ABSTRACTS – HIGH SCHOOL 2007/2008

BEHAVIORAL & SOCIAL SCIENCES

HS-2
Sean BONNELL
Behavioral and Social Sciences

The Influence of Subliminal Messaging on Viewer's Drink Selection

Subliminal messaging is widely used in advertising. Not many people are completely sure if subliminal messaging actually works. Subliminal messaging is based on the theory that the subconscious mind is capable of perceiving messages and images that are below conscious awareness. The theory goes on to suggest that people are influenced by the message to change their behavior. The purpose of this experiment was to determine if subliminal messaging can have an affect on a person's behavior. The experiment also determined if a goal relevant outcome increases the influence of the subliminal message.

First, two videos were created, one with and one without an embedded subliminal message. This was accomplished by downloading a video from the Internet and then using Adobe Premiere Elements 4.0 to create the subliminal message by inserting a picture of a can of Nestea Iced Tea into the video clip. The contrast, brightness, and saturation of the picture was altered to make it less noticeable. The control group watched the video without the embedded message and the experimental group watched the video with the message. Subjects were asked to watch the video and then pick between Brisk Iced Tea and Nestea Iced Tea. Some of the experimental group subjects were asked to eat a cookie before watching the video. The cookie was intended to induce thirst, thus making the message of iced tea goal relevant.

In the experimental group, 3 out of 10 chose Nestea. In the experimental group given the cookie, 2 out of 10 chose Nestea. The control group had the same results as the experimental group with 3 people choosing Nestea. Overall, Nestea was only chosen 26% of the time, while Brisk was chosen 74% of the time.

Based on the results, it was concluded that subliminal messaging does not have a significant affect on the behavior of viewers. Even though Nestea was the brand of iced tea used for the message, it was still chosen less than 30% of the time in any given group. Despite the fact that more people seem to like Brisk, the results still show that subliminal messaging does not have the power to overcome bias.

HS-3
Hyung NAHM
Behavioral & Social Sciences

The Correlation between the Mozart music and the Academic Task Performance

The purpose of this research project was to determine the correlation between the Mozart music and the academic task performance. In this study, the experiment was for acquiring statistical evidence that shows whether the Mozart music could actually provide the facilitating effect on academic performance.

Twelve high school students were asked to participate into the experiment for three consecutive days. One set of SAT test (consisted of one Critical Reading section, one Math section, and one Writing section) and one set of ACT test (consisted of one Reading section, one Math section, one Grammar section, and one Science section) were issued to all participants. The participants were randomly distributed into four groups, 3 people each. One of the four groups was Silence group (control group) and participants in that group were tested without any music. Three other groups were tested with different Mozart and non-Mozart music.

With a statistical analysis, it was proved that some Mozart music does have the facilitating effect on academic task performance. Overall, higher SAT and ACT scores were drawn from those of participants who had listened to Mozart music. The statistical inference was proved to be valid through the 2-sample Z test. The mean score of Silence group was 22.36 (out of 32) while that of Mozart group was 25.02. As a result of 2-sample Z test, the Z score was –1.420680 and that granted low ρ-value, 0.02777. Since ρ-value was lower than 0.05, in the 5% confidence interval, the null hypothesis – the mean score of silence group is equivalent to that of Mozart group – was rejected.

Instead, the alternative hypothesis, the mean score of Mozart group is higher than that of Silence group, was accepted. Therefore, with the sufficient statistical evidence, the "Mozart effect" seemed indubitable. In other words, it was reasonable to conclude that Mozart music had the facilitating effect on academic task performance.

HS-4
Wu, Steve
Behavioral & Social Sciences 2007/2008

BRAIN DOMINANCE AND GENDER ON SHORT TERM MEMORY

This project is designed to address the role of gender and brain dominance in determining short term memory. Educators are currently striving for the best way to teach their students, and memory plays a huge part in learning. Testing with subjects eventually led to a conclusion that will like specific students to educational characteristics.

Human subjects were chosen according to age and gender. Brain dominance was determined by a test and short term memory was measured by a video. Subjects would look at the video and then write down as many pictures as they could remember. Data was recorded in terms of number of pictures memorized and average number of pictures memorized relative to brain dominance.

Data collected showed left-brain dominant females having the greatest average short term memory. It was found that left-brain dominant males had the second greatest short term memory, with right-brained subjects tying for last place.

The results of this project were unexpected. Left-brain dominant subjects outperformed right-brained subjects who were thought to have a greater short term memory. Additionally, right-brained subjects had a greater range or answers than left brained subjects,

BIOCHEMISTRY

HS-6
Ina JOO
Biochemistry

Period of Greatest Retention of Antioxidants in Fruits

The health benefits of consuming a diet rich in fruit are backed up by a multitude of studies. Antioxidants are a wide range of compounds that interfere with the damage done to cells by free radicals which are charged particles that are produced by radiation and chemicals. Fruits are loaded with antioxidants, which range from chemicals such as the resveratrol found in red wine to the flavonoids that make strawberries red and vitamins A, C and E.

There were many studies that used updated technology to assess antioxidant levels in more than 100 foods especially fruits. Many, also, traditionally define a fruit's nutritional value through its visual appearance and texture. Thus, most people discard fruits when they are rotten. However, this experiment analyses how fruits may actually increase on antioxidant capacity and phenolic compounds when they present visual spoilage.

The experiment evaluates the influence of storage on antioxidant capacity in strawberries and tangerines. The two chemicals associated with antioxidant content studied are flavonoids and ascorbic acid. The titration method was used to measure the amount of ascorbic acid in the tangerines and by also setting up a proportional calculation. Flavonoids in strawberries were analyzed through a mixture that was measured with a spectrophotometer. The antioxidant levels of the fruits were measured at various times until the produce visually spoiled.

Through a period of a month, it was found that the phase that contains the greatest amount of antioxidants varies by fruit. The tangerines did not lose any antioxidant content in the days after purchase. On the other hand, strawberries were observed to actually increase in phenolic compounds and antioxidant capacity as they present visual spoilage.

HS-7
Philip KOOK
Biochemistry

Synthesis of unnatural Amino Acid

The purpose of this project is to synthesize unnatural amino acids through experimentation with Petasis reaction. Living organisms require amino acids for proper functioning. Amino acids are peptides which catalyzes almost all of the reactions in living cells - virtually, all cellular processes. However, amino acids cannot be taken as drugs as they get hydrolyzed by the enzymes in the body. One of the potential solutions to the above problems is usage of peptidomimetics. Peptidomimetic is a small amino acid chain designed to function like a peptide. Because peptidomimetic are made up of unnatural amino acids, they do not get hydrolyzed, so they can be considered as potential drug candidates.

Petasis reaction is a multi-component reaction that easily and effectively enables the synthesis of sophisticated amino acids. Petasis reaction is very important reaction because the reagents for the reaction (aldehydes, amines, and boronic acids) are readily avaible

commercially. Due to the diversity within the reagents, there are thousands of possibilities for new amino acids (peptidomimetics).

Using 4-Methoxy Phenyboronic acid, 2 Amino-5 ChloroBenzophenyl, and Glyoxilic acid monohydrate, the unnatural amino acid was formed and confirmed by NMR analysis (Nuclear Magnetic Resonance).

With the clear data obtained from NMR analysis, there is significant evidence that unnatural amino acid from using 4-Methoxy phenylboronic acid, 2 Amino-5 ChloroBenzophenyl, and Glyoxilic acid monohydrate is possible.

HS-8
Carolyn SINOW
Biochemistry.

CONSTRUCTION OF AN IGF-NAGLU FUSION PROTEIN FOR TREATMENT OF SAN FILIPPO B

Mucopolysaccharidosis Type IIIB, also known as Sanfilippo B Syndrome, is a genetic disorder resulting from a deficiency of the enzyme α-N-Acetylglucosaminidase (NAGLU). Synthetic NAGLU has not effectively corrected this deficiency because it has poor cell uptake. Attaching an Insulin-like growth factor II (IGF-II) tag to synthetic NAGLU may allow the enzyme to enter cells using the mannose-6-phosphate receptor. The goal of this project was to use recombinant DNA techniques to create a plasmid that coded for a NAGLU protein with an IGF-II tag.

IGF-II DNA was inserted into an initial plasmid, pCI-Neo to produce pCI-IGF-II plasmids. Isolated NAGLU fragments were then inserted into this plasmid to create pIGF-II-NAGLU plasmids. At each step, the products yielded were verified and purified using gel electrophoresis.

The intact pIGF-II-NAGLU plasmid could be identified by its expected size as measured in kilobase pairs on gel electrophoresis. Attempts to further verify the plasmid creation using double digestion techniques were limited by weak gel staining.

It appears that this project has created a plasmid for NAGLU with an IGF-II tag. The configuration of this recombinant plasmid can be further characterized by genetic sequencing. In addition, another plasmid was created, pCI-IGF-II, which may allow the IGF-II tag to be attached to other proteins besides NAGLU, to facilitate their entry into cells.

HS-9
Jane SUH
BIOCHEMISTRY 2007/2008

Microfluidic Image Cytometry to Detect PI3K Pathway Markers in Brain Cancer

Although a new generation of anticancer drugs targets molecular pathways, cancer treatment still remains inefficient and is in need of further development. Macro-scaled imaging modalities rely on reductions of tumor size to determine the effectiveness of drug treatment. However, this process takes a few months to see noticeable change. Even though patients have

similar tumors, they respond differently to treatment because of their unique molecular signature. In order to quickly assess the efficacy of drug treatment and analyze the different molecular profiles, the Microfluidic Image Cytometry was utilized.

The Microfluidic Image Cytometry platform allows for single cell level detection and analysis to compare protein expressions in a cell population's response to drug treatment. Experiments were conducted using the immunocytochemistry method of antibody specific staining. U87 cells, brain cancer cells, were fixated and expression levels were detected inside a PDMS microfluidic chip. Fluorescence dyes were attached to the antibodies to target the PI3K pathway markers in brain cancer: EGFR, EGFRvIII, PTEN, and pS6.

Optimum conditions were determined by measuring fluorescence intensity levels using Metamorph. Optimum antibody concentrations for detection of EGFRvIII, PTEN, and pS6 were established: 0.5 ug/mL, 5 ug/mL, and 4.5 ug/mL respectively. The U87 cells then underwent rapamycin drug treatment for brain cancer and pS6 levels served as readout to measure the effective concentrations, 2nM to 20nM, needed in order to inhibit the PI3K pathway.

The Microfluidic Image Cytometry is an effective and quick method for real-time analysis of cancer treatment response. This system will bring cancer treatment to a new age of development because of its small sample volume, large scale analysis, and single cell precision.

BOTANY

HS-10
Laurence CHEN
Botany

Switchgrass (*P. virgatum*) Growth by Varied Arbuscular Mycorrhizal Fungi Content

This project is the result of experimentation on the productivity of arbuscular mycorrhizal fungi in various environments. The original test subject was to be a certain plant. Consideration of project speed, then, led to grasses became as the target.

To evaluate the impact of variability in arbuscular mycorrhizal fungi (AMF) content, growth became the basis of analysis. Growth rate was determined weekly by measuring the height (in centimeters) of the tallest plant in each container. The variations of mycorrhizal inoculants were in amounts of 0, ½, 1, 2, and 3 teaspoons, applied in their respective "A", "B", "C", "D", and "E" containers. Qualitative data, such as abundance and color, were also recorded. The roots were examined, as well.

Over a nine-week period, the control, container "A", led the way with a final average height of approximately 8.03 cm, while the extreme variable of container "E" produced a

final average height of approximately 6.03 cm. The results of growth rate were less obvious, but showed that containers "C", "D", and "E" grew steadily, while containers "A" and "B" grew inconsistently. The roots of AMF containers were found to stretch in all directions, when the roots of the control grew straight down.

Strange findings resulted from the experiment, which placed the control as the leader in growth. The extreme amount of AMF in container "E" seemed to have inhibited growth, however, while maintaining a consistent growth rate, in contrast to the steep ups and downs of growth rates of the control and container "B". When examining the roots, the long structures allow the grass to absorb more nutrients, yet this concept is incongruous with the results. The roots of the control all reach downward due to gravitropism.

HS-11
Nicole Chow
Botany 2007/2008

PHEONOLGY OF TWO DECIDUOUS SAGE SCRUBS OF THE COASTAL SAGE SCRUB COMMUNITY

The purpose of my experiment was to determine the effects of drought conditions on the drought-deciduous sage scrubs, *Salvia leucophylla* and *Encelia californica.* This information can be invaluable because plants that are able to grow with minimal amounts of water can be transplanted to drought prone areas where plant respiration can continue to serve the environment.

Samples of both plants were obtained from three different sites. The first site was the droughted Portuguese Bend Conservancy that received watering only when it rained. The second site was the White Point Nature Conservancy which was periodically watered with a sprinkler system. The third site was a greenhouse lab at UCLA, which had a controlled environment. These samples were measured, dried, then weighed to determine the effects of water and drought on its growth.

The samples from the White Point Nature Conservancy, and the UCLA greenhouse lab had significantly more leaves than the sample from the Portuguese Bend Conservancy. The watered specimens also had a larger leaf to shoot ratio than the droughted plants.

It is concluded that sage plants in a watered environment will flourish when compared to those in the droughted setting.

HS-12
Christina GUNZENHAUSER
Botany

COMPARISON OF PHENOLOGICAL DEVELOPMENT *RHUS INTEGRIFOLIA* DURING A DRY AND A WET YEAR IN A COASTAL SAGE COMMUNITY

The growth characteristics of coastal sage scrub have not been fully studied. The purpose of this study was to compare various growth characteristics of the coastal sage scrub, *Rhus integrifolia*, during two consecutive years, one of which was a year of drought. The hypothesis of the study is that growth characteristics of the coastal sage scrub would be positively correlated with the

precipitation and the temperature. Six plants located at the Vicente Bluffs Ecological Reserve were studied during the period of January 2007 through January 2008. The following characteristics were measured of each plant: branch length (cm), branch diameter (mm), number of leaves, number of empty nodes, number of flowers, and the presence of fruit. Climatological data were obtained from nearby, local weather stations and included average monthly rainfall as well as average monthly mean, minimum, and maximum temperatures. All plants demonstrated growth within the study period. Consistent with the hypothesis, branch length, number of leaves, number of flowers, and the presence of fruit were positively correlated with temperature and rainfall. Branch diameter showed minimal positive correlation with weather and the number of empty nodes showed negative correlation with weather. The main findings of this study were that most measures of plant growth were positively correlated with rainfall and temperature, and that the growth of plants was not affected by increasing temperatures.

HS-13
Parisa HASHEMI
Botany

THE EFFECT OF CARBON DIOXIDE CONCENTRATION ON THE GROWTH OF *Brassica rapa*

This project tested the effect of carbon dioxide concentration on the growth of the Wisconsin Fast Plant, *Brassica rapa.* With the atmosphere's current problem of increasing carbon dioxide concentrations, the effect the crisis has on plant growth is appalling.

The carbon dioxide concentrations were arranged that the first container averaged 426 ppm, slightly under the predicted concentration by the year 2050. The first container was kept open in order to yield the concentration of the container's surrounding. The second container averaged 720 ppm, predicted concentration by the year 2075. The third container averaged 800 ppm, the predicted concentration by the year 2100. The second and third container's concentration was controlled by either fanning out the air if the calculated concentration was too high or breathing into if the calculated concentration was too low. A carbon dioxide reader was placed into each container one at a time while also connected to the computer for the current concentration to be read and recorded. The growth of the five plants in each container was measured with a ruler.

The plant surrounded by the highest carbon dioxide concentration grew an average of 1.31 cm. less than the plant surrounded by a lower carbon dioxide concentration.

The experiment concluded that the greater the concentration of carbon dioxide, the faster the plant grows yet the faster it dies, leading to a shorter life cycle. Concentrations closer to ambient allow the plant to grow slower but with an ordinary life cycle.

HS-14
Albert Hong
Botany 2007/2008

The Effects of Humidity and Temperature on Madrona Marsh Mule Fat

This project is the result of increasing the humidity and temperature in different terrariums. The humidity and temperature were increased to observe their effects on the growth of the Madrona Marsh mule fat, or Baccharis salicifolia.

4 terrariums were set up, each with a mule fat in it. The temperature was controlled by grow lamps and heat blankets. Humidity was controlled by putting 2 bowls with 400 milliliters of water into terrariums A, B, and C. The increased temperature led to the increase in humidity as well.

With the increase of the humidity and temperature, the control had the best growth out of the four plants while plant C, which was under the greatest humidity and temperature, showed the least growth. The control had the greatest growth in height. It grew 18.3 cm over the seven weeks. Plant A grew 8 cm during the experiment while Plant B grew 10.8 cm. Plant C grew only 3.2 cm over the seven weeks.

There was an anomaly in the data because plant B grew better than plant A. This can be explained by the fact that there was not a great disparity in the temperature and humidity between the two environments. However, the disparity in growth between the control and plant C shows the negative effects of humidity and temperature on plants. The evidence provided supports previous research. An increase in humidity saturates the air with water vapor and restricts transpiration. Therefore, growth is restricted. In addition to the lack of transpiration, the increasing temperature overheats the plant. Thus the increase in temperature and humidity negatively affect the plant's growth.

HS-15
Kaval Lodhie
Botany 2007-2008

Effects of Light-Emitting Diodes on Indoor Plant Growth

This study compares the various effects of light-emitting diodes on plant growth, to those from incandescent lighting and sunlight. Incandescent lighting uses approximately 120 watts of energy, while light-emitting diodes use about 5. Plants use different frequencies for different reasons, so only certain colors of light are useful for growth. Light-emitting diodes break down the frequencies into only the ones that are necessary. The results of this experiment can determine whether saving energy and heat will help plants grow healthier, while protecting the environment.

Three different light sources were used: light-emitting diodes, incandescent light, and sunlight. Pre-planted geraniums were obtained, and two were placed directly under each light. The light-emitting diode plants and incandescent plants were placed in rooms of darkness, to avoid other light. The lights were turned on and off simultaneously with the sunrise and sunset. Measurements were taken weekly of each plant, as well as pictures and qualitative data.

It was found that although the incandescent light plants grew taller at a faster rate, their health didn't last, resulting in dried up leaves, a yellow color, and wilting flowers. The plants in sunlight also grew, but remained constant throughout the experiment. The light-emitting diode plants, however, resulted in a steady growth and a fresh green color and texture, which lasted all the way through the test.

In conclusion, the light-emitting diode plants were healthier and grew at a steadier pace, while saving more than 100 watts of energy. These results showed that choosing light-emitting diodes would be a smarter choice to grow healthier plants and help the environment as well.

HS-16
Sheena Song
Botany 2007/2008

THE EFFECTS OF RECYCLED WATER ON THE NATIVE PLANT SPECIES: *BOUTELOUA GRACILIS, JUNCUS PATENS,* AND *NASELLA CERNUA*

With the growing demand on a limited water supply, the use of recycled water for irrigation offers both a long term sustainable approach as well as a cost effective plan. However, the effects of recycled water on native plant species are virtually unknown and may therefore pose a risk to the well being of plants. If native plant species are watered with recycled water, then native plants with higher exposures to recycled water are subject to ailments.

In this experiment, three water treatments were used to evaluate the responses of the three native plant species, *Bouteloua gracilis, Juncus patens, and Nasella cernua*. These treatments included recycled water, an alternating combination of recycled water and tap water, and regular tap water. Measurements of height and stem abundance were recorded approximately every one and a half weeks for 14 weeks. The roots' were examined at the end of the fourteen week period, and the roots' wet and dry masses were also determined.

In the end, usage of recycled water on the three native plant species produced mixed results. In the two species *Bouteloua gracilis and Nasella cernua*, the plants watered with recycled water generally exhibited stunted growth, compared to those treated with tap water. In *Juncus patens*, however, plants treated with recycled water showed more overall growth.

The experiment provided useful information regarding whether or not recycled water is harmful to plants. By applying the results to daily life, it is realistic to presume that recycled water may be used as a sustainable solution to the world's limited fresh water supply in certain plants species.

HS-17
Suh Young (Sharon) Woo
Botany 2007-2008

Photosynthetic CO_2 Assimilation of a Coastal Sage Scrub Plant Community of Southern California

Because of the rising CO_2 concentrations in our environment, plants become important mechanisms in reducing the CO_2 in our atmosphere. This study compared the photosynthetic CO_2 uptake, water-use efficiency, transpiration, and leaf conductance to water vapor of evergreen

and deciduous plants of the costal sage community. Through the results it examined the different strategies that plants use to cope with the Mediterranean-type environment. In addition, the relationship between the leaf lifespan and the photosynthetic carbon dioxide uptake was found.

A portable gas exchange system (LI-6400, LI-COR Inc., Lincoln, Nebraska, USA) was used to measure the maximum rates of net photosynthesis, stomatal conductance to water vapor, and water-use efficiency in three different shrub species. The shrub species included an evergreen, *Rhus integrifolia* (Lemonadeberry) , and two deciduous, *Salvia mellifera* (Black Sage) and *Salvia leucophylla* (Purple Sage).

It was found that evergreen leaves have a low photosynthetic rate while the deciduous leaves had a high photosynthetic rate. The evergreen species save their water and carbon dioxide to use when not enough water is available during drought, but the deciduous plants use all the energy up for growth so that during drought, they remain dormant. When the CO_2 uptake in relation to leaf age was measured, it was found that the rate of photosynthetic carbon dioxide uptake decreases as the leaf's age increases. The older leaves lost their ability to fix CO_2 because they do not have enough nutrients.

This study clearly showed the difference between the photosynthetic carbon dioxide uptake of evergreen and deciduous species that live in the sage scrub community and the various strategies that plants use to survive in the harsh environment.

CHEMISTRY

HS-18
Debra CHANG
CHEMISTRY

Effects of Varying Zinc Concentrations on Bioluminescence in *Cypridina hilgendorfii*

This study determined the effect of varying zinc concentration on the bioluminescence of *Cypridina hilgendorfii,* a marine shrimp. The results were compared to my previous year's project that determined the effect of phosphate on this crustacean. The result of the present experiment may be used to find the concentration of a common water pollutant, the metal zinc.

Preserved *Cypridina* were introduced into zinc sulfate solutions in concentrations of 0.05 g/ 100 mL, 0.1 g/ 100 mL and 0.15 g/100 mL. The Control Group solution was undosed distilled water. 0.05 g of ground *Cypridina* and 2 mL of zinc solution were placed in a cuvette. Four trials were done per concentration. Digital photographs were taken in a darkroom, exposing the film at 10, 15 and 20 seconds.

The results were quantified using AnalySIS software. The program calculated the percentage of the picture that was black. This percentage was subtracted from 100% to

determine the percentage of the rest of the picture, which was light in the white-to-blue spectrum. This light frequency was determined for each picture.

With increased concentrations of zinc sulfate, the light frequency also increased. These results contrasted with the results from the previous year's study, where sodium phosphate caused a diminishment of light. Future research can be done to discover why zinc enhanced the bioluminescent reaction while phosphate hindered it. Several possible explanations are presented. With the significant effect on the amount of light being emitted, it is apparent that *Cypridina* can be used as a bioluminescent indicator for water quality.

HS-19
Eric Fischer
Chemistry 2007/2008

DETERMINING ASCORBIC ACID CONCENTRATIONS BY REDOX TITRATIONS WITH IODINE

The consumption of Vitamin C must be integrated into any human diet as it is necessary for everyday bodily functions, so recognizing which orange juice contains the greatest amount of Vitamin C would be of great assistance to one seeking a healthy lifestyle. Thus, the goal of this project was to determine the different concentrations of ascorbic acid, or Vitamin C, in freshly squeezed orange juice, premium orange juice, and orange juice from frozen concentrate.

To find the concentration of ascorbic acid in each type of orange juice, the characteristics of a redox reaction were manipulated, in which ascorbic acid was oxidized and iodine was reduced. Soluble starch was the indicator in the experiment; the blue-black color brought about by iodine and starch reactions signaled the end of titrations between iodine and ascorbic acid. Also, a Vitamin C tablet was dissolved to 1 mg/mL to formulate a reference in which the iodine titrations of each type of orange juice could be compared.

The principal findings from the data show that the orange juice from frozen concentrate (0.690 mg/mL) had the greatest concentration of ascorbic acid, followed by freshly squeezed orange juice (0.644 mg/mL) and premium orange juice (0.400 mg/mL).

The relatively close concentrations of ascorbic acid in orange juice from frozen concentrate and freshly squeezed orange juice can be attributed to analogous oxygen exposures (minimal) and similar "preparation to experimentation" time frames (minimal). The premium orange juice was exposed to the most oxygen and had the greatest "preparation to experimentation" time frame, causing the greatest ascorbic acid loss.

HS-20
FREIJE, Catherine
Chemistry 2007/2008

ALTERATION OF THE CIRCADIAN RHYTHM IN BIOLUMINESCENT VIBRIO FISCHERI

Vibrio fischeri is a rod-shaped, bioluminescent bacteria which emits light based on three factors: a luciferin and luciferase reaction, a circadian rhythm, and a lux operon. Even though light is merely a product in the luciferin and luciferase reaction, the existence of a circadian

rhythm based on day and night cycles provides the possibility that light exposure has an effect on the chemical reaction. The typical circadian rhythm contributes to the bacteria having a higher intensity of light during the night than during the day. Therefore, if *Vibrio fischeri* underwent a variation in light exposure, such conditions could alter the circadian rhythm.

The bacteria was exposed to six hour cycles of light and dark. The control group was in light from 6 am to 6 pm, and dark from 6 pm to 6 am for 3 days, while the experimental group was in dark from 6 am to 6 pm, and light from 6 pm to 6 am for 5 days. Light emission was recorded by digital photographs exposed for 5, 8, and 15 seconds.

For the control group, light emission followed the typical circadian rhythm of *Vibrio fischeri*. The photographs demonstrated a higher intensity of light during the night than during the day. In the first two days of changing the light exposure, the light emission is very similar between day and night. By the third and following days of varied light exposure, the bacteria was emitting light of a greater intensity during the day than at night. Also, as the bacteria and medium aged, the glow faded near the center but remained intense along the edges.

The change in intensity of light emission clearly demonstrated that a variance in light exposure would in turn alter the typical circadian rhythm of the bacteria. The circadian rhythm shifted by about 12 hours; however the experimental conditions had initiated a slow change in the circadian rhythm. Therefore, the alteration of the circadian rhythm is a gradual change rather than an abrupt change.

HS-21
Jason KIM
Chemistry

Finding Natural Substitutes for Acrylic Retardants

There are many effective acrylic paint retardants available for painting hobbyists and professional painters alike, but one common problem that all of such acrylic paint aficionados face is the high price of such retardants. The main function of an acrylic paint retardant is this; it slows down the process of the paint's solidification so that painters can use the acrylic paint longer, not worrying about the paint's exposure to heat and oxygen. While company-based acrylic paint retardants certainly do the job needed, the majority of such products are often needlessly expensive; painters should not be unfairly charged such a high price. Another danger was the chemical substances inherent in the acrylic retardants, which contained dangerous and potentially toxic materials. Therefore, the challenge involved coming up with natural, easy-to-acquire and cost-efficient materials that can serve as effective substitutes for the company-produced retardants.

This task required a thorough understanding of the chemical components of the acrylic retardant itself, and the mechanism in which the retardant actually slowed down the process of

solidification. Meanwhile, new observations were made to find materials that are non-toxic, environmentally friendly, and still serve as functional retardants.

Through periodic experimentation, it was found that substances, including natural emollient oils, including avocado, almond, corn and Oliver oil were very good substitutes for acrylic retardants. These findings are significant because they have illustrated that hobbyists and acrylic painters alike can now concoct their own retardants without worrying about product purchases.

HS-22
Mona NEJAD
Chemistry

Efficacy of Xylitol in Comparison to that of Listerine and Water in Restoration of Oral pH

The ideal salivary pH of 7.4 is critical in maintaining healthy oral hygiene. When the salivary pH becomes too acidic, the risk of acquiring dental caries increases significantly. The objective of this experiment was to investigate the effectiveness of xylitol in comparison to Listerine and water in the restoration of salivary pH to its ideal level. It was hypothesized that Xylitol would be more effective than both Listerine and water in stabilizing oral pH from an acidic environment to the ideal, stable pH.

Thirty volunteers were split into three groups of ten. The three groups tested water, Xylitol, and Listerine. The volunteers in every group were first given a substance that induces an acidic oral environment. Their induced pH was measured and recorded. Then, depending on their group, one of the three substances, Xylitol, Listerine, or water, was administered to the subjects. After rinsing with the substance, the salivary pH of the subjects were again measured and recorded.

The results confirmed that Xylitol was the most effective means of restoring the salivary pH to 7.4. Xylitol was most consistent and restored pH to about 7.3, only 0.10 away from the ideal pH. Water was not as consistent or effective, but still increased the pH to about 7.0, which is 0.40 away from ideal salivary conditions. Listerine surpassed the standard pH levels and created the more alkaline pH of about 8.0.

The alkaline pH at levels produced by the Listerine increases the risk of acquiring dental caries. By frequently using substances like Listerine, which cause basic salivary pH, the body naturally begins to increase the production of acidic saliva. The acidic environment then creates favorable conditions for the mutans streptococci bacteria that cause dental caries. In contrast, Xylitol restores ideal pH and is thus the most effective means of reducing the risk of acquiring dental caries.

COMPUTER SCIENCE

HS-23
Alice LEE
Computer Science 2007/2008

Optimization of the Traveling Salesman Problem for Artificial Ant Colonies Through Synchronous Updating of Deposited Pheromones

This project sought to determine another method of optimizing the Traveling Salesman Problem simulated by artificial ant colonies. More specifically, an attempt at synchronous pheromone updating to optimize the shortest path created by the Traveling Salesman was investigated. Unlike previous simulations of this problem, this study designed multiple ants to average their pheromones before depositing them on paths.

To simulate a comparison between synchronous and asynchronous updating, two computer programs were designed. In one program, the ants immediately deposited pheromones on traveled paths, after each cycle. In the other program, 500 ants averaged their pheromone amounts before synchronously depositing that average to their paths.

Comparison of paths created between the synchronous and asynchronous simulations showed that asynchronous updating produced varied, inconclusive data, while synchronous updating produced the optimal, shortest path.

It was concluded from this study that synchronous, averaged updates of multiple amounts of pheromone optimizes the Traveling Salesman Problem.

HS-24
James Lin
Computer Science 2007/2008

Modeling Effects of Urea Cycle Disorder Treatments Using JDesigner 2

Currently there is not a definite cure for the Urea Cycle group of disorders. These disorders can occur from childbirth and can be potentially fatal because of elevated toxic ammonia byproduct. JDesigner 2 is a computer simulation program which allows users to create biologic system and test different scenarios. This opens up a pathway to allow scientists to simulate how the Urea Cycle works and allows them to test out different parameters and test out potential treatment paradigm. I believe that raising the arginine concentration could potentially lower the concentration ammonia and help patients with urea cycle defects.

JDesigner 2 was used in conjunction with the data for the Urea Cycle for experiment. The program was used to arrange the reactions in the Urea cycle to simulate the cycle. The concentration of arginine was also changed from original conditions to higher concentrations to simulate an infusion of arginine that could possibly lower ammonia output.

My hypothesis was partially confirmed. As the arginine concentration simulation was moved up, the ammonia concentration inversely went down. At 10 units of concentration, the ammonia concentration was 18.249 after 10 units of time; at 20 units of concentration, the ammonia concentration was 18.198 and at 200 units it was 17.341. This showed a decrease in ammonia. The carbamoyl phosphate, when increased, did not have an effect on ammonia after 100 units of time, although it did increase as I predicted after 10 units of time.

I conclude that if there is a deficiency which causes a coma due to raised ammonia medics can infuse arginine to counteract the raised concentration and reduce the production of harmful ammonia. If the Urea cycle disorder comes up in patients, it means that there is a raised output of ammonia which could potentially be fatal to them. By giving arginine to patients, a significant decrease in ammonia may signal a cure for the urea cycle disorder.

Ammonia byproduct. JDesigner 2 is a computer simulation program which allows users to create biologic system and test different scenarios. This opens up a pathway to allow scientists to simulate how the Urea Cycle works and allows them to test out different parameters and test out potential treatment paradigm. I believe that raising the arginine concentration could potentially lower the concentration ammonia and help patients with urea cycle defects.

EARTH & SPACE SCIENCE

HS-26
John KIM
Earth & Space Science

Quantitative Comparison of Skyglow between Los Angeles and Palos Verdes

Skyglow is a specific type of light pollution that is visible by the glowing effect seen in the skies over cities. Through the use of a digital camera, the amount of skyglow can be quantitatively measured and can be used to compare light pollution levels in certain areas. Digital cameras can capture the night sky, and computer programs can analyze the levels of the gray pixels in a certain area of interest. The average pixel intensity shows how much energy the pixels are receiving, so the more pixels there are, the more energy it receives, and consequently, the brighter the object. The higher pixel gray levels show that there is more skyglow in that area.

The general procedure involved taking photographs of Orion's belt using a Nikon D40 camera using complete manual settings. Photographs were taken from Los Angeles, Huntington Park, Torrance, and Palos Verdes, a varying distance from the major urban center in our area, downtown Los Angeles.

The results show that a greater distance away from the major urban area result in a decreased amount of skyglow. Each area consistently shows nearly the same level of skyglow, but the regions further away from Los Angeles show decreased amount of skyglow.

The results are significant because we are provided with a quantitative measure of skyglow using a common apparatus such as a digital camera. Furthermore, the results suggest that observatories in and around the immediate Los Angeles area are threatened by the greater levels of skyglow in the area.

ENGINEERING

HS-27
Anna CHEN
Engineering

EFFICACY OF INSOLATION CONVERSION OF ALTERNATIVE ENERGY SOURCES

Almost all renewable, alternative energy sources such as photovoltaic and crop biomass (ethanol and biodiesel) are essentially solar energy conversion. If the efficacy of insolation conversion of alternative energy sources is calculated, then modern photovoltaic cell technology will prove to be more effective than any other source of alternative energy. This research is from a scientific point of view and does not consider the economics of building the infrastructure for each of the energy alternatives. This provides a theoretical upper limit of solar energy conversion efficiency by which to compare the long-term potential of each alternative energy approach. In this way, the comparison will be independent of any local or short-term changes in energy economics that can temporarily make one energy alternative more attractive than another.

The results of this research proves the hypothesis that photovoltaic technology is the most efficient for solar energy conversion at 15% to 20% for conventional solar cells, and increasing

to greater than 30% for new three-junction solar cells. Sugarcane ethanol is second at 0.183% followed by corn ethanol at 0.118%. The least efficient is soybean biodiesel at 0.0267%. This means that the land area for a photovoltaic (solar cell) farm is over 100 times smaller than that required for any of the biomass farms to produce the same amount of energy. Not only is the land area smaller, but it also does not have to be arable or irrigated thereby promising a future that does not force us to choose between food and energy.

HS-28
Vikram DHAWAN
Engineering

Detecting Inaudible Frequencies in the Classroom

Cheating is a major problem in schools and colleges across America. One invention that students have managed to convert into a new device that can assist them in cheating is the mosquito ring tone. This ring tone, which functions on frequencies that are inaudible to most adults over the age of 24, is used by students to send text messages during a test. In order to alleviate the number of students cheating with the use of this ring tone, a device was required that could pick up the ring tone and alert an adult when it is in use. In this project, a blueprint of a device that can pick up this ring tone and can alert adults when it is in use has been constructed.

In order to construct such a complex device, all other frequencies except the desired frequencies must be filtered out. This is achieved by using an operational amplifier coupled with two resistor-capacitor circuits. After the frequency is filtered, a detector circuit must be built. In this case, the detector is comprised of a Light Emitting Diode that turns on when a certain number of volts is passed through it.

After the lay out had been completed, it was found that, if constructed according to the plan, the device would be able successfully detect the mosquito ring tone when it was in use. However, the calculation for some of the resistor-capacitor circuits may vary depending upon the project.

This device can be very proactive in reducing the number of students cheating in America. By following this plan and conducting some experimentation, a device can be created that will be able to detect a ring tone that hundreds of students across America are using to cheat.

HS-30
Anshu VAISH
Engineering

Magnetorheological Fluid Based Links in Morphing Aircraft Structure

The project aims to create an active hinge link to move the internal load carrying structure of the morphing aircraft wing based on magnetorheological principles. The research estimates the level of resistance (rotational shear stress) of magnetorheological fluid as a function of a varying strength external magnetic field and amount of fluid.

Rotational shear stress was determined by attaching a plastic spindle to the electromagnet. Wooden dowels of varying diameters (1.0 cm, 1.5 cm, and 2.0 cm) were obtained to vary the amounts of magnetorheological fluid and test the subsequent effect on the fluid's rotational shear stress. Each dowel was cut in two pieces with one piece attached horizontally to

the other vertical piece and strings were attached to the horizontal pieces. An external dual pulley system was also erected. The dowel was then inserted into the spindle and the gap between the spindle and dowel was filled with magnetorheological fluid. For each dowel tested the electromagnet had varying voltages in 5 V increments up to 30 V run through it and identical masses were attached to each pulley until the dowel rotated five degrees. This procedure was repeated for each different dowel and the masses were recorded.

The rotational shear stress of the fluid stayed constant to the 20 V mark (10 g mass was needed on each pulley) and then increased to 20 g where it stayed constant to the final 30 V mark. This was true in each of the different diameter dowel experiments. Because of identical results in all three different diameter dowel experiments, it was found that rotational shear stress was not affected by the amount of magnetorheological fluid.

Since rotational shear stress did eventually increase, the application in of an active hinge link in aeronautics is viable. Future research would involve developing a morphing wing based on a bird's wing with changing active hinge link "feathers" which use magnetorheological fluid as the locking agent.

ENVIRONMENTAL SCIENCE

HS-31
Joyce CHAI
Environmental Science 2007/2008

MODELING THE TOXIC EFFECTS OF SILVER NANOPARTICLES UNDER VARYING ENVIRONMENTAL CONDITIONS

The basic concept of nanotechnology focuses on reducing the size of macroscopic systems to roughly 1 to 100 nanometers and enhancing a number of unique physical phenomena that occur only at the nanometer scale. With an increased surface area to volume ratio, silver nanoparticles exhibit a more efficient antimicrobial potential than its metallic counterpart, silver ions. The abundance of silver nanoparticles in the consumer market, however, increases the risk of environmental exposure. This investigation attempts to model and quantify the toxicity of silver nanoparticles under varying environmental conditions and to measure the toxicity of "nanosilver" in a model consumer product.

Preliminary experiments conducted under varying interaction times and particle concentrations determined the optimum time and condition for the assay. From this, a novel, high-throughput

bacterial toxicity assay was developed. Toxicity, redefined as the percentage of dead cells that died *in excess* to that of the natural death of cells, was subsequently quantified using the live to dead cell fluorescence intensity ratio. A JAVA computer program was written specifically for this investigation to facilitate the analysis of the high-throughput data. A water filtration system was developed to provide a practical application of the bacterial toxicity assay to a model consumer product containing silver nanoparticles

From the preliminary experiments, the optimum interaction time between the surrogate bacteria and the silver nanoparticles/silver ions was determined to be approximately 3 hours. The bacterial toxicity assay showed that silver nanoparticles and silver ions induce equal toxic effects on the environmental bacteria. The results from the high-throughput assay revealed that silver nanoparticles and silver ions induce a greater toxicity in gram-negative bacteria than in gram-positive. Finally, the practical application of the water filtration system revealed the potential risks of using nanosilver consumer products.

The conclusions of this investigation demonstrated three essential concepts. First, this novel bacterial toxicity assay technique is a reliable, reproducible approximation of the potential toxicities of silver nanoparticles. Secondly, the toxicity assay revealed that the silver nanoparticles induce high toxic effects, including overwhelming cell death and cell inactivity, in a relatively short period of time. The environmental risks over a longer period of time, however, may be extremely detrimental. Finally, the practical application of the toxicity assay substantiates the known efficacy of silver nanoparticles, but questions the reliability of using nanosilver consumer products. This investigation took fundamental steps toward understanding and quantifying the potential environmental consequences and risks of using nanoparticles.

HS-32
Monica Chen
Environmental Science 2007-2008

OPTIMUM CONCENTRATION OF SODIUM PHOSPHATE FOR OIL BIOREMEDIATION

This project was designed to identify the concentration of sodium phosphate tribasic (Na_3PO_4) at which oil-degrading bacteria would most effectively remediate oil-contaminated water. By pinpointing this concentration, biostimulation of oil-degrading bacteria can be maximized using a preset level of nutrients. This is, accordingly, a proficient way to enhance microorganisms' digestion of hydrocarbons. Oil spills, ubiquitous catastrophes in recent times, can be handled cost-efficiently using this method, without the production of toxic byproducts.

Six containers were filled with a constant amount of water, oil, and oil-degrading microbe suspension. Then, with the exception of the 'control' container, varying amounts of Na_3PO_4 were added to the containers, starting from 0 ppm in the control and thereon increasing by increments of 500 ppm until the highest dosage, 2500 ppm, was applied to the last container. Aeration for 10 days was provided for efficient mixing and for use by bacteria. For 10 days, every 4 days, starting from Day 2, a sample was removed from each container and taken to a laboratory for analysis of remaining hydrocarbon.

Laboratory analysis revealed that the container with the highest amount of Na_3PO_4 (2500 ppm) had the least amount of hydrocarbons remaining. Other containers also presented substantial evidence that nutrients, like Na_3PO_4, boost the performance of bacteria, promoting their degradation of oil at a faster rate. Some anomalies were present in the data, so scatter plots were drawn for each container, to show the relative rate of hydrocarbon loss, and a trend line was determined for each graph to present a clearer analysis.

The remaining amount of hydrocarbons in the containers implies that the higher the Na_3PO_4 concentration ($\leq$ 2500ppm), the higher the amount of hydrocarbons degraded. During the conditions that prevailed in this experiment, 2500 ppm of Na_3PO_4 was found to be the optimum concentration necessary for the degradation of oil in water by certain bacteria. This biostimulant procedure can be applied to water-contaminated areas for an economical oil spill cleanup. It is also possible that a modification of this procedure could be used to clean up oil spills on land, such as drill-site spills and oil seeps.

HS-33
Hanui CHOI
Environmental Science 2007/2008

The Use of Cursorial Arthropods as Bioindicators of Restoration Success

The harmful effects of degradation by invasive vegetation have led many nature preserves to begin restoring areas to biological stability through planting native species. The native plants are planted so that they could once again resume ecological dominance over the nonnative plants. To indicate how successful restoration efforts are, many factors could be taken into consideration. In this study, the effectiveness of cursorial arthropods in indicating restoration success was assessed.

Nine pitfall traps were placed in three areas of a preserve under restoration to collect arthropod samples. One area was a native area, another was between the native area and the area being restored, and the other was an area in restoration. The traps were deployed for the first two weeks of restoration efforts on the preserve. The samples were then separated from plant matter and debris, and sorted into families. The data was analyzed through various statistical equations on Microsoft Excel.

The data pointed to the area in between the native and restoration areas as the group of traps with the most number of individuals and species diversity. Out of a total of 4779 individuals counted, 1747 of them were from samples of the area in between the native and restoration areas. The Shannon index value of the area was the highest out of the three, at 1.4444161.

The hypothesis was proved because without the restoration, the native area would have undoubtedly been the most stable area. Because of the restoration efforts, the area between the two sections contained the most organisms and species. Therefore the cursorial arthropods responded positively to the restoration, showing an increase in population and species richness.

HS-35
Natalie INOUE
Environmental Science

Variance in Indoor and Outdoor Organic and Elemental Carbon Level Caused by Daily Conditions

With many respiratory health problems increasing in number, such as asthma and poor lung development in children, recent pollution concentrations are of great importance to the Environmental Protection Agency and to human health. Therefore, the objective for this experiment was to investigate the relationship between both daily indoor and outdoor conditions, and elemental and organic carbons concentrations in the air.

Airchek Samplers were used to collect concentrations of organic and elemental carbons that were deposited on quartz filters. These filters were then analyzed at the University of California, Los Angeles through thermal ramp combustion. Differentiating between organic and elemental carbons by the temperature in which they burn, the thermal/optical transmittance analyzer found the concentration of carbon per 1.5 square centimeters of quartz filter.

Through the analysis of the data collected, it was found that with an increase in indoor activity, like cooking and cleaning, organic and elemental carbon levels also increased. This also held true with outdoor carbon levels and increasing yard work, fireplace, and barbeque activity. Also, precipitation tended to decrease the amount of carbon due to the fact that it removed particles from the air.

Overall, although organic carbon levels were generally almost twice as high indoors compared to levels outdoors, elemental carbon concentrations showed little differentiability between the two locations. In conclusion, the hypothesis that with an increase in activities, organic and elemental carbon levels would also increase was proven to be correct.

HS-36
Kayla KELLY-SLATTEN
Environmental Science

Human Population Effects on Humidity Levels in the Coachella Valley

This research project was constructed to demonstrate the effects that the growing human population has on humidity levels in the desert region of California. Many people have a difficult time relating to and then coping with the ideas of climate change and global warming. Because of these reasons, this specific study was completed with a hope to bring about a change of perspective and to make it simpler for a person to understand the consequences of mankind's ignorance.

Due to the fact that this type of analysis is mostly data collecting and researching, there were no major procedures and methods followed. Instead, time was spent online and at home completing charts and formulas. The order taken was merely for organization purposes and began with choosing the cite of research, setting specific time intervals, and collecting population numbers. Then, dew point data and air temperature numbers were needed so as to calculate the relative humidity percentage on an online calculator. This arrangement aids in the movement and neatness of this survey.

At the end of data compilation, no key pattern was noticed. However, jumps were noted in between years with huge population growth increasement. These years were then accompanied by the rise of the moisture, verifying my hypothesis and leading to the conclusion of adaptation.
As an outcome of human population enlargement, the Coachella Valley, not its people, has learned to transform and adapt to its new surroundings. In other words, it is finding ways to coexist with the thriving human population. Adaptation is the only idea that could possibly fit the irregular data that

this experiment has supplied. Even if the Valley has adjusted, it does not mean that the desert's problems are solved. Actually, this creates a continuation of setbacks, including human distress and the truth found behind the theory of climate change.

HS-37
Michelle Kim
Environmental Science 2007/2008

PHYTOREMEDIATION OF PHOSPHATES USING FLOATING CALIFORNIA TULES

Over a period of four weeks, an experiment was conducted to determine how much total phosphorus an average *Schoenolectus californicus*, commonly known as tule, contains (per kilogram of plant) and the rate of uptake of dissolved phosphate (PO_4^{-3}) in tubs containing sump water from Madrona Marsh. Tule plants of size range 36.5 centimeters (cm) to 219.3 cm were exposed to various concentrations of phosphate ions.

After dosing the tubs with sodium phosphates (3Na4OP), initial samples of water were analyzed at Associated Labs in Orange County for dissolved phosphate ions. Once a week afterwards, one whole tule plant and water sample from corresponding stations were analyzed. In all, three complete plants and two water samples were studied.

Using a mathematical sampling technique, the results of the complete tule phosphorus results were converted to fit a theoretical "average tule plant". The results indicate that the average tule contains about 1 percent phosphorus (by weight). The rate of uptake of phosphate by the average tule plant was about 2230 milligrams per kilogram (mg/Kg) per week, and the rate of decrease in dissolved phosphates was about 6.72 mg per liter per week for two weeks.

The results appear to show the significance of phytoremdiation of phosphorus. Since not much work on this topic has previously been completed, the results cannot be compared with other researchers. However, the amount of phosphorus, about 18.83 grams per 136.50 centimeters of plant, and the rate of uptake 2230 mg/Kg per week seem high.

HS-38
Katherine Koehler
Environmental Science 2007/2008

The Most Efficient Way to Clean Up an Oil Spill

The purpose of this experiment was to determine the most efficient way to clean up an oil spill as among various methods currently used, including skimmers, sorbents and chemical dispersants. I hypothesized that the skimmer method would result in the greatest quantity of oil recovered in the time allotted (five minutes for each method) and thus would be the most efficient.

Six pans each containing 4000 ml of seawater with 200 ml of motor oil floated on top were used. The first pan served as the control. For the second and third pans, a 10 ml capacity syringe and a 44 ml capacity turkey baster, respectively (simulating skimmers) were used to suction up oil. For the fourth and fifth pans, pieces of cotton and polypropylene pad, respectively (simulating sorbents) were placed on the oil. For the sixth pan, 100 ml of liquid detergent was distributed over the oil. The amount of oil recovered using each method was weighed with a

metric scale (except for the chemical detergent method, which produced immeasurable results). The experiment was repeated a second time and the results averaged.

The sorbent method (cotton) retrieved the most, followed by the skimmer method (turkey baster), the sorbent method (polypropylene pad), and then the skimmer method (syringe). The results may have been skewed in part by the fact that the methods used in pans 2 through 4 also picked up significant amounts of water, which was not separated from the oil prior to measurement.

In the real world, application of each of the methods depends on the prevailing conditions of a given oil spill (e.g., skimmers do not perform well in rough water) and thus it is important to choose the method or combination of methods that will be most effective in remediating the particular situation.

HS-40
Jennifer SMOLKE
Environmental Science 2007/2008

EFFECTS OF CALCIUM CARBONATE ON PHOSPHATE CONCENTRATION

Eutrophication, a common problem in bodies of water, is a principle issue at Madrona Marsh due to naturally high levels of phosphate in the sump water and in the sediment. This project attempted to find a relatively inexpensive solution to reduce the high levels of phosphate by adding calcium carbonate. Calcium carbonate may react with phosphate to form the precipitate calcium phosphate or the phosphate may adsorb to the calcium carbonate to form a surface complex, especially at the level of phosphate concentration of Madrona Marsh. It was hypothesized that calcium carbonate can precipitate phosphate in amounts proportional to the amount of calcium carbonate added.

The effects of calcium carbonate on phosphate concentration were determined by dosing five containers filled with equal amounts of distilled water and sodium phosphate to establish the initial baseline concentration of phosphate. Increasing amounts of calcium carbonate were added to each container and a sample of each container was taken after twenty-four hours.

The results indicated that the initial and final concentrations of the dissolved phosphate were about equal with slight fluctuations in amount of dissolved phosphate. The largest fluctuation occurred in Station 3, which had the second-greatest amount of calcium carbonate added. However, the changes in phosphate concentration were so small that they could easily fall within the margin of error.

Therefore, the results of this experiment were inconclusive. Error could have resulted from inaccuracy of the scale or tests for phosphate as well as unequal distribution of phosphate in the water.

HS-41
Katherine YU
Environmental Science 2007/2008

STUDY OF EFFECTIVENESS OF AERATION ON MADRONA MARSH SUMP WATER

Although nature does clean up water by itself, its effect is too small nowadays due to water contamination caused by humans. Scientific technology is needed to manage the water for safe human use. Aeration purifies water and filters out harmful compounds and has been used for secondary treatment of sewage wastewater, beer fermentation, and oxygenation of the fish aquarium water. But it was uncertain if aeration was indeed effective enough to improve quality of any type of water, even sump water full of bacteria and organic and fecal matter.

Over 6-week period, experimentation was conducted to determine how aeration affects the numbers of bacteria present, biochemical oxygen demand, pH, dissolved oxygen, and total suspended solids in an aquatic environment, using the sump water from Madrona Marsh. Following parameters: pH, DO (Dissolved Oxygen), BOD (Biochemical Oxygen Demand), and bacteria counts were checked every two weeks. Total suspended solids tests were done at the end of the 6 weeks on the CONTROL and 6-WEEK aquarium water.

As the time progressed on, the results indeed indicate that aeration had positive effects on the water. The pH remained stable around 7.40; DO concentration increased during the study and decreased as soon as the aeration was cut off; BOD and number of bacteria colonies decreased as the length of time of aeration increased.

The experimentation successfully proved that aeration can improve the water quality, even that of sump water. Also the longer the aeration, better the water quality was became.

HS-43
Lisa ANDERSON
Medicine & Health

HIGHLY IRRADIATED ANTERIOR CRUCIATE LIGAMENT ALLOGRAFTS VERSUS HISTORICAL LITERATURE

The anterior cruciate ligament (ACL) is an important ligament that connects the bones of the knee joint and is often torn from pivoting during athletic endeavor. Allografts from cadaveric tissue are often used to reconstruct an injured or absent ACL. Allograft tissue used to reconstruct the ACL is often irradiated to remove infectious diseases so that they will not be transmitted to the recipient patient during the reconstruction operation. Though literature has stated that highly irradiated ACL allografts have a high failure rate, it is hypothesized in this study that they are successful.

Eleven patients who had undergone highly irradiated allograft ACL reconstruction underwent clinical evaluation at an average of 2.9 years postoperatively. Knee range of motion, the Lachman test, the single leg hop test and Tegner scores were evaluated.

The range of motion did not meaningfully differ between operative and non-operative knees. The Lachman test averaged grade 1, which signifies 3-5mm translation of the knee joint. The operative and non-operative extremity hopped similar distances during the hop test. The Tegner scores comparing the patients' activity level before injury and after surgery revealed a

two point reduction possibly due to patients' change in age and/or discontinuation of a sport or activity due to other reasons. No patient required revision of the original surgery at the time of follow-up evaluation.

Generally, this clinical evaluation argues that highly irradiated ACL allografts can be successful in knee ligamentous reconstruction, compared to a 33% and a 23.1% failure rate reported in literature.

HS-44
June CHOO
Health and Medicine 2007/2008

Antifungal Effects of an Extract of the Oriental Herb, *Cnidium monnieri*

Many current antifungal medicines pose dangerous, long-term side effects that outweigh the benefits of treating the fungal infection. Many of these drugs present adverse effects on the liver, which is difficult to restore back to normal conditions. This project seeks an alternative to these drugs through the oriental medicinal herb *Cnidium monnieri*.

To test its antifungal effects, 12 different flasks with the same amount of media were separated into four different groups. The first group served as controls, with just 20 mL of water. 2 mL of the *Cnidium monnieri* seed extract and 18 mL distilled water were added to the second group; 7 mL of C. monnieri extract and 13 mL of distilled water were added to the third group, and just 20 mL of extract was added to the fourth group. Equal amount of the yeast *Saccharomyces cerevisiae* were placed into the flask, and incubated at constant temperature. Once the *S. cerevisiae* entered the logistic growth phase, 1 mL samples were taken at four different time points for seven hours. Using the spectrophotometer, the Optical Density of each sample was measured, and the growth rate for each group was determined. A hemacytometer was then used to count the individual cells for certain values of O.D. measurements, in order to correlate O.D. to cell density.

The group with the highest concentration of *C. monnieri* extract showed the most inhibition, decreasing the rate by 66.9%. However, the results for the groups with intermediate concentrations of the extract showed varying results, which was attributed to the nutrient content of the seeds.

With further research, *C. monnieri* presents promising future as an antifungal medicine not only in the Eastern countries, but throughout the world.

HS-45
Jergens, Jill
Medicine and Health 2007/2008

THE MANIPULATION OF SCAR MATURATION

The purpose of this experiment was to discover if an IPL laser could be used to manipulate the maturation of the local environment of a scar (closed, result of abdominoplasty). It was hypothesized that the laser treatment would increase the rate of maturation and produce more aesthetically pleasing results than routine postoperative care of the scar. Three middle-

aged women who had undergone an abdominoplasty (tummy tuck) three to four months prior to experimentation were the test subjects. Each subject's scar was photographed before treatment. Each subject received an IPL laser treatment on half of her scar once a month for three months. The other half of the scar underwent routine postoperative care (control). Photographs were taken again at the lapse of the treatment. The before and after photos taken of each subject's scar were visually compared to each other. The characteristics observed were the degree of redness and inflation. It was concluded that the halves of the scars that received the IPL laser treatment showed to be more advanced in their maturation process than the half that did not receive this treatment. This shows that the IPL laser treatment increased he rate of maturation and produced more aesthetically pleasing results compared to the routine postoperative care.

MEDICINE & HEALTH

HS-46
Jessica Kwan
Medicine 2007/2008

Analysis of the Diameter of the Ascending Aorta in Relation to Age and Gender

Most cardiovascular diseases occur because of atherosclerosis, or the blockage of coronary arteries through calcification. A method to reveal atherosclerosis is by measuring the diameter of the ascending aorta, a blood vessel which supplies oxygen-rich blood to the coronary arteries, and comparing the measurement to a standard value for that particular age. In this analysis, the age range in which the diameter of the ascending aorta changes greatly from the measurement of the younger age group was determined. Also, it was determined whether or not gender has an affect on the size change.

The analysis attempted to verify that the most significant change in the diameter of the ascending aorta would occur at the age group of 50 to 54 years old. Also, gender would not play a significant role, and therefore the age range stated would apply both to females and males. For the analysis, the Cardiac Computerized Tomography (CT) scans of 624 patients (300 females and 324 males) were collected at Harbor UCLA Medical Center. The diameter of the ascending aorta of each patient was measured and then grouped first by gender, then by age.

From the analysis, it was determined that that gender does affect the age group at which a significant change occurs in the diameter of the ascending aorta. The result of the study did not support the initial hypothesis, which stated that gender would not affect the change in ascending aorta and therefore the age group would be from 50 to 54 years olds. Rather, from the age group ranged from 60 to 64, females showed a larger change in ascending aorta diameter while, for males, the change occurred at the age group from 70 to 74 years old.

Generally, the analysis provided useful information which can be used to aid in educating patients about cardiovascular disease prevention. The ascending aorta increases in size because of coronary calcification, and a great enlargement signifies the presence of a disease. This data can be applied to medical examinations as a screening test at a certain age to prevent cardiovascular disease or to bring awareness about a present disease and how to combat it. With a spread of awareness, the number of cardiovascular disease may decrease, prevention may increase, and the overall international population may be healthier.

HS-48
LEVENSON, Joseph S.
MEDICINE and HEALTH 2007/2008

The Effect of Transcendental Meditation on Resting Heart Rate

The purpose of this research was to compare the difference in heart rate change between an eyes open and an eyes closed period for Transcendental Meditators and non-meditators. Meditators practiced the technique of Transcendental Meditation during the eyes closed period and the non-meditators simply sat with their eyes closed. Twelve Transcendental Meditators and twelve non-meditators were selected to participate. They were measured during the two periods using a Polar F11 heart monitor as they sat in a standard chair. The eyes open period lasted five minutes and the eyes closed period lasted ten minutes. Heart rate measurements were taken at minute intervals.

The meditators' average heart rate change was an average decrease of 6.47% between the two periods with a median change for that group being a 6.58% decrease.

The non-meditators' average heart change was an average increase of 3.54% between the two periods with a median change for that group being a 1.34% increase. Eleven out of twelve meditators' average heart rate decreased between the two periods with all eleven having a greater heart rate percent decrease than any one of the non-meditators had between the two periods. The study clearly demonstrated that Transcendental Meditators' resting heart rates will likely decline while they are meditating. When that decline is compared to a change in heart rate for non-meditators between the two periods studied, the meditators' change was profound. In fact, through statistical analysis, it was concluded that the likelihood of this data resulting from chance was less than 0.5%.

HS-49
Neel RAVAL
Medicine & Health 2007/2008

Neonatal Anesthetic Neurotoxicity: Testing the effects of Isoflurane on Neurons in Rat Pups

This project was a result of increasing concern involving infants undergoing anesthesia. The chemical isoflurane is a commonly used anesthetic agent. The purpose behind this experiment was to test the effects of isoflurane on the neurons of rat pups, to see if it has detrimental effects, and if so, to figure out a way to counteract those effects. This information could then be used to help make anesthetic usage safer for humans.

The project was conducted by culturing the neurons of rats at postnatal days 5, 14, and 21, exposing them to isoflurane, and evaluating cell death in various ways. Cell death was measured mainly by comparing levels of cleaved caspase 3 (a protein involved in the apoptotic pathway resulting in cell death) in cells that were exposed to isoflurane versus those that were not, by means of western blotting and immunofluorescence. Those cells that showed higher levels of cleaved caspase 3 were the ones that showed neuronal death. A separate group of cells was also given various dose levels of tPA prior to being exposed to isoflurane, because it was hypothesized that this would minimize cell death.

The results showed that isoflurane was indeed neurotoxic to the 5-day-old rat neurons, but not the 14 or 21-day-old neurons. The 5-day-old neurons showed increased levels of cleaved caspase 3, while the 14 and 21-day-old neurons did not, proving that the effects of isoflurane are age dependent. However, the 5-day-old rat neurons that were given tPA prior to isoflurane exposure showed that increased levels of tPA resulted in normal levels of cleaved caspase 3. This reveals that tPA counteracts the detrimental effects of isoflurane.

The contributions of this project are highly important. Not only did it show that isoflurane is neurotoxic and results in neuronal damage, but it also showed that adding tPA prior to anesthesia can prevent its harmful effects.

HS-50
Wu, Helena (Hao)
Medicine & Health 2007/2008

Comparison between alcoholic and normal liver using CT Phantom Calibration

The objective is to engineer a noninvasive methodology for precisely determining the volume, mass, and density of the liver. The secondary goal is to apply this method to obtain an accurate calculation of the average mass, volume, and density of healthy livers compared to alcoholic livers. Previous techniques for finding organ measurements relied on autopsy, an impractical and inexact method since deceased organs undergo a change in mass.

This study innovates a medical imaging method that focuses on use of Computed Tomography (CT) and Phantom calibration, which creates a standard for evaluating the fluctuations on the scanner and electric current. 60 nonalcoholic patients and 30 alcoholic patients were scanned with full-body Phantom and the image results were analyzed using software program Reformat.

The data collected from the patient population revealed that both consistency and accuracy were achieved using the Phantom calibration methodology. The standard deviation for the volume and mass indexes was relatively low and in the case of specific gravity, accounts for only 1% fluctuation. Results from an auxiliary experiment involving deceased pig organs validated the accuracy of this study. In addition the ratio between normal and alcoholic measurements was successfully determined. Results indicate that alcoholic livers are larger in

volume compared to normal, nonalcoholic livers and the fat content is also higher in the alcoholic group. No significant difference in density was found although alcoholic livers were slightly higher in mean density in correlation to the increase in scar tissue from alcohol induced liver disease. In regards to other measurements, alcoholic patients demonstrate a higher ratio for liver mass, volume index, and mass index. Only for specific gravity is the value higher for non-alcoholic livers.

It was concluded that Phantom calibration produced more accurate and consistent results than autopsy or CT alone. This information can be utilized as a guideline to detect abnormalities in volume, mass, and density of the liver, which can be the first signs of steatosis hepatis, cirrhosis, and fatty liver in many patients. The contributions of this project may be utilized for future research in assisting doctors in making treatment decisions for liver disease victims.

MICROBIOLOGY

HS-51
Brandea BUNNAG
Microbiology 2007/2008

RESISTANCE OF BACTERIA TO DISINFECTANTS

A study was conducted in order to find which disinfectants were most affective, as in the amount of resistance displayed by the bacteria in which the disinfectants were being applied to.

Each of two different bacteria's was swabbed onto nutrient agar plates. The bacteria to be tested included *Escherichia coli,* and *Bascillus subtilis.* Sterile filter disks the size of a single standard hole punch, were dipped into each of three different disinfectants. The disinfectants to be used included regular household disinfectants such as 409, Clorox, and Pine Sol. Six of each disinfected filter paper disks were placed in one of the three different bacteria's. Seeing that there were two types of bacteria and three types of disinfectant, there were six growths taking place on six different nutrient agar plates. These agar plates containing the bacteria to be tested were then incubated at a temperature of 30 degrees Celsius. After a period of seven days, the bacteria had been given a chance to grow. The zones of inhibition were measured, and the bacteria's were tested for resistance.

It was found that the household disinfectant "409" was the most affective, as the average measurements of zones of inhibition were highest, therefore resulting in a less amount of

resistance by the bacteria. This experimentation gives us realization that bacteria can easily become resistant to many of the household disinfectants that we use.

HS-52
Christine DEAKERS
Microbiology 2007/2008

SACCHAROMYCES CEREVISIAE'S EFFECT ON HUMUS QUALITY AND GROWTH RATE OF BRASSICA RAPA

The purpose of this research was to discover alternative methods of improving humus quality of home gardening potter's soil. The use of saccharomyces cerevisiae, or common baker's yeast, was employed as an element that could manipulate the humus quality and change the growth rate of Brassica rapa, commonly known as mustard mizuna. Because yeast when combined with water yields carbon dioxide, different concentrations of 0%, 1.33%, 5.33%, and 9.33% were tested.

In order to begin testing, four pots had soil in them and four seeds of Brassica rapa. The plants were watered daily with the concentrations. Soil was put in a test tube and filled with deionized water, then humus screening reagent powder was added.. From there, soil flocculating reagent was added, and then the mixture was allowed time to settle. The solution was filtered, and then it was compared to a color chart and assigned a number value, which described the humus quality of 1 through 5, low to high.

The control of the experiment had a consistent humus quality of 1. After the 6th day of watering and testing, the 1.33% pot changed from a humus quality of 2 to 3. The 5.33% concentration changed the soil from 3 to 4 after the 19th day of testing. The 9.33% concentration humus quality went from 3 to 4 after the 10th day. The soil with the concentration of 5.33% sprouted first, then came the 1.33%, the 9.33%, and the 0%. While the 9.33% was, 2 cm, the 0% ended at 1.3cm, 1.33% was 1.5cm, and 5.33% was 1.8cm.

In conclusion, it was demonstrated that the 5.33% saccharomyces cerevisiae concentration yielded the best quality humus value, while the 9.33% concentrations had the best growth rate outcome.

HS-53
Ashley Han
Microbiology 2007/2008

Salad Bar Bacteria

In order to determine the various strains of bacteria present in open salad bars, a study was conducted.

Samples of spinach were taken from the open salad bars of Ralph's, Whole Foods, and Chuck E. Cheese. The samples were then swabbed onto nutrient agar plates and incubated for three days. The bacteria were then put onto microscope slides and gram stained. The gram stained bacteria were then observed under a microscope and compared to similar pictures of bacteria to determine its genus.

The bacteria were gram negative, and had different variations of a rod-shaped figures. Looking at the physical attributes of the bacteria, it was concluded that bacteria such as E. coli, Salmonella, Shigella, Pseudomonas, Vibrio, and Acinetobacter could have possibly contaminated the spinach in three different open salad bars. The risk of food poisoning and in some cases mortality caused by the ingestion of the bacteria found in the salad bars should be made aware of.

This study questions the sanitation of salad bars and the health risks of eating spinach in general.

HS-54
Rita Johnson
Microbiology 2007/2008

Effects of Toxic Debris on Normal Bacterial Flora

This project is intended to study the connection between the effects of toxic debris released into the environment and bacterial flora. The idea was inspired after watching a documentary on the 9/11 first responders and subsequent developed diseases presumed to be somehow related to the toxic debris the individuals were exposed to.

Initially, my project consisted of identifying threes specific bacteria to follow through exposure. The complexity of identification of different types of streptococcal and staphylococcal organisms and use of sophisticated microscopes for identification were impractical, leading to the limited testing of staphylococcal and streptococcal organisms as they are exposed to toxic dust and debris simulating the 9/11 air quality.

The procedure was divided into two parts: the collection and growth period of bacteria and the exposure period. Three areas were sampled for bacteria: the nose, the mouth, and the skin. Each agar gel growing the various bacteria were exposed and allowed to incubate for duration of six days. From the exposure group, the effects of toxic debris and dust on the growth rate and morphology of bacterial colonies were observed.

Not surprisingly, the bacteria underwent change in terms of size and shape their colonies. As with any toxic exposure, the cells expectedly became distorted and slowed in growth. Unexpectedly, the color of some select few was altered. It was suspected that the ash caused the change in color. In addition, the samples collected from the nose were affected by the toxins the most in comparison to the other areas. This follows the assumption that disease specifically within the lungs and airways is most affected by toxins and affects normal bacterial flora. Furthermore, the experimentation demonstrated that with the diminished growth of the exposed normal bacterial flora, diseases are able to develop due to a reduction in the normal human body natural defenses.

The results are important in the study of post 9/11 diseases that developed in those who were first responders to the attacks of September 11th. The added toxic debris and dust released into the air, as demonstrated in this project, prove to disrupt the normal bacterial flora. With this disruption of human natural body defenses, diseases such as the ones developed by the first responders, are likely to develop as a direct result toxic debris. In the identification of the debris effects on the bacterial flora, environmental actions to avoid or minimize exposure and prevent a reduction in the normal human immune defenses i.e. normal bacterial flora, my help to prevent

infections or chronic diseases. Also, studies may be conducted on the exact mechanism of the effect of toxic debris on the normal bacterial flora and bacterial growth and discover ways to reverse the damaging effects and facilitate a search for cure or prevention of the chronic illnesses seen in 9/11 responders.

HS-56
Kelcey Nishihara
Microbiology 2007-2008

Effects of Dilutions of Disinfectant on the Development of Bacterial Resistance

The purpose of this research was to determine how different dilutions of Lysol disinfectant affected the development of resistance in *Staphylococcus epidermidis* bacteria.

An incubator was constructed from an aquarium and a light bulb, which was the heat source. Three Lysol solutions of 100%, 50%, and 25% strength were created. Disks of filter paper were dipped into each solution and then put on *Staphylococcus epidermidis*, which had been cultured on Tryptic soy agar plates. After incubation for 48 hours, the diameters of the zones of inhibition around each disk were measured and the averages were calculated. The bacteria immediately surrounding the zones of inhibition were cultured again on new plates and the process was repeated four more times.

The zones of inhibition did not become significantly smaller as experimentation progressed and the results varied. The results of the 100% solution were the most inconsistent, the results of the 50% solution were somewhat inconsistent, and the results of the 25% solution, the weakest dilution, were the most consistent.

Repeated exposure to different dilutions of Lysol disinfectant did not cause resistance to develop in *Staphylococcus epidermidis*.

HS-57
Elaine OUYANG
Microbiology 2007/2008

THE TWINKLING LIGHTS OF THE DEEP SEA: BIOLUMINESCENCE

The purpose of this research was to see how Dinoflagellates are influenced by certain environmental changes through observing its behavior in bioluminescence tendencies. The procedure's for this experiment was firstly, acquiring three 50 ml. Dinoflagellates and seawater. Dinoflagellate jar C (control) was placed under 12 hours under natural light, 12 hours under darkness. Dinoflagellate jar B was under the conditions of, 12 hours limited natural lighting and 12 hours under artificial lighting from a florescent bulb source. Dinoflagellate jar A thus was placed under the testing conditions of complete darkness with tin foil wrapped around the jars exposed surfaces; to exclude light intrusions. All three Dinoflagellate jars were then disturbed at approximately 10:00 pm daily and calculated from a scale of 1-10; 1: low, 5: control, and 10: high. The key results to this experiment was that, Dinoflagellate jar C (control) resulted in the highest bioluminescence levels at 5 continuously during testing. Dinoflagellate jar B showed a 3 on the scale. While, Dinoflagellate jar A concluded at 4. The behavioral differences also varied. Jar C augmented population growth to an estimated 20%. Jar B remained identical in the number

of Dinoflagellates present. Jar A severely lowered in population to only 5% survival rate at the end of the experiment. To conclude, it was proven that the natural cyclic process of an exposure to 12 hours of natural light and 12 hours of darkness (control) will in fact exhibit the highest rates of bioluminescence tendencies and general growth of the Dinoflagellates.

HS-58
Brian S. Park
Microbiology 2007/2008

Viability of *Escherichia coli* in Dry Soil of Madrona Marsh Preserve

The purpose of this experiment was to find out if, and in what number, *Escherichia coli* existed in the dry soil of Madrona Marsh Preserve in Torrance, in order to show that *E. coli* could live and reproduce in dry surroundings without the presence of fecal matter.

To do this, two tests were utilized: a presumptive test to detect coliform in the soil, and a test specific for *E. coli*, to detect the existence and concentration of *E. coli* in the dry soil. 5 different areas of Madrona Marsh were sampled. For the presumptive test, a LaMotte coliform indicator test kit was used; this kit contained test tubes, which had tablets inside them. The tablets contained nutrients to stimulate coliform growth, gas-producing gel, and a pH indicator; the soil was put into the tubes, mixed with water, and left to stand for 24 hours. If coliform were present in the soil, then the test tube's contents were yellow and effervescent. If no coliform was in the soil, then the test tube's contents were pink and had no bubbles. For the specific test, which was done at Associated Labs by lab technicians, the procedure outlined in the Food and Drug Administration's Bacterial Analytical Manual was utilized. The soil samples were placed in various agar and broth mediums, diluted, and incubated; afterwards, the mediums were examined under a UV light, and the Most Probable Number (MPN) of *E. coli* per gram of soil was calculated using the FDA's MPN index.

The presumptive tests for all 5 samples were positive, as all 5 test tubes were yellow and gassing, so coliform was present in the dry soil. The specific tests for *E. coli* also were all positive, showing that *E. coli* did exist in each of the dry soil samples. *E. coli* existed most heavily in the samples taken from the Finger Bay, South Bay, and East Creek areas, and were less numerous in the Dog Willow and Honda Tree area soil samples.

In conclusion, the positive results for the presumptive and specific tests meant that *E. coli* most likely existed in all areas of Madrona Marsh, because of the wide area over which the dry soil was taken from. The fact that the Finger Bay, South Bay, and East Creek area soil had high MPNs meant that the *E. coli* within those areas were able to live and reproduce unaided; on the other hand, the small MPN in the Dog Willow and Honda Tree areas most likely meant that the *E. coli* in those soils was not manifesting itself as greatly as the other areas, and was most likely from fecal origin.

HS-59
David TANG-QUAN
Microbiology

Antimicrobial Peptide Susceptibility of *Candida albicans* Kinase Mutants

Disseminated candidiasis occurs in hospitalized patients when the fungus, *Candida albicans*, enters the bloodstream and infects almost all organs of the body. The mortality rate of this disease is close to 40%. Immunocompromised patients can also develop oropharyngeal candidiasis, or *Candida* overgrowth in the mouth. Although the mechanisms behind *C. albicans* defense against reactive oxygen intermediates have already been discovered, the mechanisms for resistance to antimicrobial peptides are still unknown.

Sixty-four kinase mutants were screened with protamine containing antimicrobial peptides to discover mutant strains that were hyper-susceptible. Serial dilutions of each strain were pipetted onto protamine and YPD plates, starting at 10^8 cells/ml and decreased by a factor of 10 until the final concentration of organisms was 10^3 cells/ml. Hyper-susceptible strains were retested and the validity of results was further confirmed in a trial using a second, independent clone.

Results from the first 96-well microtiter plate of kinase mutants showed three genes that are responsible for hyper-susceptibility to antimicrobial peptides: *PBS2*, *YCK2*, and *HST7*. Findings from the second 96-well plate of kinase mutants were unconfirmed, but six possible hyper-susceptible strains and some likely hypo-susceptible strains were discovered.

It was concluded that the genes *PBS2*, *YCK2*, and *HST7* play a significant role in *C. albicans* resistance to antimicrobial peptides. Further research to confirm the validity of these results includes gene complementation and a clean knock out of genes. Pharmacologists and others can use this research to determine which genes need to be inhibited when developing medications for *Candida* infections.

PHYSICS

HS-62
Hong Ye Mai
Environmental Science 2007/2008

Smoke Degradation of Solar Cell Efficiency under Various Frequencies of Light

Particulate matters are one of the most common air pollutants in urban areas. They are significant light scattering materials in the atmosphere. This research determines when various frequencies of light pass through particulate matters, whether or not they undergo different amount of absorption and scattering.

To quantitatively measure light degradation, the experiment uses the solar cell power output as a medium and tracts its degradation. First, a solar cell is placed in a transparent plastic box, with leads connecting to a circuit to determine power output. Then, red, green, and blue light are incident on the solar cell separately. To determine maximum power, resistance is gradually lowered until the voltage starts to drop, then voltage and current at that point are multiplied. After that, car exhaust, wood smoke, and rubber smoke are infused into the box one at a time and the previous procedure is repeated. The new power outputs under particulate matters are divided by corresponding figures from clean air to yield degradation percentage.

The result of the experiment confirms the hypothesis that light with higher frequency is less affected by particulate matter and retains more energy. Among the three particulate matters, rubber smoke has the most significant scattering effect on light.

This research discovers the ability of high frequency light to retain energy after penetrating the atmosphere. It provides information for future photovoltaic material research, that solar cells should have a band gap more sensitive to blue light.

ZOOLOGY

HS-64
Laura BOTZONG
Zoology 2007/2008

The Effects of Environmental Nitrite Levels on the Reproductive Success of Purple Sea Urchins

The purpose of this experiment was to determine how environmental nitrite levels impact the reproductive success of purple sea urchins. The hypothesis of this experiment was that higher environmental nitrite levels have a negative affect on reproductive success. As part of a three-year study, the hypothesis this year was based on previous results which showed that higher levels of nutrient pollution do not encourage larval growth. In addition, high nitrogen levels are toxic to a variety of marine life. To test if high nitrogen levels are toxic to purple sea urchin larvae, mature purple sea urchins were collected from two test sites, which differ in their pollutant levels (as rated by Heal the Bay Beach Report Card): Inner Cabrillo Beach and Portuguese Bend Cove. The sea urchins were spawned, their eggs fertilized and fixed with formalin, and the number of eggs counted. A water sample from each site was tested concurrently for nitrite levels. The data supported the hypothesis; Inner Cabrillo Beach had

lower water nitrite levels than Portuguese Bend Cove, and there were more eggs counted in the Cabrillo samples. These results call for deeper, more comprehensive research with revised protocols on this subject.

HS-65
Giselle CAMARILLO
Zoology 2007/2008

Training *Octopus bimaculoides* to Camouflage to Unnatural Colors

The purpose of this research was to investigate the possibilities altering the pigments in the body of octopuses to display more diverse colors than the pigments known. If the octopuses are to be exposed to a range of colors in their growing years they may possibly adapt to the colors and produce the color as a pigment in their body.

Two, juvenile two-spotted octopuses were used as data. Two tanks were arranged with artificial algae and gravel; one tank had red algae and gravel, while the other had green algae and gravel. The colors began with natural shades , and ended with the more extreme shades of the two: bright green and bright pink. An intermediate color was used to transition into the extravagant shades.

Six trials were taken in total. Three from both the green tank and the red tank. Pictures were taken of the octopuses ability to camouflage to their environments. The octopuses responded to the colors of their surrounding when first introduced to it or during feeding time.

The octopuses camouflaged best to the first two stages, not very well to the last stage. Capturing their camouflage on camera at times failed leaving the experiment with open variables since there was no poof of their color change. Also, if given more time the octopuses may adapt better to their surroundings and be able to produce the unnatural colors in adulthood.

HS-66
Emmelyn Hsieh
Zoology 2007/2008

Bioluminescence of *Renilla koellikeri* in Differing Calcium Levels

This project investigates the effects of various calcium levels on the bioluminescence in sea pansies. Often in the wilderness animals too small or too weak to defend themselves are easily attacked by predators. This experiment was constructed to increase the effectiveness of the bioluminescence performed by sea pansies in response to potential threats. Another purpose of this project was to determine to what extent environmental calcium affects the degree of bioluminescence.

Eight sea pansies of the species *Renilla koellikeri* were collected and placed into four tanks of varying calcium hardness levels. Every week the testing animals were stimulated using dry ice and photographed as they glowed. The pictures from each trial were analyzed using computer software to measure the brightness levels of each animal's bioluminescent display.

Throughout six trials, it appeared that sea pansies housed in higher calcium levels exhibited brighter light emissions upon stimulation. Another finding was that with repeated experimentation, the bioluminescence of all the sea pansies gradually declined as their

reactionary systems wore down from frequent use. The water hardness, a measure of calcium levels in the water, of the tanks yielding the strongest glowing sea pansies ranged from about 1000 parts per million to about 1500 parts per million. In contrast, the water hardness of the tanks with the weakest glowing sea pansies extended from around 600 parts per million to around 900 parts per million.

The conclusion of this experiment was that with an increase in ambient calcium, the bioluminescence of the sea pansies intensified just as the hypothesis predicted.

HS-69
Justin J. LEE
Zoology 2007/2008

The Effect of Filtered Light on the Growth of Vanessa Cardui

Thus far, some scientific researches were conducted regarding the relationship of color and butterflies. This project attempts to take the research further and tries to determine the effects that colored lights—with different frequencies and wavelengths—might have on the development of butterflies.

This project requires live larvae that will grow into the imago stage. *Vanessa Cardui*, generally known as Painted Lady Butterfly, were used in the experiment. Two separate sets of live larvae were ordered online. Of these, one set was exposed to filtered light; the other was exposed to white light. The light source was left on for 12 hours per day. The two sets of *Vanessa Cardui* were exposed to their light source until the subjects being tested developed into the imago stage. Throughout the growth of *Vanessa Cardui*, physical characteristics, such as size and wing color vibrancy, and habits/ behaviors in the two respective sets were observed and recorded in a table.

It was found that exposure to an environment consisting of filtered light does not cause any significant changes in the development of *Vanessa Cardui*. The experiment began with 5 larvae in each set. Although two larvae died in the set exposed to white light and one larva died in the set exposed to filtered light, the larvae in both sets grew at a similar pace to a similar size, and entered the pupa stage after the same number of days. The pupa stage lasted 9 days in both sets, and by the end of the experiment 3 butterflies were alive in each set.

The findings in the experiment showed that no significant effects are induced by the various frequencies and wavelengths of filtered light on the butterflies.

HS-71
Kelly McCulloh
Zoology 2007/2008

DETERMINING A RELATIONSHIP BETWEEN A DECAYING HAIR ROOT AND THE POSTMORTEM INTERVAL USING DIGITAL IMAGING

The current investigation is the result of the need for a more reliable technique to establish the postmortem interval of an individual. This investigation attempts to determine if the length and width of a mouse's decomposing hair root is related to its time since death. Furthermore, using the hair roots photographed under the light microscope, a micrometer to pixel relationship was derived using an experimental setup.

Two trials were used to get an accurate idea of how a hair root changes in size postmortem. In Trial 1, hairs were pulled from certain parts of the body every 12 hours for 224 hours to determine a bound in which the hair root stops changing. Hairs were photographed under a light microscope and were measured using the derived μm/pixel relationship. In Trial 2, hairs were pulled from the same parts of a different mouse's body every two hours between the hours of 12 and 38.

From Trial 1, the hair root doubled in size around the 24-hour mark. This supports the idea that after 24 hours, the outer layer of the follicle loosens and decays before the inner layer of the follicle, were the keratin has just hardened. Furthermore, a knob on the roots was noticed to move locations in a uniform manner as time elapsed. From Trial 2, proximal end root banding was found to occur at hours 20 and 30.

The conclusions from this experiment established two important concepts. First, the size of a decomposing hair root is related to a mouse's postmortem interval. However, an accurate time of death may not be able to be calculated using the data collected, only roughly estimated. Secondly, a more accurate way of determining postmortem interval would be to look at the shape of the root instead of the size.

HS-72

Nicole NAKATA
Zoology

HYDROID PREFERENCE FOR NUDIBRANCH FLABELLINA IODINEA

Nudibranchs are finicky animals; the majority of species eat only one specific genus or species of whatever type of organism they consume. This is difficult for aquariums that have these animals on display. It was found in one source that *Flabellina iodinea* (common name Spanish Shawl) consumes the sticky hydroid *Eudendrium ramosum*, and when the nudibranchs were collected, they were resting on the branches of the hydroid. To ascertain that they did indeed eat the *Eudendrium*, one group of nudibranchs was fed the *Eudendrium*, and another group was fed another hydroid common to the area called *Aglaophenia struthionides*. The weights of the nudibranchs were taken to determine which of the hydroids were preferred by the nudibranchs.

The nudibranchs were fed weekly, with weights taken the day of feeding, the day after, and one week later (before the next feeding). Weights were taken using a small petri dish filled with water, measured in grams. Since nudibranchs gain their coloring from the chemicals within their food, the *Aglaophenia* hydroid was soaked in astaxanthin, the pigment that causes the coloring in the nudibranchs, to make it more appealing.

However, the nudibranchs showed no interest in the *Aglaophenia* hydroid and steadily lost weight. On the contrary, the nudibranchs fed the *Eudendrium* hydroid gained weight when weighed 24 hours later. The nudibranchs were often found grazing on the *Eudendrium*, whereas none were found on the branches of *Aglaophenia*.

After comparing the weight changes in the two groups of nudibranchs, it is clear that Spanish Shawls prefer the hydroid *Eudendrium*. In addition to raising the nudibranchs, culturing methods for the *Eudendrium* were tested for the maintenance of the nudibranchs.