamma (PPARγ), which is an anti-apoptotic transcription factor that mediates cellular proliferation and differentiation. Therefore, this study investigates the impact of MFR on placental apoptosis and PPARγ expression. This research is focused on the two placental positions (proximal horn and mid-horn) as the extremes of the nutrient/oxygen supply, and the two distinct placental zones (basal, the site of hormone production; and labyrinth, the site of feto-maternal exchange).

Pregnant rat dams were fed an ad libitum diet (Ad Lib) or were 50% MFR beginning at E10 of gestation. At E20, fetal and maternal placentas were collected. Placentas from left proximal and mid-horns were separated into basal and labyrinth zones and used for TUNEL staining. The corresponding right proximal and mid-horn placentas were analyzed for zone and region specific expression of PPARγ (Western blot). Immunostaining was done for caspase-3 and the relative percentage was calculated.

The results showed that maternal body weight as well as fetal weight was significantly reduced in the MFR as compared to the AdLib dams. In both proximal horn and mid-horn placentas, the weights of MFR basal and labyrinth zones were significantly decreased compared to their respective AdLib placental zones. Also, in both proximal horn and mid-horn placentas, apoptosis and caspase-3, a pro-apoptotic marker, were significantly increased, while PPARγ protein decreased in the MFR basal and labyrinth zones as compared to their respective AdLib placental zones.

Therefore, MFR may have a negative impact on the development and function of the placenta with subsequent effect on the fetus. Further, MFR induced placental apoptosis may, in part, be mediated by PPARγ.

19
Sinow, Carolyn
Biochemistry 2009/2010

IN VITRO ANALYSIS OF A SYNTHETIC PROTEIN: A MODEL FOR ENZYME REPLACEMENT THERAPY

Mucopolysaccharidosis IIIB (MPS-IIIB), also known as Sanfilippo B Syndrome, is a genetic disorder resulting from a deficiency of the enzyme α-N-Acetylglucosaminidase (NAGLU). Previous studies have shown synthetic NAGLU is not effective treatment because of poor cell uptake. Attaching an Insulin-like growth factor-2 (IGF2) tag to synthetic NAGLU may allow the enzyme to enter cells using the mannose-6-phosphate receptor. My previous research showed that attaching the IGF2 tag directly to NAGLU causes incorrect folding of NAGLU. In my current project, a glycine-serine linker is used to attach the IGF2 tag to NAGLU to overcome this problem. My goal was to use recombinant DNA techniques to create a functional NAGLU-IGF2 fusion protein for preclinical testing.

The cDNA sequence for NAGLU with a glycine-serine linker attaching the IGF2 tag was cloned into expression vector *pCI-Neo* to create plasmid *pNagGScIGF*. *pNagGScIGF* was amplified using *E. coli* cells. Plasmids were extracted from *E. coli* and screened by restriction enzyme digestion and agarose gel electrophoresis. DNA sequencing verified correct construction of *pNagGScIGF*.

pNagGScIGF was transfected into Chinese hamster ovary (CHO) cells to express the modified NAGLU-IGF2. CHO cells producing NAGLU-IGF2 were subcloned. Western blots and NAGLU activity assays confirm that NAGLU-IGF2 was successfully produced and secreted into the growth media with enzymatic activity. NAGLU-IGF2 was collected from the culture media and purified using concanavalin A and c-myc affinity columns, sequentially. The purity of NAGLU-IGF2 increased 140 fold in the chromatographic procedures. NAGLU-IGF2 was applied to human MPS-IIIB fibroblasts, and uptake assays revealed that NAGLU-IGF2 is successfully entering cells.

CHEMISTRY

31
FAROOQ, Summer
CHEMISTRY 2010

Water Quality at High Tide and Low Tide at Cabrillo Beach and White Point

This project is an experiment that compares and contrasts three different variables including salinity, pH, and ammonia levels at the Cabrillo Beach and White Point tide pools at both high tide and low tide. Comparing the water quality at high tide versus low tide and at the two different tide pools leads to a better understanding of the oceanic environment.

Water samples were taken from the Cabrillo Beach and White Point tide pools at high tide and low tide. Three different trials were taken, with twelve samples total excluding the "control" which was the distilled water. The water was cleansed to rid of any organisms not visible to the human eye and then used to test for salinity by using a refractor and the pH and ammonia levels by using a colorimeter.

The data reveals the salinity levels are unaffected by changes in tide or location of the tide pools. The ammonia levels are nonexistent at high tide but vary at low tide. The variation in ammonia levels was caused by the abundant amount of rain received in January and February of 2010. The pH levels were basic, rather than acidic.

In conclusion, the levels of ammonia were higher at low tide than high tide, but generally the same at Cabrillo and White Point. The salinity did not change from tide pool to tide pool or from tide to tide. The pH levels were generally higher at White Point at both high tide and low tide.

33
HONG, Kimberly
Environmental Science 2009/2010

NANOPARTICULATE FOULING OF POLYPROPYLENE MICROFILTRATION MEMBRANES BY CLARIFIED SECONDARY TREATED WASTEWATER AND RIVER WATER

This project was conducted in order to analyze the flux rates of Nanoparticulate fouling of microfiltration membranes in two different types of feedwater: clarified secondary treated wastewater and Santa Ana River water. The initial idea was to conduct an experiment working with different types of nanoparticles, such as silver and gold nanoparticles. Some further research led to the formulation of analyzing flux rates of different types of feedwater by using fluorescent nanobeads instead of actual nanoparticles.

Flux rate was determined by mimicking a microfiltration set-up. First, water samples were collected from clarified secondary treated wastewater from Orange County Sanitation District and Santa Ana River. Then, a mimic microfiltration was set up, consisting of a vacuum pump, a 4 place electronic balance, and a computer that grammatically collected flow data with an acquisition program. A microfiltration test cell was prepared using several 20-cm long tubes of 0.2μm nominal size polypropylene membrane tubes. Next, base flow of deionized water was measured for 3 minutes. (A base flow rate with

deionized water was done before each flux rate measurement with the feedwater.) Next, the deionized water was spiked with Fluospheres® carboxylate-modified microsphes 0.1 μm, orange fluorescent (540/560) nanobeads using a pipet. Each flow rate was measured two times each. After, each feedwater was spiked with the same nanobeads, and the flow rate, which lasted for 22 minutes, was measured two times each. Finally, at the end of each flow rate experiment, the fiber was frozen and cross sectioned for microscopic observation and photos.

Clarified secondary treated wastewater fouled more quickly (its flow rate decreased more rapidly) than Santa Ana River water. By comparing the two different types of feedwater' flux rates, the flux rate at 15.08 minutes of the clarified secondary treated wastewater already had 10.02% average flux rate while the Santa Ana River water had 28.68% average flux rate.

The contributions of this project were beneficial. It is seen that clarified secondary treated wastewater fouled more quickly than Santa Ana River water, a realization that further study of nanoparticles and their effect in different feedwater should be conducted.

34
Hsieh, Emmelyn
Chemistry 2009/2010

Determining D-Glucose and D-Fructose in Beverages via Enzymatic Assays

An experiment has been conducted to measure the amounts of sugar in various soft drinks using glucose, sucrose, and fructose enzymatic assays. This project has been designed to examine the discrepancies between various methods of measuring carbohydrate levels.

The glucose and sucrose assays were based on enzymatic reactions that convert the sugars and form NADH as a byproduct. The assays were colorimetric assays, in which absorbance of NADH at 340 nm was linearly dependent to the glucose or sucrose concentration in the measured sample well. Fructose assays were based on enzymatic reactions that produce MTT formazan. The MTT formazan was observed spectrophotometrically at 570 nm, and linearly proportional to the concentration of assayed fructose.

The experimental results provided two significant findings. First, the concentrations of fructose, glucose and sucrose were noticeably lower than the listed carbohydrate levels in the soda samples' nutrition facts. Second, the enzymatic assays were greatly affected by sample pH, temperature, and reaction time. These limitations resulted in the lack of both accuracy and precision of the enzymatic assays for determining the sugar concentrations in each of the soda samples.

Based on the findings above, it was determined highly unlikely for soda companies to use enzymatic assays to report the sugar concentrations in their distributed consumer beverages. Instead it was inferred that the soda companies most likely use chromatographic methods such as liquid chromatography and gas chromatography that provide higher sensitivity, specificity, and reproducibility.

37
Lowe, Patrick and Emily
Chemistry, 2009/2010

THE FEASIBILITY OF GASIFICATION OF BAMBUSA OLDHAMINI INTO BIOFUEL

Our present society is based on an infrastructure dependant on fossil fuels, a finite source of energy. The technology does not exist to sustain our current infrastructure without a radical social change. Until technology improves, biofuels are our best option. While algae and other crops have a high potential yield these methods require specialized equipment and procedures. For developing countries a different source is needed one that is plentiful, easy to convert, and does not require much precious water resources. Bamboo is a perfect example. Bambusa Oldhamini is the fastest growing plant in the world and is copiously abundant in Asia. It is also a hardy plant that can grow under a wide range of conditions in many places. The gasification process, which does not require specialized equipment, is a sustainable and dependable method for converting biomass into biofuels. Paired with gasification, Bambusa Oldhamini would make a good source of biofuel for developing countries especially in Asia. Culms of Bambusa

Oldhamini were cut into smaller pieces to be put in the gasification chamber. The gasification chamber was heated via a hotplate to ensure precise and accurate temperatures. In practical use the gasification chamber would be heated by bamboo charcoal, which is a byproduct from gasification. Vapors were collected in a condenser and the condensed liquid was collected in flasks. After the distillate was filtered Infrared Resonance, Nuclear Magnetic Resonance, and PH tests were run on the samples to determine their chemical makeup.

Infrared Resonance tests resulted in wave numbers indicating absorption around the 3300-3500 and 1648 cm^{-1} mark. Other various curves were determined to be background. The 3300-3500 wave numbers were surmised to be an indicator of an OH group later determined to be not indicative of an alcohol, and the 1648 wave numbers were inferred to be a carbonyl group.

Nuclear Magnetic Resonance tests resulted in an indication of no alcohol present.

PH tests resulted in a pH of 4.

We concluded that biofuel from Bambusa Oldhamin by way of gasification was unfeasible.

COMPUTER SCIENCE

39
KASPEROVICH, Alexander
Computer Science 2009/2010

A Study of the Capabilities of Virtually Parallel Machines

The purpose of my project was to determine whether the Isopod controller board is capable of running three or four processes that are dependent or independent of each other without any of them impeding one another, and also to consider the applications of such capabilities. The idea for this project initially came from seeing an advertisement for the isopod online, and not understanding what was meant by 'virtually parallel machines.'

The testing of the capabilities was accomplished through first, achieving an understanding of the programming language used (Isomax, derived from FORTH), then, programming multiple machines that would burden the processor and create outputs that are either dependent on or independent of each other. Miscellaneous materials other than the controller board were also needed, such as servos, LEDs, and buttons: things to facilitate the external control and measuring of the performance of the machines.

There was no significant variation shown in the performance of the machines after additional loads were added on the processor. The variations that did occur over the course of the three trials showed no specific trends, so it is safe to assume that they were caused by errors in measuring the outputs.

It is possible to conclude from this that the Isopod controller board is capable of running machines in a parallel manner, as increased loads on the processor created no significant difference in run times. As thus, it can said that the capabilities op this controller board will be immensely beneficial in robotics, as the processes run on th processor have no negative effects on each oth

40
Kelley, Sean
Computer Science
2009/2010

MODELING EUROPEAN HAPLOGROUP INTERACTION WITH APPLICATION TO AGRICULTURE

Quantifying how humans moved into Europe has allowed for the determination of which haplogroup brought agriculture to Europe. Previous experiments have been unable to determine this. The objective was to determine which haplogroup either R1b or J2 carried agriculture into Europe and if the haplogroup that brought agriculture to Europe had any genetic advantage over other haplogroups.

Haplogroup frequencies were found for 18 haplgroups in 125 geographic locations throughout Europe. Combined this information the genetic variance of haplogroup R1b was used because it did not

follow the diffusion process that all other haplogroups exhibit. To make this determination a computer simulation was developed which created individuals. These individuals were given a realistic life cycle, and given membership in a particular haplogroup. Each geographic location was a given a time when agriculture arrived at that location which was gathered from other studies which used archeological information. The interaction table gave two estimates one of the amount of interaction between groups and the other when certain groups arrived at locations.

A comparison of the arrival of various groups to the geographic locations to that of the arrival of agriculture was made. By then comparing which haplogroups migration most closely followed the time and geographic spread it was possible to then say which group brought agriculture to Europe. It was determined that agriculture most likely arrived in Europe via the R1b group instead of the commonly thought J2 haplogroup. The simulation showed that R1b was able to closely match the pattern of frequency and geographic distribution which indicated a genetic advantage must be present. With regards to the J2 haplogroup, the simulation was unable to match the pattern of frequency distribution even with a genetic advantage.

42
LOW, Melvin
Computer Science 2009/2010

UTILIZING COMPUTER VISION IN RED LIGHT TRAFFIC CAMERAS

Current red light camera (RLC) systems, used to detect vehicles which have run a red light, are inaccurate and often make mistakes. Some of the more common errors include ticketing the wrong vehicle, and missing the offending vehicles completely. The purpose and engineering goal of this project is to create a program which can assist the RLC systems and law enforcement personnel in order to reduce the frequency of these mistakes.

The developed program must accomplish two tasks: detecting the vehicles in a given RLC photograph, and then determining which of the detected vehicles are in a given intersection. These vehicles are presumed to have run a red light, since the RLC only takes photographs during a red light. In order to accomplish the two aforementioned tasks, the program has two separate parts, one for each task. The first part uses Ivan Laptev's object detection algorithm to detect the vehicles in the photograph. The second part uses the ray-casting and winding number algorithms in order to determine whether or not the detected vehicles are in a given intersection.

The final program succeeded on some levels but failed on others. The program failed to detect all of the vehicles in the test photographs, and sometimes detected objects which were not vehicles. However, of the successfully detected vehicles, the program was able to determine with 100% accuracy whether or not they were in the given intersection.

The problems that this program faces do not carry as heavy a weight because the program was developed only to be an assistant to, and not a replacement for, current RLC technologies. In addition, as object detection algorithms become more rigorous, the program will only become more accurate in detecting the vehicles in any given photograph. Thus, the engineering goal of this project was met.

45
RAJEWSKI, Justin
COMPUTER SCIENCE 2009/2010

UTILIZING ARTIFICIAL NEURAL NETWORKS TO CREATE A LEARNING ROBOT

As artificial intelligence continues to improve, artificial neural networks (ANN) are on the cutting edge. An ANN simulates a biological neural network using a mathematical model. The network consists of interconnected neurons. The problem with ANNs is that while they are able to find patters in a set of data, they need a set of data to be trained on before they are useful. In the real world the data is not always available.

To create a robot that is able to learn using ANN an algorithm for generating a set of inputs and corresponding outputs had to be created. By creating a robot that is able to detect collisions and measure the distance of objects in front of it, an algorithm that is capable of generating a set of inputs and corresponding desired outputs could be tested.

By using a trial and error based algorithm the robot was able to acquire a set of data that it could train the ANN with. The training set is added to every time the robot makes a mistake and collides with a wall. The trial and error algorithm tries to find a solution to the error and uses that to prevent the robot from making similar mistakes. This approach to training and running an artificial neural network has many applications beyond this simple robot.

46
ZHANG, Andrew
Computer Science, 2009-2010

COMPUTER MODELING OF ATMOSPHERIC ADVECTION TRANSPORT

Atmospheric material advection is the movement of particles, such as pollution, in the air and is an important factor of weather. Because of the increasing amount of pollution in the air, the particles affect weather patterns. To help the research of the atmosphere, accurate measurements of the particles must be calculated.

A computer simulation of material advection was created to calculate the transport of particles. An upwind numerical method is used to make the program for simulating material transport. For one integration, the material shifts according to the wind velocity and the Courant-Friedrichs-Lewy condition. The data can be plotted with visualization software and analyzed. Different data sets can be used to check the accuracy of the material advection implementation program. The time used for the simulation is also calculated to see whether it is computationally efficient.

The simulation gave mostly accurate results, and was computationally efficient. As the number of integrations the program ran increased, the accuracy increased, but the time also increased. The one dimensional simulations were more accurate and efficient than the two dimensional simulations.

Predicting the transport of pollution would definitely benefit the world by allowing weather calculations to be more accurate. Because material transport affects meteorological models, an accurate scheme for advection would improve accuracy for other weather research.

EARTH AND SPACE SCIENCE

50
LIN, Jacqueline
Earth & Space Science 2009/2010

THE EFFECTS OF 2009 PORTUGUESE BEND BRUSH FIRE ON SOIL

Southern California has frequent brush fires that change the chemical composition of soil. My project's focus was to determine the effects of the surface burn on soil.

Three months after the fire, three pits were dug, labeled by burned vs. non-burned, native vs. nonnative (vegetation). The levels of soil pH, nitrogen, potassium, phosphorus were obtained using a testing kit. The drainage was found by a drip test. The structure and texture were determined by a ribbon test. Color change was recorded using a Munsell Soil Chart. Other observations on physical characteristics were also recorded.

Some of the tests did not show considerable differences, for the levels of pH, nitrogen, potassium, and texture were all relatively similar in all pits. However, the levels of potassium were significantly higher in the burned sites in comparison to the non-burned sites. In addition, the times of absorption of the drip tests also increased in the burned sites due to the formation of the hydrophobic layer. At the topsoil, the burned pits had darker colors and angular blocky structure.

The increased levels of potassium indicate that cations were released, which is consistent with post-fire soil nutrient recycling. On the other hand, the hydrophobic layer signifies less available water for plants, and therefore decreased vegetation growth. The overall consensus reveals that the tests follow the general structure of combustion on soil.

ENGINEERING

53
AU, Kristin; HARA, Ellie
Engineering, 2009/2010

CONSTRUCTING A PIEZOELECTRIC WIND TURBINE TO POWER A LIGHT EMITTING DIODE

Piezoelectric materials, when mechanically stressed, have the ability to generate electricity. In this project a vertical axis wind turbine of the Savonius type was built to generate electricity via the piezoelectric effect in thin polymer films of polyvinylidene diflouride (PVDF).

The rotor of the turbine was constructed from a plastic spool internally fitted with vanes made of a thin plastic sheet shaped into opposing air scoops. The rotor was mounted on the shaft of a motor whose armature and windings were intact and mounted to the motor case with low friction thrust bearings. The bearings provided a convenient low friction turbine rotor mounting structure and the armature windings allowed for direct comparisons of piezoelectric to conventional electromagnetic energy generation.

A strong wind (>15 mph) bent the piezoelectric PVDF film fastened to one vane of the turbine alternately back and forth as the rotor revolved in the wind stream. This generated an alternating current originating from the electrodes of the piezoelectric element. Rotating electrical feedthroughs were used to extract an alternating current (AC) which was then converted to a direct current (DC) via a bridge rectifier and subsequently used to charge a capacitor. When fully charged, the capacitor was shorted through a bank of light emitting diodes (LEDs) which flashed brightly verifying that the wind energy harvested from the PVDF was successfully stored. The charging rate of the capacitor and its dependence on wind velocity and the design of the energy harvesting electric circuit were also measured.

The piezoelectric film was able to generate enough electricity to power the LEDs. Although electricity was obtained, the film was shown to slow down the rotation rate of the wind turbine. In general, the piezoelectric films are not nearly as efficient as a conventional wind turbine but may prove to be useful in certain situations.

55
COULTER, Brennan
Engineering 2009/2010

THE POTENTIAL FOR "TREE BASED" OILS AS A SUBSTITUTE FOR DIESEL FUEL

This research investigates the potential for tree based oils as a substitute for diesel fuel. Prior research considered the use of oils such as peanut, canola, and soybean which were found to run well in a diesel engine. A major drawback, however, was uncovered. The yearly production per acre of oil is less than the diesel required to plant, tend and harvest the crop (Fine). There is a net negative energy contribution which destroys the environmental benefits and the economics of the fuel. For an oil to be a viable substitute for diesel, it must provide comparative performance in terms of miles per gallon, demonstrate a positive net energy gain, reduce carbon emissions and have economics on a cost per mile basis equal to or better than diesel fuel. The oil must also be scalable in order to have an impact.

Oils from trees such as palm, coconut, avocado, castor and jojoba tend to be much heavier oils. The fatty acid molecules are longer and, as a result, the viscosity of these oils can overwhelm the fuel system of a vehicle. These oils tend to turn solid at much higher temperatures with coconut and palm oils being solid at 70 F. Thus the properties of these oils, their viscosity and ability to flow in the fuel system of a car, are

major concerns. The advantage of the tree oils, is that unlike crops that are planted and harvested each year, the oils from trees require much less fuel to plant, grow, and harvest the crops. Yearly yields of oil per acre are much higher with for example, avocados, producing 282 gal/acre/year while using only 30 gallons of fuel to grow and harvest. Soybeans produce 48 gallons/acre/year and require roughly 140 gallons of diesel: a net negative energy contribution. Tree oils also offer the advantage of being able to use the surrounding land to feed grazing animals or to grow other crops.

In this research, the properties of following five tree oils and five diesel blends were studied for their properties as a fuel: viscosity; cloud point, melting point, density, and blendability with diesel. From this assessment palm, castor, and jojoba oils were eliminated as candidates leaving avocado, a blend of avocado and diesel, and a blend of coconut and diesel as possible fuels.

The fuels that could be run in the test vehicle, a converted 1987 Mercedes 300TD, were evaluated for miles per gallon performance on a test course of 11.4 miles. The fuel consumed in each of the four to five runs was measured in grams and converted to gallons. The testing showed a baseline performance of Diesel of 27.0 mpg, followed closely by Jojoba at 25.5 mpg, Castor at 24.7 mpg, and Avocado at 24.3 mpg(all within the expected ranges). The blended fuels (85% diesel) were also tested with results landing between diesel and the pure tree oil. The avocado oil emerged as having the best overall properties as a fuel with the best blending characteristics. The other tree oils were eliminated for a variety of reasons.

Avocado oil is viable only if it can be sourced at a cost delivering a cost per miles equal to or better than diesel and can be scaled to produce 6 billion gallons. Based on an economic model for the production of avocados, a delivered cost of $1.74/gal to Houston was estimated which is below the threshold $1.82/gal to be equivalent to diesel. Tax credits of $1.00/gal for the oil make the economics more favorable. To produce 6.0 billion gallons of avocado oil, it was determined that 14.2 million acres would need to be planted. A United Nations study shows that countries in Central America and the Caribbean have a total of 73.6 million acres of unplanted crop land that is viable for this purpose. Avocado oil has been found to meet all the criteria to qualify as a viable substitute for diesel fuel and may provide the US consumer a savings of $0.05 per gallon; a first for an environmentally friendly bio-fuel.

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FINE Erica & SIDHU Sonya
Engineering 2009/2010

The Potential for Vegetable Oil Based Fuels as a Substitute for Diesel

Compare the trade-offs in performance between petroleum based Diesel and Vegetable Oil based fuels in Diesel Engines in terms of Emissions (CO2; CO; NOx; Hydrocarbons), Carbon Footprint, and Miles per gallon and Economics. Test the performance of different Fuels in our converted Mercedes Research Vehicle: Vegetable Oil (Soy, Canola, Peanut, Corn); Waste Vegetable Oil (Soy); Bio-Diesel; and Diesel. Evaluate the potential for Vegetable Oil based fuels to play a greater role in our Energy Economy.

We converted a 1987 Mercedes diesel to run on a variety of fuels. A special test tank, fuel pump and heat exchangers were installed. Each fuel was tested on an 11.4 mile test course and the MPG determined. Each fuel was also tested for emissions using calibrated smog equipment.

In terms of emissions, vegetable-oil based fuels were clearly superior over diesel in its impact on greenhouse gases (CO2), but did show higher levels of nitrous oxides (NOx) and hydrocarbons. In terms of performance, Diesel has the highest BTU/gal and we expected to see a 13% drop in MPG for vegetable oil. We measured a reduction of only 5.6% which may be due to more efficient combustion. When we compared a number of vegetable oils, we found the best performance with Waste Soybean Oil and Canola Oil. We believe the higher performance is due to the lower levels of saturated fats. The economics of fuels was determined on a cost per mile. Waste Vegetable oil was the cheapest at $0.03 per mile. Pure vegetable oil based fuels were about 40% more than diesel. This gap could be reduced if vegetable oil was produced at greater scale. Waste vegetable oil will only ever provide about 0.5 B gallons of fuel compared to a need for 63 B. We considered how high-oil yielding plants such as castor beans, jatropha, coconut and palm oil could be leveraged to displace a greater quantity of diesel. The highest oil producing plant on a gal/acre/yr basis is algae which could be scaled to displace petroleum based diesel.

If we were to take 10% of the 243 m gas vehicles off the road and substitute high MPG diesel cars (+75 mpg), we would displace +10 B gallons of fuel, more than any other energy conservation effort. With

a greater number of cars burning diesel, algae oil and plant based oils could be scaled. Substitution of these fuels will benefit the environment, reduce our dependence on imported oil and potentially reduce energy costs. Our project considers the trade-offs in performance, emissions and economics of vegetable oil based fuels as compared to petroleum based diesel and looks at how we can reduce greenhouse gases and our dependence on imported oil.

57
Ronald Lee
Engineering 2009/2010

The Construction and Testing of a Hybrid Rail/Coil Electromagnetic Launcher

This project aims to build an operational dual stage electromagnetic launcher with a coil gun as its initial stage and a rail gun as the second stage. Also, a number of tests, including measurements of the velocity of the projectile and the energy efficiency are taken to assess the practicality of the launcher.

The launcher itself was built in accordance with a schematic also made during the experiment. Also, in order to test the velocity of the projectile shot from the launcher, an improvised velocity meter was built. The test itself categorizes the velocity, kinetic energy, and energy efficiency for projectiles fired from only the coil and rail stage, and the combined electromagnetic launcher. The time the projectile takes to cover a preset distance was recorded for several voltage amounts in the capacitors. In the testing of the separate stages, the capacitors were charged to approximately the same voltage and fired. For the use of both stages together, the capacitors attached to the rails were charged to a constant charge of 250V. With the time and distance, the velocity and kinetic energy was calculated and the energy efficiency (energy output to energy input) was determined. The velocity was measured in meters/second while the energy was measure in joules.

Overall, through the three trials conducted at 175, 200, and 275 volts, the combined launcher's velocity, energy, and efficiency were greater than that of the separate stages.

This project's contributions seem to demonstrate that the dual stage launcher is overall more effective (in efficiency and speed) in shooting a projectile. Finally, this project demonstrates the feasibility of constructing such a launcher.

58
NEE, James
ENGINEERING

FIRE POWER: GENERATING ELECTRICITY FROM LTD STIRLING ENGINES USING REED SWITCH BRUSHLESS MOTORS

The future of electricity generation is still up in the air. Recently, there has been a strong resurgence in nuclear energy, and hydrogen fuel cells get slimmer every day. One technology, however, that has the potential to revolutionize the renewable energy industry, has been overlooked. Stirling Engines, first developed by Reverend Robert Stirling, have been in existence for nearly two centuries, but has been largely unexplored as a means of electricity generation. This project aims to explore the potential powerhouse that is the Stirling Engine.

This idea of applying Stirling Engines to generate electricity is nothing new. This project, however, looks at Low Temperature Differential Stirling Engines, considered "model Stirling Engines" and examines whether there exists a way to convert the energy produced into electrical energy. LTD Stirling Engines produce low amounts of torque relative to their high temperature brethren, thus it appears that the best way to approach this problem is through using a brushless motor. Brushless motors, when compared with Stirling Engines, produce very similar results. Both can operate at relatively high speeds given their input energy, but both produce low amounts of torque.

To test this hypothesis, a reed switch brushless motor was mounted perpendicular to a LTD Stirling engine with magnets attached to its rotational disc, and then the output voltage was measured with

a multimeter and compared to a normal brushless motor to examine if the Stirling Engine set up can generate electricity as effectively.

The results were much lower than expected, with the brushless motor generating, on average, .4 milivolts of electricity, and the Stirling Engine generating .2 milivolts. Clearly, a reed switch brushless motor is not the best choice, but the results clearly show that LTD Stirling Engines are capable of generating electricity. From here it becomes obvious that better alternatives for electrical generation must be used.

59
NGUYEN, Lauren
ENGINEERING 2009/2010

OPTIMIZING MICROBIAL FUEL CELL OUTPUT BY VARYING RELATIVE SURFACE AREA

In the modern world, there is still a need to provide for low or sporadic power applications, such as military and environmental sensors and rural network device (cellular phone) charging. The purpose of this research project is to optimize the output of a sediment microbial fuel cell (MFC) by varying the ratio of anode to cathode effective surface area. Sediment microbial fuel cells work by utilizing the potential difference between the anode in the biologically active mud and a cathode in the water above. The anode undergoes an anaerobic reaction; whereas, the cathode requires oxygen for its reaction. As a result, the cathode can have its effective surface area increased by oxygenating the water with an air pump, providing the required precursor for the cathode reaction. It was expected that in a 1:1 configuration, the anode would be the limiting factor due to the semi-solid transport limitations of the bacteria that must be in close proximity with the anode.

In this experiment, an initial fuel cell with a 1:1 anode to cathode ratio was constructed. Baseline measurements of voltage and current were taken with a digital multimeter. Then, MFCs were built with 2:1, 3:1, 4:1, and 6:1 ratios, incorporating any lessons learned from the original MFC. The measurements taken were compared to the measurements of the initial MFC. After a baseline was established for each configuration, the effective cathode surface area was increased by oxygenating the water around the cathode.

The results support a conclusion that an optimum can be reached between the effective surface areas of the anode and cathode. The 2:1 MFC seemed to produce the most voltage and current. However, worms that were indigenous to the mud started to appear in each microbial fuel cell after each cell was oxygenated using an air pump. The worms, surprisingly, inhibited the fuel cell reaction as the voltage and current dropped dramatically after the air pump was removed.

The unexpected appearance of mud worms in the MFC highlighted the need to consider the actual environment that the fuel cell will operate in. Before the installation of these cells in actual use, engineers need to consider and anticipate the wildlife that grow and live in the planned environment. Precautions must be taken so that the indigenous wildlife will work in harmony with this particular fuel cell design. This research project shows that MFCs can be a viable power source in the future. An effective microbial fuel cell could provide 3rd world, rural civilians with network connectivity, such as cellular and telemedicine applications. Additionally, MFCs could power long-term sensor applications for environmental monitoring and military situational awareness.

ENVIRONMENTAL SCIENCE

61
CHEN, MONICA
ENVIRONMENTAL SCIENCE 2009/2010

ANTIBACTERIAL PROPERTIES OF CHITOSAN NANOPARTICLES ENCAPSULATED BY COCOS NUCIFERA-DERIVED PEPTIDES

With the world population growing at a rapid pace, especially in developing third-world countries, the search for widely available, inexpensive, and readily biodegradable water disinfectants has become

more essential than ever before. Two potential biocides, chitosan nanoparticles, nanoparticles derived from chitin, a component of the exoskeletons of arthropods, and antibacterial peptides derived from *Cocos nucifera*, young green coconuts have been found to possess bactericidal capabilities against several common strains of bacteria and are fairly abundant.

This study sought to identify the potential of a novel biocide system consisting of chitosan nanoparticles encapsulated by the peptides found in green coconut water (GCW). Through ionotropic gelation, chitosan nanoparticles were formed and mixed with filtered green coconut water (GCW) to promote encapsulation. The physiochemical properties of the biocides were analyzed through zeta potential and particle sizing analyses. A bacterial bioassay was conducted to determine the antibacterial properties of the combined biocides against Pseudomonas *putida*, a common bacteria specie found in wastewater.

The biocide system was shown to be less effective against *P. putida* when compared to the antibacterial activity of chitosan nanoparticles, but more bactericidal in comparison to the GCW peptides. Thus, the procedures used to combine the two biocides did not produce a biocide system with significantly enhanced bactericidal properties.

64
ISLAM, Tasneem
Environmental Science 2009/2010

RELATIONSHIP BETWEEN WATER QUALITY AND PLANKTON RICHNESS DURING THE WET SEASON

During the wet season, excess rainwater drains the land and carries urban runoff to the coastal waters which affects the water chemistry and quality, and consequently impacts the planktonic inhabitants. It is hypothesized that this excess rain water will cause the water quality parameters of salinity, dissolved oxygen, pH, and nitrogen to stray from the normal Pacific Ocean conditions, and as a result, change the species diversity in the particular sites.

For experimentation, weather was monitored and after a three day dry period or after a shower, water samples were collected at Cabrillo Beach and Redondo Beach and tested for levels of salinity, dissolved oxygen, pH, and nitrogen. The organisms were preserved until the end of data collection when they were identified.

The data revealed that the wet season water had lower levels in all four tests than the dry season water; however, this did not necessarily suggest that the water was harming the organisms because the number of species present in both periods did not vary greatly. A statistical analysis was conducted which showed that the quantitative data were fairly common occurrences and that these seemingly low levels of salinity, dissolved oxygen, pH and nitrogen, had a slight impact on the species diversity.

These results thus proved that after rain drains the land, the water quality does in fact change and thereby impacts the types of marine organisms present. The study is significant in showing that urban runoff is affecting the species diversity in the coastal areas right off the shore.

65
KELLY-SLATTEN, Kayla
Environmental Management, 2009/2010

THE EFFECTS OF HUMAN TRAMPLING AND EXPLORATION ACTIVITIES ON TIDAL POOL ECOSYSTEMS

Ecosystems make up Earth's biosphere, varying from the simplest rock to the deepest ocean trench; whatever the size or degree of complexity, however, most ecosystems are relatively sensitive to human activities. Tidal pools show no exception to this when families come to explore some of Earth's wondrous creatures. Although visiting and touching the various organisms is fun and often educational, many people tend to not be aware that continuous treading, picking up of organisms, tripping into and on the rocks, poking species, collecting shells and trinkets, etc. can be damaging to the community of

organisms as a whole. To attempt to demonstrate the negative effects that humans have on tidal pools, this research study was conducted at Cabrillo Marine Aquarium Rocky Shore, where much of the public enjoys spending a weekend or holiday.

In order to collect data at an organized and fairly accurate level, a specific day of the week was chosen in which data was to be continually gathered. Two locations were scouted a distance away from where the general public often visits and explores, while one was chosen in the area where most people tend to tread. As long as weather permitted, data was gathered every week, but usually it was every other week. Typical tests included water and air temperature, pH, salinity, dissolved oxygen, and later ammonia, nitrate, and phosphate concentrations. Other data collected included the percent coverage of algal species and the diverse animal species and their sizes. All this data was written by hand onto personalized data sheets and then typed up neatly. It was then graphed, analyzed, and conclusions drawn.

The conclusions that were taken from the study did not follow the stated hypothesis completely. The location most accessible to the public, even with evident footprints, showed the most stable environment for organisms to grow and develop with high levels of dissolved oxygen, low levels of the hazardous compounds, and less disruption from waves and tides. In contrast, the other two "inaccessible" regions had less animal variety and higher concentrations of the abiotic substances, although their algal variety was much more intense. Therefore, it can be said that this research project had many other outside factors that affected the results; these include wave motion, tide, general size and area of the tide pools, and weather. Aside from these variables, the data that was analyzed did lead to the possibility that human trampling has to be very heavy to cause any major damage to the tidal pool ecosystems.

68

McCloud, Sierra
Environmental Science 2009/2010

ELECTRICITY EMISSION AND WATER CONSERVATION IN THE HOUSEHOLD

For a few years now, the economy has been at its lowest and the government calls it a repression. This repression has not only effected companies and businesses, but it has severely affected families in this local community. To help families save money, the most practical ways to cut back and save up money were implemented. All over the world, people are not aware of the amount of money loss from overuse in electricity and from keeping the water running for long periods of time. Electricity and water bills can skyrocket and if a typical family can simply conserve in the amount of electricity and water used, huge sums of money can be saved and could perhaps help the financial hardships.

To solve this economic problem, an efficient and practical study of how much money a family could save from turning of the lights and computers when not in use and from using the dishwasher and taking shorter showers instead of baths was created. Living with two young sisters and a very stubborn father who like the idea of conservation, but find it difficult to remember to do so, does not simplify the study. In order to get them to help out, the challenge of the study, incentives to bribe them into helping the study to be a success were sustained. Sisters were given money and were served their needs. For just over three months, electricity and water was conserved and monthly bill results were compared to previous year's bills.

As a result from the conservation, electricity savings began to shoot up to the hundreds of dollars; however, the water bill seemed to increase from December to January. The reasoning was determined to be the fact that the dishwasher was not used. For the next month, instead of washing the dishes, thinking that manual labor would save water, the dishwasher was used and money on the monthly water bill was saved. It was as close as a fifty dollar difference. Furthermore, dishwashers are meant to conserve water because it certainly saves more money and physical strain from labor, which is always a plus.

Overall, the hypothesis was valid and accurate. A typical family of any size can take the initiative to cut off lights when not in use or take showers instead of baths, which wastes gallons and

gallons of water a second. Once a family gets in the habit of conserving it will be a second language and no hassle at all. There is certainty that the simplest way to save up money starts in the home.

72
WATHUGALA, Melanie
ENVIRONMENTAL SCIENCE 2009/2010

THE EFFECT OF DISSOLVED SUN SPRAYS ON *TETRASELMIS* SP. GROWTH

Sunscreen is said to bleach coral reefs because of its effect on coral's symbiotic algae. The purpose of this experiment was to find out if dissolved sun sprays (sunscreen and aloe spray) affect algae other than the coral variety.

Three groups of green algae, *Tetraselmis* sp., consisting of three flasks each were made: a control group, a sunscreen (N) group, and aloe spray (G) group. One fourth of an index card was put into each flask, with the appropriate sun spray applied to the card (the C group had no spray), emulating the way it would enter the water in a real life situation. The flasks were put under a UV light. The population density for each flask was measured weekly during two week trials. At the end of each trial pH and dissolved oxygen levels were measured as well.

The experiment yielded clear results. After just the first week, the N group had a significantly lower population density than the control group. It was even visibly different, clear when the control group was green. The G group had a comparably similar population density with the control. After the second week, all of the populations had decreased, but the N group was still lower than the other two. The pH levels and dissolved oxygen levels did not vary enough to make conjectures. The second trial yielded the same results. The N index cards had an orange residue by the end, the G index cards were slippery, but not discolored, and the control cards felt like wet paper.

In the end, the sunscreen most dramatically affected the algae, seeming to kill all of the algae immediately and the aloe spray did not significantly affect the algae's growth. Unfortunately, the exact reason the sunscreen had such an effect could not be conclusively determined. However it seems likely that the orange residue hints toward a chemical reaction that may have inhibited algae growth. Or, did the dissolved sunscreen block the UV light reaching the algae like it blocks UV rays from reaching our skin? Regardless of the reason, we know now that not only do we have to worry about coral reefs, but also other aquatic plant life.

MEDICINE & HEALTH

77
FONG, Jennifer
MEDICINE & HEALTH 2009/2010

Double Blind, Randomized Prospective Trial of Impact on Pain Scores of Intrauterine Lidocaine vs. Normal Saline Infusion at the Time of IUD Placement

IUDs are the most frequently used method of reversible birth control; world wide 165 million women currently rely on IUDs. In the US, the percentage of women using IUDs is much lower, but because of the top tier of efficacy, convenience, safety and non-contraceptive health benefits, the number of women now getting IUDs is increasing rapidly. In the Women's Health Clinic, more than 10 women a week have IUDs placed. The placement procedure is fairly straightforward, but can cause the woman cramping and pain. Every woman is advised to take Ibuprofen or acetaminophen prior to her appointment. Women sometimes have measurable pain during and immediately after the procedure. Other investigators have shown that infusion of the anesthesia liquid lidocaine into the inside of the uterus can reduce the pain that is associated with other procedures, such as biopsying the lining of the uterus. This study seeks to determine if similar infusion made before IUD placement may reduce pain scores during IUD placement. Because pain is a subjective complaint and because plastic tubing is being used to sound the uterus instead of the usual metal probe (a uterine sound); we have included a placebo arm with saline infusion. All women will receive oral medication in advance of placements, so no woman will be subject to a placebo only. We had

planned to screen 100 patients to enroll 30 in each arm for a total of 60 patients. However, we enrolled only 43 patients; 16 in one arm, 20 in the other. All the routine IUD placement steps will be done. A bimanual exam and a speculum exam will be done. The tenaculum will be placed on the woman's cervix and she will rate the pain score. A standardized pain scale from 1-10 with 10 being the worst pain in the patient's lifetime, will be used here and at every point in the study. The depth of the uterine will be determined by introducing a plastic tubing into the woman's uterus. This tubing will either be filled with 1cc of normal saline or 2% lidocaine. The liquid will be infused at certain points within the cervix and uterus. The tubing will be left in place for 3 minutes, during which time the patient will again be asked to rate her pain score for that correct position, but before removal of the tenaculum, the patient will again be asked to assign an overall pain score. After IUD placement, the patient will report another pain score. Once the patient has dressed, she will report a final global pain score representing her entire experience. Pain scores between placebo and study drug used will be compared (mean, median, mode and range). Sub-analysis will be done comparing which women have never been pregnant to those who have. Sub-analyses of other influential factors like type of IUD placed, clinician method and presence of menses were done. Pain score averages after tenaculum placement, after infusion/sounding, and after IUD placement were all lower in the Lidocaine group. However, the global pain score average was lower in the normal saline group. After sub-analysis of demographic data like age, reproductive history, presence of menses, and IUD use history, the two study groups were very similar. Their differences were determined insignificant to the results of the study. One clinician had patients with overall higher pain score averages than the patients of the other clinician. Also, the type of IUD placed may have contributed to the pain perception of patients. Overall, the study did not indicate clear success of intrauterine Lidocaine as a method of reducing pain upon IUD insertion. Tenaculum placement pain score averages for subgroups of the data were also calculated in both the Lidocaine and normal saline groups. However, the data did not indicate a significant pain reduction trend using the Lidocaine method for any specific group. Overall, the study clearly illustrates how individual variability in pain perception cannot be measured objectively.

MICROBIOLOGY

83
Katherine Bailey
Microbiology 2009/2010

Determining the Effects of Cryoprotectant Exposure on Tetraselmis Microalgae

Cryogenics is the intricate procedure of cell preservation using liquid nitrogen. Several previous studies involving cryopreservation involve the experimentation on abalone, grunion gametes, and sea urchins. The purpose of this research is to determine the survival of Tetraselmis microalgae when exposed to propylene glycol. The species of microalgae involved is a motile, green Tetraselmis algae.

A cryoprotectant, propylene glycol, is used to prevent cell rupture while avoiding toxicity of the microalgae.It is important that the time of exposure be long enough for the chemical to get across the cell membrane without causing toxicity. This timed exposure was the variable being manipulated. The hypothesis proposed was that if the microalgae were to be exposed to propylene glycol for a longer time interval, it will have a higher survival rate than those exposed for a shorter interval.

The Tetraselmis was collected after a repeated process of centrifusion and then exposed to propylene glycol for specified intervals. It was then immersed in liquid nitrogen and thawed at room temperature. Cells were counted and sorted on microscope slides to record ruptured cells.

The microalgae cells exposed to propylene glycol for a longer time interval showed less rupture rates than those exposed for a shorter time interval. In the final analysis, the hypothesis was not supported because there were no survival rates. These findings are significant because whole microalgae are still important for aquaculture and feeding. As a result, the data from this experiment may be used to compare with the data of previous experiments and further studies.

84
CHANG, Hana
MICROBIOLOGY 2009/2010

TESTING BACTERIAL CONTAMINANTS ON SELF-SERVE ITEMS IN RESTAURANTS

Restaurant employees are required to clean certain areas of their restaurant (i.e. drinking nozzles) every single day, but is the task always done? This project in its present form is the result of bacteria contaminants found on a variety of items in restaurants.

A total of four restaurants were used to test samples: The Grand China Buffet, Souplantation, Starbucks, and In 'n Out Burger. Bacteria were collected by using sterilized cotton swabs to swipe the items' surfaces in each restaurant. Nutrient agar under 37 degrees Celsius was used to allow all specimens to grow into a visible size. The bacteria were grown in a period of four days. To slim down the possibilities of the unknown bacteria, the gram stain method was used and then the bacteria were observed under the microscope.

Spots ranging from white to orange began to settle on the agar dishes after the first two day. Thus proving that there were some types of bacteria living on the restaurant items where bacteria ought not to be. Forms of *Streptococci* and *Staphylococci* are possibilities of what many of the bacteria might be classified as.

The experimentation contradicts the hypothesis which states that there would not be harmful bacteria on restaurant items which should be cleaned thoroughly each day. This outcome will likely impact restaurant patrons to be more aware of microorganisms that could come in contact with their food and potentially harm them.

87
Anais Gharabegian
Microbiology, 2010

Bacteria Removal by Soap and Water, from Porcelain Dishes

The bacteria on kitchen dishes can be hazardous to humans, and it is essential that as much as possible of these bacteria are washed off, in order to reduce their consumption. The processes used to hand wash dishes vary in procedure and efficacy. In this experiment, different water temperatures and soaps were tested for removing bacteria from the plates. The purpose of the experiment was to determine which process of washing would result in the least amount of bacteria on a plate.

The temperatures of sink water used were cold (15 C), lukewarm (26 C), and hot (38 C). The soaps used were Dawn, Palm Olive, and Life Tree Citrus. Each experiment was conducted under one of the three temperatures, using either plain water, or one of the three soaps. In total twelve trials were completed. After all the twelve dishes were washed, each surface was swabbed with a sterile swab and rubbed against the surface of an agar Petri dish in two perpendicular zigzag motions. The Petri dishes were then sealed and put in an incubator for two days, so the bacteria could grow. After the two days, the Petri dishes were placed under a microscope, and the numbers of bacteria colonies were counted.

The bacteria results for each trial were then compared. The colony count for dishes washed without soap was 63 for hot water, 60 for lukewarm water, and 89 for cold water. The colony count for Dawn soap was 40 for hot water, 45 for lukewarm water, and 49 for cold water. The colony count for Palm Olive soap was 29 for hot water, 36 for lukewarm water, and 61 for cold water. The colony count for Life Tree Citrus soap was 66 for hot water, 69 for lukewarm water, and 57 for cold water.

The results conclude that although Dawn soap removes more bacteria in cold water, Palm Olive soap removes the most bacteria overall and therefore is the more effective soap. Also some soaps wash better in different temperatures, such as Life Tree Citrus, which happens to remove more bacteria in cold water than any other temperature.

90
Lee, David
Microbiology, 2009/ 2010

Dangerous Backpacks

The advent of new diseases such as the SARS or the recent H1N1 flu, have greatly augmented people's awareness against protecting themselves from pathogens such as bacteria or virus. With recent researches on finding deadly bacteria on common everyday items, the idea of this project was to determine how unsanitary and dangerous the students' backpacks were by investigating the types of bacteria the students accumulated on their backpacks throughout an ordinary school day.

The experiment was conducted through two processes, which were: collecting bacteria and gram staining. In order to collect bacteria, a piece of duct tape, about 5 inches, was taped underneath the backpack and sterilized with Lysol in order to simulate a clean, unused "backpack". At the end of school day, the "backpacks" were collected, swabbed and incubated for bacteria cultivation. After three to four days of incubation, bacteria was transferred to the slides and stained using the Gram staining procedure. After staining the bacteria, a compound microscope was utilized to identify the bacteria.

After investigating the gram stained slides, the results were indeed surprising yet consistent for all the slides tested. Many demonstrated the presence of deadly bacteria such as streptococcus, fusobacterium, propionibacterium, etc.

The findings were significant in proving that the backpacks the students carry everyday, were indeed dangerous and unsanitary. Therefore, it is of utmost importance that students are aware that they not only carry a dirty object, but also transfer deadly bacteria.

92
RAMAYYA, Sulekha
Microbiology 2009/2010

EFFECTS OF FLOSSING AND TOOTHBRUSH STORAGE LOCATION ON TOOTHBRUSH BACTERIAL GROWTH

This project was undertaken to assess the bacterial growth on the toothbrush and any effect certain variables like flossing and toothbrush location may have on the same. This was relevant in the context of gingivitis and the incidence of bacterial endocarditis occurring due to bacteremia from infected gums amongst other infected sources in the body. So it was pertinent to identify any factor(s) that would affect the total bacterial load on the toothbrush, which in turn could reflect the burden of infection.

Bacterial growth was determined by standard collection and culture methods, and the species were identified under the microscope. Subjects were divided into four categories based on the two variables of flossing and location. Basic standards were maintained equally among all groups by dispensing the same brands of toothbrush, toothpaste, floss, etc.

The two common groups of bacteria identified were *Staphylococcus aureus* and *Pseudomonas aeroginsa*. Even though the group that flossed and had their brush outside of a toilet setting had the least growth, and the group that did not floss and had the toothbrush in a toilet setting had the most growth, the results from the other two groups mixed.

In conclusion, it was easy to see that flossing and brush location both had an impact on the toothbrush bacterial growth and that their combined effect was more than either one alone. Secondly, the overall bacterial count in each group was insignificant.

PHYSICS

96
KIM, Jonathan
Physics 2009/2010

CONSTRUCTION OF MULTI-ULTRASONIC TRANSDUCER MICROPARTICLE MANIPULATION SYSTEM

The project performed was an attempt to design and test a device that, using high-frequency ultrasound, would be able to trap microparticles of size 30 μm or smaller by exerting opposing forces on the particle on multiple axes. The idea was to create a sort of tweezing effect by propagating ultrasonic waves that would create opposing forces, which would then squeeze the particle and hold it in one place.

As a prototype, two directional transducers were used in a setup that allowed them to be mounted in such a way as to allow for total control over all movements. They were suspended from metal arms, which allowed for them to be immersed in a water-containing beaker without contact with the beaker itself. Then, fluorescent microspheres were placed into a three-inch diameter round beaker with enough water to immerse the two transducers. The success of the two transducers in capturing particles was observed by using a long-range microscope connected to a computer so that the microspheres present could be seen.

The principal findings were unsuccessful; the device, throughout hours of testing, failed to capture a solitary particle. Various setups were used, with varying bonding methods and lighting methods. With all kinds of different setups the device failed to capture an isolated microparticle.

The reason for the device's failure to capture a microparticle consists mainly in the device's inaccuracy. There was insufficient accuracy and alignment of the two directional transducers, so that it was in doubt as to whether a focal zone was actually being created or not, due to the high degree of uncertainty and inaccuracy. The second reason was that the principle upon which we based the device was actually flawed. While it was assumed that the device would exert force on multiple axes, the truth is that the acoustic beams combined to exert opposing force only on one axis.