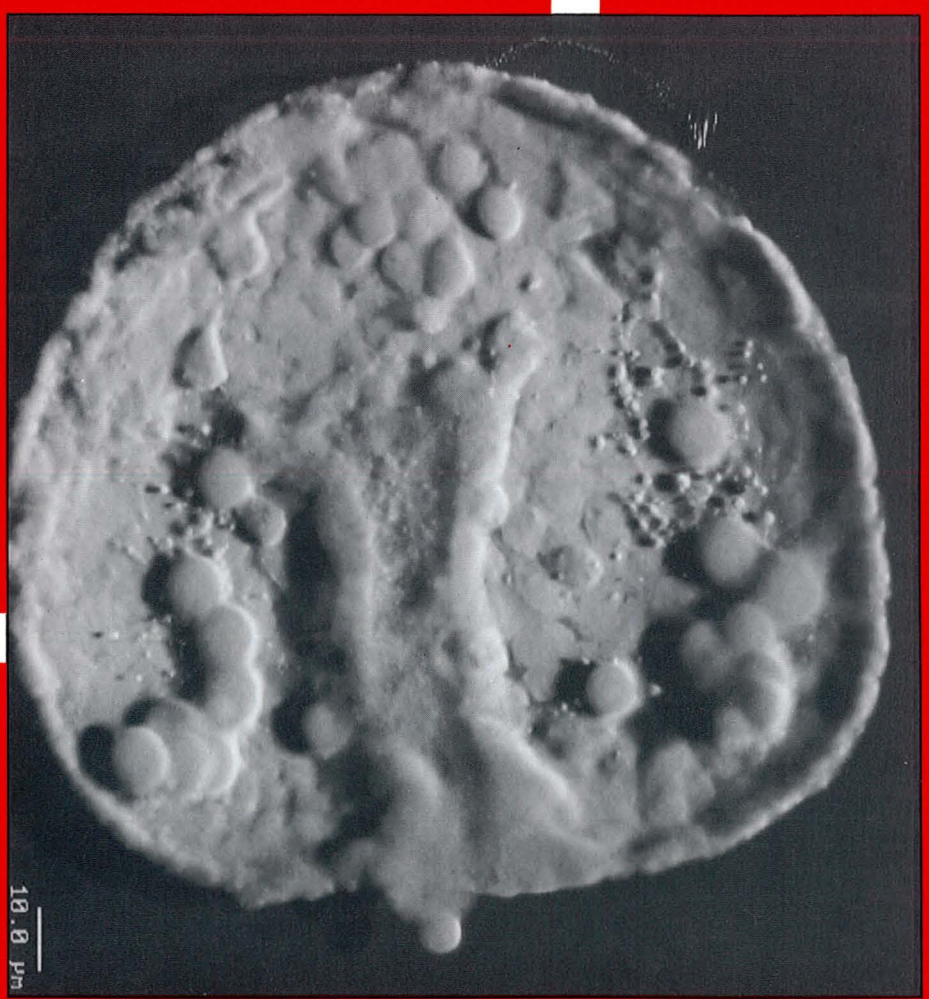
Journal of Student Research Abstracts

Volume V
2000



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Volume V
2000

Editor
Steven B. Oppenheimer

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Northridge, California

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JOURNAL OF STUDENT RESEARCH ABSTRACTS

Volume V, 2000

An Annual Journal For Young Investigators And Their Teachers

STAFF

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Cover Photo of sea urchin embryo using a Meridian confocal microscope. We thank Dr. Melinda Frame of Meridian Instruments and Laura Cazares for assistance.

2000 JSRA HONORED TEACHERS

This year's awards for dedication to long term, high quality student research published in JSRA go to:

Steve DeGusta, John F. Kennedy High School, Sacramento, California

and

Bill Van Duzee, Saugus High School, Saugus, California

These honored teachers receive citation, here, in this journal and a personally signed copy of Nobel laureate Francis Crick's book. Dr. Crick has been Honorary Chair of the teacher enhancement programs that have led to development of this journal.

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ABOUT THE EDITOR

Steven B. Oppenheimer received the Ph.D. degree from Johns Hopkins University and is currently Professor of Biology and Director of the Center for Cancer and Developmental Biology at California State University, Northridge. He is author or co-author, mostly with his Cal State students, of over 100 publications including 12 books, was awarded over $4 million in research and science education grants serving as Principal Investigator, and served on National Institutes of Health and National Science Foundation grant review panels. He is recipient of 21 distinguished teaching awards, distinguished research awards, outstanding professor awards and other honors from local, statewide and national organizations. In 1984, he was named statewide Trustees Outstanding Professor of the California State University system (the system's highest honor), and in 1992 he was elected Fellow of the American Association for the Advancement of Science (AAAS), The AAAS defines a Fellow as "a member whose efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished."

ABOUT THE JOURNAL AND SUBMISSION OF ABSTRACTS

The Journal of Student Research Abstracts is published yearly on or about May 1 by Burgess International.

The journal is intended to provide students and teachers with: (1) a vehicle to honor young investigators and their teachers by showcasing their work, motivating them to continue their involvement in research science, (2) a sourcebook for both students and teachers who are looking for ideas for research projects, (3) a volume to disseminate student research discoveries, and (4) an exercise in analysis of good science versus science that could be improved. Many abstracts included in the journal demonstrate good science, i.e., clear introductions describing hypothesis to be tested, methods, results and conclusion statements, and most important, sufficient numbers of appropriate control and experimental samples and repetitions of experiments. Other abstracts do not display one or more of the principles of good science. Students and teachers, therefore, could use these abstracts to learn about the right and wrong ways to approach scientific experiments. For this reason, we do not eliminate abstracts that do not demonstrate perfect science. The editor, however, reserves the right not to publish abstracts that are seriously flawed. Those abstracts were deleted from this issue. Any opinions, findings, and conclusions or recommendations are those of the individual authors of the abstracts presented in the journal, and do not necessarily reflect the views of the National Science Foundation, the other sponsoring agencies, the university or the journal staff.

SUBMISSION OF ABSTRACTS

Any science teacher may submit student abstracts following the exact format given in the abstracts in this volume. After the title (in caps), followed by student author names and teacher name (teacher), school and school street address, city, state and zip, abstracts should begin (after a 3 space indentation) with the purpose of the study, followed by how it was done, the results and conclusions. All abstracts must be typed (no dot matrix printer) neatly, error free, in a rectangle 6 3/8 inches wide by 4 1/8 inch long. If the abstract is typed in a drawn rectangle, leave about 1/8 inch margins next to all boundary lines. Typing must not touch boundary lines. Messy abstracts and those not following proper format will be discarded. The journal is not responsible for any abstracts received or for publication errors. Students and teachers are advised to photocopy abstracts before mailing.

Only teachers may submit their students' abstracts to the journal. They should be mailed along with a cover letter on school letterhead to: Dr. Steven Oppenheimer, Editor, Journal of Student Research Abstracts, Center for Cancer & Developmental Biology, California State University, Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8303. Deadline for receipt of abstracts for each annual volume is Feb. 1. Abstracts received after the deadline or those accepted after the volume fills will be held for the next annual issue. Supplies permitting, a complimentary copy of the journal will be sent to teachers whose students' abstracts are published in that volume. **If students, parents or principals wish a copy of the journal, a $25 check per copy, payable to CSUN Center for Cancer and Developmental Biology must be mailed along with the abstract.**

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Number following name refers to abstract number

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Subject Index

Number refers to abstract number

ABSTRACTS

2637

DO THE SAME FAMILIES OF *COLLEMBOLA* POPULATE THE LEAF LITTER AND THE SOIL?

L. Aries, K. Bailey, J. Baker, V. Balian, C. Beers, V. Blore, C. Bononi, M. Campos, M. Cananea, R. Carbajal, A. Carll, C. Chan, D. Chernobelsky, S. Chon, D. Clark, Q. Colgin, E. Cooley, A. Dadvand, L. Davis, N. Deremer, K. Dicus, A. Espinosa, B. Feldman, T. Goldberg, O. Hashim, B. Herrera, A. Hickey, F. Javier, D. Jukowicz, J. Josephsen, F. Kapadia, T. Kapadia, E. Lindquist, Y. Mann, K. Markowicz, E. Martin, K. Meisel, A. Milazzo, J. Miller, B. Miskowich, E. Mitchell, C. Ntoya, F. Nunez, J. Ong, A. Pierantoni, R. Potts, A. Purcell, A. Reed, D. Rodriguez, E. Rosales, L. Ross, P. Russell, M. Santiago, S. Shamoiel, D. Sokolovsky, L. Spector, D. Sproatt, L. Stiteler, M. Stone, D. Swerdlove, T. Torres, H. Vartevanian, B. Walker, T. Warner, J. Winick, J. Wolpe, C. Yoon, J. Zinberg, T. Miller (teacher). Parkman Middle School 20800 Burbank Blvd. Woodland Hills, CA 91364.

The purpose of our investigation is to determine if the same families of *collembola* live in leaf litter and in soil. We believe some *collembola* families would be more resistant to heat. Therefore, different families of *collembola* would be found in the leaf litter and in the soil. *Collembola* are microscopic arthropods that live in soil and leaf litter environments. The common name for *collembola* is springtails. This study examined the soil and leaf litter at the Parkman Middle School Garden to conclude if different families of *collembola* live in leaf litter or soil habitats. Eighteen soil samples and eighteen leaf litter samples were taken from the school garden. The Tullgren funnel technique was used to separate *collembola* from the leaf litter. The floating method was performed to loop *collembola* from the soil samples. All *collembola* were collected and placed into prepared culture dishes. We identified the *collembola* by families with the use of stereomicroscopes. Five families of springtails were located from the *entomobryidae*, *onychiuridae*, *sminthuridae*, *isotomidae* and *neelidae* families. All of the families were found in the leaf litter and in the soil samples. Our data suggests generally, that *collembola* are as comfortable living in the leaf litter as in the soil. Only one group, the onychiuridae had twice as many *collembola* found in the soil sample as in the leaf litter sample. Our results did not prove our hypothesis correct. We believe more data should be collected.

2638

EFFECTS OF VARIOUS AMOUNTS OF GLASS POWDER AND YEAST IN THE MICROBIAL LAVA LAMP

Ian Keighley; Teacher: Tracy Mikulak; John Adams Middle School, 2425 16th Street, Santa Monica, CA, 90405.

For my project, I made microbial lava lamps and tested what happens to them when you increase or decrease the amount of yeast and glass powder. What I did was make eight different lava lamps and alter the ingredients a little. I made lava lamps with 4 grams, 6 grams, 8 grams, and 10 grams of glass powder. I also made lava lamps with 0.5 grams, 1 gram, 1.5 grams, and 2 grams of yeast. The control in the experiment had 10 grams of glass powder per mixing chamber, and 1 gram of yeast per mixing chamber. In each test lava lamp, I either increased or decreased the amount of yeast or glass powder. My hypothesis was that adding more yeast would increase the respiration rate, and adding more glass powder would increase the movement of the beads.

The control had a respiration rate of 2 bubbles per minute, and the beads were pretty active. Decreasing the amount of yeast to 0.5 grams slowed the respiration rate to 1 bubble per minute. By increasing the amount of yeast to 2 grams, it increased the respiration rate to 3 bubbles per minute. When I decreased the amount of glass powder to 6 grams, the movement of the beads slowed down. When I decreased the glass powder to 8 grams, surprisingly there wasn't much movement at all. From this experiment, I discovered that by decreasing the amount of yeast, the respiration rate slows down, and by increasing the yeast increases the respiration rate. By decreasing the amount of glass powder, the beads didn't move as much.

2639

CHARACTERIZATION OF YEAST CELLS EXPRESSING A HUMAN MAP KINASE.

Negin Sohrabi and Dan McDonnell (teacher). Sherman Oaks Center for Enriched Studies, 18605 Erwin Street, Reseda, CA 91335.

In yeast there are six identified pathways that contain mitogen-activated protein kinases (MAPKs). In humans, the best-studied MAPK is ERK1, an enzyme that is itself activated by MEK1. It has been shown that ERK1 has a strong similarity with the yeast MAPKs Kss1p and Mpk1p. Kss1p and Mpk1p are involved in the pathways that help maintain the integrity of the cell wall in yeast. A fusion protein of human MEK1 and ERK1 (MEK/ERK) was introduced into yeast cells and unusual morphology as well as growth retardation were observed. The pseudohyphal filamentation and delay in growth were further enhanced by an increase of temperature (from 30 C to 37 C. At 37 C the cells completely arrested. However, we observed that with the addition of 1M sorbitol these effects were lessened significantly. We believe that sorbitol mitigated the effects of high temperature by creating isoosmotic conditions that overcame the cell wall defects resulting from MEK/ERK expression.

2640

CONSTRUCTION AND GENOTYPIC/PHENOTYPIC CONFIRMATION OF A DOUBLY ANTIBIOTIC RESISTANT PLASMID.

J.G. Anderson, D. Gobrial, J.M. Heisler, D. Hoang, S. Kafai, G.E. Metzenberg, I.A. Moizesch, R.M. Orozco, D.R. Rodstein and J. McLaughlin (teacher). Granada Hills High School, 10535 Zelzah Ave., Granada Hills, CA 91344.

The purpose of this study was to construct a plasmid with resistance genes to two different antibiotics using recombinant DNA techniques, and to determine whether plasmids that survived a phenotypic screening process had the expected restriction endonuclease map. Using the Amgen Plasmid Fusion lab protocol, a hybrid plasmid was constructed from pBR325, which contains a chloramphenicol-resistance gene, and pUC 18, which contains an ampicillin-resistance gene. Each plasmid was digested with the restriction enzymes Aat II and Sph I which flank the respective antibiotic resistance genes. The restriction enzymes were heat-inactivated, and the digested plasmid samples were mixed and ligated using T4 DNA ligase and ATP. The mixture of plasmids was used to transform competent *E. coli* cells, and the desired result was selected for on LB plates containing both chloramphenicol and ampicillin. Original research began when transformants that survived the selection were amplified in liquid culture and DNA was extracted (using High Pure Plasmid Isolation Kit by Boehringer-Mannheim) for restriction mapping. Analysis of DNA (which included gel electrophoresis for characterizing the size of restricted fragments) revealed the anticipated restriction map using the enzymes Aat II, Sph I, and EcoR I. The EcoR I analysis was particularly revealing since the predicted recombinant plasmid was expected to have EcoR I fragments of different sizes. The results suggest that the phenotypic screening process was successful in eliminating recombinant plasmids lacking both resistance genes from the experiment.

2641

IMPLEMENTING THE "MICROBIAL LAVA LAMP" AS A SCIENTIFIC TEST INSTRUMENT IN A HIGH SCHOOL CLASSROOM.

A. Ben-Blkanah, E. Crayton, A. Donanville, L. Goras, M. Hamzavi, Y. Kakan. M. Niknar, T. Ortega, N. Pezeshki, J. Forter, N. Sarouha, J. Schuller, J. Vincent, J. Zaman, and D. Gaughen (teacher). Taft High School, 5461 Winnetka Ave., Woodland Hills, CA 91346.

The purpose of this study was to demonstrate the "microbial lava lamp" as a useful test instrument in high [illegible] classes. The "microbial lava lamp" was developed by microbiologists Alan King and Paul

Tomasek. The "lamp" is constructed from colorful yeast beads encapsulated in a glass/alginate mixture. When the beads are placed in an enclosed container or sugar and water, they will slowly rise to the surface of the partially filled container, pause momentarily, then slowly descend to the bottom. The motion of the beads repeats until all of the sugar is metabolized by the yeast. The slow, continuous movement of the colored beads is reminiscent of the 1960's lava lamps. Quantitative measurement of this metabolism is recorded by carbon dioxide bubble counters (fermenters) placed on top of the containers, usually two-liter plastic bottles. Students were able to implement the King-Tomasek protocol, construct the "lamp", and measure optimal sugar (sucrose) concentrations. Sugar concentrations in different containers were "tagged" by different colored yeast beads with uncolored beads given to the control of no sugar or 0% concentration. Students evaluated carbon dioxide productivity by (a) maximum bubble count, and (b) longevity of output. Bubble counts were recorded on a daily basis for a number of days. A 20% (by weight) sugar concentration was found to be optimal by the students according to productivity criteria. This optimum can serve as a control for further student experimentation on yeast-sugar (or sweetener) metabolism.

2642

UNDER WHAT CONDITIONS DOES YEAST RESPIRE THE MOST RAPIDLY?

Stephen Herr, and Shirley Deedon (teacher). Valley Presbyterian School, 9200 N. Haksell Ave., North Hills, CA 91343.

Experiments were developed to determine the optimal conditions for yeast respiration as measured by the production of carbon dioxide that was collected by water displacement. Flasks containing 2.0 grams of baker's yeast, *Saccharomyces cereviseae*, and a constant amount of sucrose, were placed in water baths at different temperatures from 10° to 70° C. It was determined that yeast respired best at approximately 45° C. When the experiment was repeated at 45° C using sugar concentrations from 0 to 30% (by weight), it was determined that yeast respired most rapidly in a 24% sucrose solution. Keeping the temperature at 45° C, yeast was put in 24% sugar solutions ranging from pH 1 to 12 and it was found that yeast respired most rapidly at pH 7. It was determined that the addition of salt reduced the respiration rate when temperature, sugar concentration and pH were kept constant at optimal values. When Nutra-sweet® was substituted for sucrose the respiration rate decreased indicating that yeast respires more rapidly in natural sugar. It was concluded that baker's yeast respires most rapidly at 45° C, in 24% sucrose solution, at a pH of 7, with no additional salt.

2643

CAN *COLLEMBOLAS* BE LOCATED ON HARTE MIDDLE SCHOOL CAMPUS?

Cindy Martinez, Jose Lopez and Dr. Charles B. Lawrence (teacher). Bret Harte Preparatory Intermediate School, 9301 Hoover Street, Los Angeles, CA 90044.

Experiments were designed to test the hypothesis that *collembolas* could be found on Harte M.S. Campus. Six (6) separate sites were used to collect leaf litter and soil samples. Each site was indicated on the data sheet and school site maps produced by the class and each site was tested for *collembola*. The Tullgren funnel and floating methods were used along with a loop to collect *collembola* from the collecting jars and place the located *collembola* into a culture jar, which was established using activated charcoal and plaster of paris. Two species of *collembola* were found at three of the six sites. *Entomobryidae* were located on two sites both in leaf litter, *neonuridae* were located on one site, also in leaf litter. A completed data sheet and site map of all findings is being kept. Culture jars consisting of *collembolas* located are being kept, fed household yeast and watered with a pipette on a daily basis, as culturing is continuous. It is concluded that *collembolas* can be located on Harte M.S. Campus.

2644

THE EFFECT OF CALCIUM CONCENTRATION ON SEA URCHIN FERTILIZATION.

R. Aden, J. Adams, R. Aghopogli, P. Aliabadi, A. Antonio, A. Arpiza, D. Ayala, T. Babila, M. Baumgarten, I. Baumgartner, K. Bevington, M. Blank, R. Braff, J. Choenchavalit, K. Cilengir, S. Contreras, D. Cortes, S. Crawford, Y. Cruz, L. Darling, B. DeShields, N. Diego, S. Ebneyamin, D. Farag, M. Fernandez, D. Flax, M. Flores, J. Franco, D. Garcia, A.Gest, D. Ginsburg, C. Gonzalez, A. Green-Dove, R. Griffin, V. Guerra, D. Haft, G. Hernandez, S. Holt, E. Horwitz, A. Hutterer, C. Jaramillo, A. Johnson, D. Jones, C. Kass, F. Landis, E. Lemus, D. Lenvin, H. Lopez, M. Lopez, O. Luis, S. Mahboobian, B. Martinez, J. McDonald, I. McFields, C. McGrath, B. Mitchell, D. Morgan, K. Morris, C. Munoz, R. Nagler, K. Narayan, W. Noor, J. Olmedo, A. Ordonez-Chu, C. Page, L. Perez, D. Phillips, K. Pinto, L. Pullan, B. Rabinowitz, R. Ramos, J. Reivitis, D. Reynoso, M. Rios, G. Rosenfeld, R. Rosenstein, R. Salim, J. Schkud, J. Schlierman, A. Siegel. S. Taren, L. Tistaert, A. Valenzuela, K. Vashkevich, A. Vasquez, M. Viault, J. Volz, R. White, K. Wick, C. Wilson, N. Wu, N. Wyman, T. Yuki, and P. Mayerson (teacher). Santa Monica High School, 601 Pico Blvd., Santa Monica, CA 90405.

PURPOSE: To examine the effect of calcium on sea urchin fertilization. HYPOTHESIS: An increase in calcium ion concentration will result in an increased amount of fertilization. PROCEDURE: Male and female sea urchins of the species S. purpuratus were injected with 0.5 M KCI and the eggs and sperm were collected in plastic tubes and kept on ice for 22-26 hours. Sperm were kept concentrated and eggs were placed in Artificial Sea Water (ASW) (pH 8.0) containing 9.25mM calcium. One drop of egg suspension was put onto each slide. Each student group followed one of three protocols: (1) egg suspension + 2 drops of ASW containing calcium, (2) egg suspension + 1 drop ASW with Ca and 1 drop ASW without Ca, (3) egg suspension + 2 drops ASW without calcium. All groups counted the eggs in one field of view on low power (100x) and then added one drop of diluted sperm suspension in ASW with Ca. Each student counted the total number of eggs in one field of view and the number of fertilized eggs. Fertilized eggs can be easily identified by their fertilization membrane which gives each egg a halo. RESULTS: Group 1: Eggs in artificial sea water containing 100% ASW with 9.25mM calcium showed an average fertilization rate of 76%. Group 2: Eggs diluted to 6.94 mM calcium showed an average of 33% fertilization. Group 3: Eggs diluted in half to 4.625 mM calcium had an average rate of 40.3% fertilization. There was a lot of variation in results. CONCLUSION: Our hypothesis was probably correct. Artificial sea water containing the suggested levels of calcium gives the highest rates of fertilization (variation from 55%-98%) while lower calcium levels gave lower fertilization levels and more variation in results.

2245

HOW DOES OZONE AFFECT RUBBER?

C. Griego, T. Lee, N. Lin, T. Mui, and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

The ozone that is part of the atmosphere around Earth affects many of the materials that are used in our daily life. The purpose of this experiment was to evaluate the specific effects of ozone on everyday materials used by society. Rubber was the particular material that was used to test atmospheric ozone's effects. We experimented with this by isolating rubber gloves, erasers, and balloons in an air tight container containing artificial ozone created by an ozone generator. The results were visible within minutes and were measured using various techniques. Atmospheric ozone causes rubber to disintegrate and also alters the form and durability of this material.

2646

HOW WILL LIGHT AFFECT THE SURVIVAL OF OUR *COLLEMBOLA*?

Samael Garcia, Francisco Peña; Teacher: C. F. Hajdu Mulholland Middle School, 17120 Vanowen Street, Van Nuys, CA 91406.

We collected *collembola* from our school's garden and cultured them in the classroom. We put three of our *collembola* culture jars containing 5 *collembola* per jar into a shoebox where they were exposed to darkness for 3 days and put 3 other *collembola* culture jars under a 60-watt plant grow light at a distance 1 foot under the light, exposing them to the light for 3 days. After 3 days the 3 jars exposed to darkness had 2-5 survivors per jar, and only 1 of the jars exposed to the light had one survivor. The other two jars exposed to the light had no survivors. Our experimental results suggest that the *collembola* we collected and cultured survive better in darkness.

2647

ATTENTION SPAN OF HUMANS.

B. Bhakta and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

Attention is the focus of consciousness as a whole, the state or form of concentration of seeing, thinking, remembering, feeling or doing. In society today, factors such as television and the Internet contribute to the shortening of the attention span of the average human being. The purpose of my experiment is to test the attention span of human beings by having them perform different tasks that require 100% of their attention. I performed different types of experiments on the same 15 human subjects, thus retrieving the affects of their attention span on the assigned task. I found that the average high school senior does not have as long an attention span in completing simple assignments as they do in performing long and important tasks.

2648

ARE WORMS AS SMART AS THEY ARE SLOW? A LOOK INTO THE WONDERFUL WORLD OF WORMS.

B. J. Roman and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

Worms are the underground citizens of the world. In my experiment, I observed meal worms, to see if they have an inborn tendency to go either to the left or to the right, when they are faced with an obstacle and forced to choose. 100 worms (50 red, 50 yellow) were placed in a "T" shaped maze. In order for them to continue their journey, they had to make a turn. After 6 trial tests on each group of 50 worms, the results were unanimous. 67% of the yellow worms and 70% of the red worms went to the right; 33% of the yellow worms and 30% of the red worms went to the left. Next I placed a copper wire that was connected to a battery on the right side to see if the shock would cause them to turn the opposite way, or if they would return to the shock. Instead of moving, 99% of the worms were immobilized by the shock.

2649

WILL *COLLEMBOLA* BE AFFECTED DIFFERENTLY BY SUGAR AND SALT?

Alejandro Barahona, Manik Yervandyan; Teacher: C. F. Hajdu. Mulholland Middle School, 17120 Vanowen Street, Van Nuys, CA 91406.

The *collembola* we collected from our school garden were used for this experiment. We put a pea-sized amount of sugar into three of our *collembola* culture jars, and a pea-sized amount of salt into three of our other *collembola* culture jars. Each *collembola* culture jar had 5 *collembola*. After three days we found that there were no survivors in the *collembola* jars that had salt. In the jars that had sugar there were 1-4 survivors in each jar.

2650

HAMSTERS R' US.

G. Gabaldon and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd., Alhambra, CA 91803.

In this experiment of "Hamsters are Us" I decided to see the effects that different environments would have on hamsters. I initially used two different foods a healthy hamster diet with low amounts of sugar and then a food that was high in sugar levels. Every week, I recorded their levels of carbon dioxide in the Logger Pro system that I obtained in school. After observing them for a two week period with different foods, I then decided to see how different brands of cigarettes would affect their carbon dioxide level. I used Carlton cigarettes with a low concentration of tobacco and then Marlboro with a higher concentration. After recording my results with the Logger Pro, I decided to expose the hamsters to an ozone level of 4 ppms, high enough to have an effect on them but not enough to harm them. My results concluded that, with different foods, the carbon dioxide level kept stable or constant reading. The only difference between the foods was that the food with a higher concentration of sugar remained at a higher reading than that with a lower concentration. With the tobacco smoke, I concluded that the higher tobacco smoke made the hamsters start at a lower concentration rate. Finally, the results with the ozone concentration were inconclusive because the hamsters reacted normally. The ozone had no affect on the hamsters.

2651

USING THE MICROBIAL LAVA LAMP WE STUDIED THE EFFECTS OF TEMPERATURE ON YEAST

Ty Blake-Holden, Rodrigo Navaro, Angel Yanez, Dennis Mendoza. Reseda High School Police Academy Magnet, 18023 Kittridge, Reseda, CA 91335.

In the first experiment we created the beads by mixing alginate solution, 8.5 grams of glass powder, 1 ml of Glo-Sperse, and 1 grain of active dry yeast. Using an eye dropper we slowly droped our final solution into a calcium chloride mixture to make our beads. Then we put 1/2 a cup of granulated sugar into the 2 litter bottle along with the beads we created. After putting on the bubbler and gave the yeast 24 hours to adapt, we counted the bubbles and we had 9 bubbles in a 5 minute period. In the second experiment we did everything the same except at the end we rose the temperature from 9 degrees celcius to 52 degrees celcius. This produced 300 bubbles in a five minute period, or 60 bubbles per minute. After which we rose the temperature another 3 degrees celsius, and the bubbles slowed down. The more bubbles there are the more active the yeast is. So in conclusion 52 degrees celcius is the ideal tempature for yeast activation.

2652

CAN *COLLEMBOLA* SURVIVE IN THE REFRIGERATOR?

Karina Avalos, Daysi Castro; Teacher: C. F. Hajdu. Mulholland Middle School, 17120 Vanowen Street, Van Nuys, CA 91406.

We used the *collembola* we collected from our school garden to do this experiment. We took 3 of the *collembola* culture jars that we cultured in the classroom and put them in the refrigerator (-4 degrees Celcius) for 3 days. We left 3 other *collembola* culture jars in the classroom (approximately 20-28 degrees Celcius) for 3 days. Each *collembola* culture jar had 5 *collembola* in it. After three days only one *collembola* was alive from the three culture jars that were left in the refrigerator. The jars left in the refrigerator were very dry. After three days the *collembola* culture jars left in the classroom had 1-3 *collembola* in each jar. Our experimental results show that more *collembola* survived in the room than the refrigerator but we are not sure if the *collembola* in the refrigerator did not survive because of the lower temperature or the dried up culture jars.

2653

EFFECTS OF ALZHEIMER'S DISEASE-LIKE TREATMENTS ON RAT BRAINS.

S. F. Flagan, Dr. S. A. Frautschy (mentor) and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

This study examines possible causes of Alzheimer's Disease (AD) through a look at the reduction of synaptophysin and the Aβ amyloid in the brains of rats. The hippocampus, cortex, cerebellum, and thalamus were dissected from lab rats treated with chemicals that cause symptoms similar to AD, then freeze dried and powderized. After pulverizing them, the brain samples were assayed for protein and synaptophysin concentrations. The elisa determined the toxicity of each of the treatments by comparing the concentrations of the Aβ amyloid and synaptophysin to controls. The results proved that apolipoproteins J (apo J) were most toxic in the super soluble form with apolipoproteins E (apo E) were most toxic when mixed with other substances. The results also proved false previous suggestions that TGFβ2 and Aβ are toxic when alone. The two are actually protective of the brain when mixed together. Whereas apo J in its super soluble form and apo E when mixed with other substances are possible contributors to AD, it is unlikely that TGFβ2 and Aβ are contributors when mixed together.

2654

HOW LONG DOES IT TAKE FOR *COLLEMBOLA* EGGS TO HATCH?

Jennifer Covarrubias; Teacher: A Momary. Mulholland Middle School, 17130 Vanowen St., Van Nuys, CA. 91406.

My class and I started a project on *Collembola. Collembola* is a small microscopic organism that can only be seen with a microscope, or magnifying glass. We collected *Collembola* from our schools garden. In the garden we collected leaf litter and soil. The *Collembola* was not found in the leaf litter. Due to the weather, the *Collembola* was found in the soil. We added water to the soil and put it tinder a microscope. To loop these small organisms out, we made a small instrument out of a barbecue toothpick and a thin wire. The loop worked great even though it was a very challenging task to loop the tiny organisms out. I was able to loop three *collembola.* I classified the *collembola* to be from the *Isotomidae* family of *Collembola.* I put the *Collembola* in a culture that we made by putting plaster of Paris, coal powder, and water together in a baby food jar. My three *collembola* survived on yeast and water. Two weeks after the collection, I noticed that the amount of *collembola* had tripled. I had not noticed any eggs in the culture. Nine days later I found three clusters of eggs. I watched the eggs for five days. On the sixth day I noticed that one of the three clusters had more eggs on top. Two days later I found maybe about fifteen babies around the eggs. Half of the largest cluster had hatched. The two other clusters had hatched too. As a result it takes about six to seven days for the eggs to hatch.

2655

USING THE MICROBIAL LAVA LAMP, WE STUDIED THE EFFECTS OF YEAST

Denis Pavlov, Kyle Wallace, Igor Sheynkman, Marcus Burns. Teacher: Mr. Stone. Reseda High School Police Academy Magnet, 18230 Kittridge St, Reseda, CA 91335.

First, we make solution I, which will be used to make beads: pour about 30 milliliters of alginate solution (41-46°C or 105-115°F) in the mixing chamber, add 8.5-9.0 grams of glass powder, add 1 milliliter of Glo-Sperse pigment using a plastic pipette, add 1 gram of dried yeast, close the mixing chamber and don't stop shaking it until the beads are made. In the meanwhile we prepare the chloride solution: fill up 2/3 of the cup with 5% calcium chloride solution. Now, let's make the beads: fill a pipette with our solution I, start dropping it, one-by-one, in the chloride solution about an inch above the cup, when solution I is used up, let the beads stay in the chloride solution for about 5 minutes and then rinse them about 5 times. After we are done with the beads, we need to make our next solution, where we will have our beads go up and down: fill up 3/4 of the 2-liter bottle with tap water, add about 1/2 of cup of granulated sugar, add about 1/4 of a teaspoon of active dry yeast, add the beads, stick the bubbler on top on the bottle or a fermentation airlock (which should already have 1 milliliter of water). Wait about 5 minutes and you will see the yeast metabolize and produce bubbles. After counting we get 1 bubble in a minute. Then we do exactly the same thing over again, except, instead of active dry yeast, we used bread machine yeast, and instead of getting 1 bubble in a minute, we got 2 bubbles a minute. That proves that by using bread machine yeast instead of dry active yeast, the number of bubbles increases twice.

2656

REACTIONS OF GORDIAN WORMS TO VARIOUS STIMULI IN THEIR HABITAT.

A. Arroyo, A. Campos, V. Lopez, S. Salvi, A. L. Rodriguez, and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

Worms play a significant role in improving the soil by allowing air and water to reach deeper into the ground. The purpose of this experiment was to see the different reactions of gordian worms to various stimuli in their habitat. We polluted the gordian worms' habitat with everyday products, such as Canola oil, vinegar, Ajax, sugar, hand soap, Windex and starch. Litter and pollution make up the chemicals that greatly affect the well-being of the gordian worms in their habitat. Even a few chemicals can alter the welfare of the gordian worms. If land, air and water pollution from our wastes continue, gordian worms will die off and possibly other creatures as well. Their significant roles in the environment would eventually end, which will affect not only the gordian worms and other animals, but humans as well. We basically tested to see the gordian worms' reactions to pollutants of everyday products in their habitat.

2657

IT'S A MATTER OF LIFE OR DEATH.

P. Castaneda, K. Canon, A. Ho, A. Sanglimsuwan, and A. T. Flagan (teacher). Ramona Convent Secondary School 1701 West Ramona Road, Alhambra, CA 91803-3099.

Almost all organisms are "dependent" on other organisms to survive—and certainly all organisms need substances such as nutrients, water, and gases from the environment. By studying ecology, biologists have come to recognize the interdependence of organisms and the physical environment. However, with the era of industrialization, people have been polluting the physical environment lately by dumping non-biodegradable waste and toxic materials. The purpose for this experiment was to "demonstrate" how pollution can affect an organ-

ism's environment as well as the well-being of the organism itself. To do this, our group obtained some Tubifex worms (fresh water worms) and put them in three different environments: fresh water, water and vinegar, and water and oil. We were successful in demonstrating how pollution can harmful pollution can be—for the Tubifex worms in the "water and vinegar" solution died almost immediately after we added the vinegar, and the worms in the "water and oil" solution died a few hours later after we added the oil. The Tubifex worms in the fresh water environment (which had no altered pH and enough air for the worms to breathe) survived instead.

2658

WHAT HOUSEHOLD SUBSTANCES ATTRACT *COLLEMBOLA*?

Richard Rummell, Joshua Zugarazo. Teacher: C. F. Hajdu Mulholland Middle School, 17120 Vanowen Street, Van Nuys, CA 91406.

Collembola were collected from the Mulholland Middle School garden and cultured in our classroom. Various household substances were mixed into paper tissue wads of approximately 1 centimeter in diameter. Each tissue wad was placed into a *collembola* culture jar containing 5 *collembola* per jar. The culture jars were treated in triplicate and observed over a period of 30 minutes to see if the *collembola* were attracted to each household substance. Our experimental results showed that the *collembola* were attracted to (moved toward) the yeast and were not attracted to (did not move toward) the baking soda, vinegar, dish soap, and water.

2659

USING THE MICROBIAL LAVA LAMP WE STUDIED THE EFFECTS OF SUGAR WATER ON YEAST

Group—Edgar Bravo, Ruben Bucio, Jacob Hoffert, Brian Lemus. Teacher: M. Stone. Reseda High School Police Academy Magnet, 18230 Kittridge St. Reseda, CA 91335.

First we put 8ml of glass powder, Alginate, Gleo-Sperse (pigment), and quick dry yeast in a plastic tube container. (Shake a lot) We sucked the color from the container with a long dropper and dropped them in a glass cup with some glass powder in it. Drop them very quickly, try not to get any air in the drops and drop as many as you please. Wash the beads thoroughly. We got a two liter bottle and put 1/2 cup of sugar in it, and fill about 1/4 of the bottle with water. Drop the beads in the bottle with a tube and get a cork with a bubbler on top and insert it in the nozzle of the bottle. We got 34 bubbles in 5mi/6.8 bubbles in 1mi. (vs) We took out the beads out of the bottle and put 2 cups of sugar instead of 1/2 and added more yeast. Our group got the average of 40 bubbles for 5mi/8 bubbles for 1mi. (Bubble amount may differ)

2660

HOMEMADE SOAP SAVES THE EARTH.

C. Yeung, A. Tran, S. Park, J. Rosales, and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

In the "Homemade Soap Saves the Earth" experiment, the purpose was to make a soap that would be environmentally better than factory soaps. To do this, we replaced the chemicals used in factory soaps with oil, honey, peanut butter, and other substances. However, one chemical that was necessary to use was lye (sodium hydroxide.) Without it, the soap would not be successful. Mixing all the ingredients with hot oil made the soap. After testing it with many objects, such as plants, animals, and fabric, our result was that homemade soaps cleaned materials better and was better for the environment.

2661

COLLEMBOLA IN CAPTIVITY.

B. Arias and M. Mommary (teacher). William Mulholland Middle School, 17120 Vanowen St., Van Nuys, CA 91406.

The purpose of this study was to determine if more than one family of *Collembola* could be found in the same area of the northwest garden at Mulholland Middle School, and to determine how long they can survive in captivity. My hypothesis was that many families of *Collembola* can be found at the same site and survive captivity.

Collections were made from a 20cm. by 20cm. mapped area of the garden. *Collembola* was collected using the Tullgren funnel and looping techniques. Cultures were maintained in an activated charcoal and plaster of Paris base. Cultures were kept at room temperature and fed yeast and water as needed. *Onichiuridae* family was identified in one of the cultures, but they died after 24 hours in captivity. *Isotomidae* family was also identified but they are still alive after four weeks and they are active and reproducing. Eggs and youngsters can be identified. I conclude that my hypothesis was correct. Different families of *Collembola* were identified at the same site and I have successfully maintained cultures of *Isotomidae* in captivity.

2262

THE EFFECTS OF ULTRAVIOLET RADIATION ON CHLOROPLASTS IN *EUGLENA* AND *ELODEA*.

Alex Vaynerman and B. Krieger (teacher), Pacoima Middle Schoot, 9919 Laurel Cyn. Blvd, Pacoima, CA 91331.

Objective. Our project's main purpose was to determine the effects on oxygen production when a concentrated UV source was used to bombard *Euglena* and *Elodea* organisms at 24, 48, 96, 192, and 384 hour increments, thus simulating the earth's futuristic conditions. Since all life on earth depends on the oxygen given off by chloroplasts, and since 90% of the earth's oxygen comes from the oceans (which contain *Elodea*) we believed that this project would make a very outstanding contribution to our futures.

Materials and Methods: We took use of the *Euglena* and *Elodea* and kept a control group of each under a growing lamp and an experimental group set in a box with a growing lamp and a UV light source of 300nm-400nm wavelengths. The *Elodea* was kept close to the surface of the pond water and the *Euglena* were kept in petri dishes with a wheat and rice medium. After each session we would count the number of chloroplasts in each organism by eye through a phase microscope. We originally tried using a spectrophotometer to determine the amount of oxygen being released by these chloroplasts, but early results proved to be too insignificant to support any results. Counting chloroplasts provided us with the best idea of the detrimental effects that UV light would have on organisms.

Results: We found that there were severe reductions in the number of chloroplasts available for the *Euglena* and *Elodea*. The *Euglena* had a much greater loss in chloroplasts than the *Elodea* did, causing us to believe that *Euglena* might be more susceptible to UV radiation. Thus oxygen production decreased.

Conclusion: Our results backed up our premises on the damaging effects that an ultraviolet ingested earth would have to face in the coming decades. Our world as a whole will face staggering losses in oxygen as well as life if the polluted trends continue to wreak havoc on the ozone layer. Our project was able to prove that in a futuristic condition with more UV light in the atmosphere, which is the way trends are continuing right now, life will have an immensely difficult time surviving.

2263

READY OR NOT... HERE COMES MOLD.

D. Bustamante, S. Lujan, C. Lorenzo, Y. Valenzuela, and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

The purpose of this lab was to find out how long can we possibly preserve bread from developing or spreading mold by using natural and/or edible substances and by heating (such as microwaving). To do this, we used several kinds of substances such as baking soda, honey, oats, vegetable oil, and so on to add on to separate dishes of bread in order to carry out the whole experiment. We also spread mold onto the bread to speed up the results. Then, we left the matter to set into the bread and carry out their purpose. Last, we were to observe the results to see which of the substances and/or techniques failed or proved to be successful. (Please note: All bread is subject to mold no matter what the substance is in order for the bread to be edible. Also, none of the results were actually consumed whether any mold was present or not.)

2264

WOMEN OF THE NEW MILLENNIUM: HAS BIRTH ORDER DECIDED THEIR FUTURE?

L. M. Smith and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

The lingering hypothesis remains, is there any valid correlation between birth order and personality type. Society has continued to speculate through the years in response to this possibly important concern but no real active research has been taken to address the issue. Through the use of comprehensive Myers-Briggs Type Indicator Test, teenage women were tested in order to determine four components of their personality. Along with the above test, the female subjects were asked to fill out a simple questionnaire that sought information about their siblings and family. After analysis of results, some correlation was detected. However many similarities in personality can be attributed to general social attitude toward women and normal character development.

2665

WHAT FAMILY OF *COLLEMBOLA* DOES MULHOLLAND MIDDLE SCHOOL HAVE?

Mary Chakmakjian, Amber Smith. Teacher: M. Momary. Mulholland Middle School, 17130 Vanowen St., Van Nuys, CA 91406.

My hypothesis was that there could only be one family of *Collembola* in our Mulholland environment. I collected soil and leaf litter from the southwest garden. I used the Tullgren funnel and looping techniques for collection. *Collembola* was found only in the soil.

Collembola was placed in a culture jar with an activated charcoal and plaster of Paris, they were maintained with yeast and water. I was able to identify three different families: *Onichiuridae*, *Isotomidae* and *Neonuridae*. After observation and classification, I proved my hypothesis wrong. Three different families were found in the same site.

2666

THE GROWTH OF PLANTS IN THE PRESENCE OF ACID RAIN AND OZONE.

M. E. Guzman and A. T. Flagan (teacher). Ramona Convent Secondary School, 1701 W. Ramona Rd, Alhambra, CA 91803.

Pollutants are all around us. Ozone fills the air and acid rain pours down on everything in its path. I studied the effect these two pollutants have on our plant life, especially crops. I grew bean and squash plants and I tested the growth rate of the plants after being exposed to pollutants at different stages of development. I tested both plants that have grown outside as well as indoors. The plants that have been exposed to ozone and acid rain or a combination of the two tend not to grow as healthy as the plants that are not grown in the presence of pollutants.

2267

UTILIZING SCIENTIFIC METHOD FOR MIDDLE-SCHOOL BOTANY EXPERIMENTATION

School: Clay Middle School. Teacher: Vince Papineau Jr. Student Participants and Coauthors: Devon Barney; Guadalupe Carrillo; Sherleey Cerella; Anthony Chandler; Sam Contreras; Monica Ellis; Chardae Foster; Lennisha Hicks; LaToya Lewis; Vance Lewis; DeMarls Martinez; Dakenya Moore; Michael Pitts; Jose Ramierz; Ronell Ray; Christopher Robertson; and Vermercedes Vaughn.

The scientific design for this botany investigation is twofold. The first phase involves a three week botany experiment that requires the students to successfully plant and germinate one of the following tree seeds: the *Carolina Cherry* and the *Granny Apple*. It is interesting to note that the student researchers' tree seeds were randomly selected by them. Each student selected out of a New York Yankee baseball cap, a folded piece of paper that pictured on it the following letter and number: A1 (Granny Apple-1st shelf); A2 (Granny Apple-2nd shelf); A3 (Granny Apple-3rd shelf); C1 (Carolina Cherry-1st shelf); C2 (Carolina Cherry-2nd shelf); C3 (Carolina Cherry-3rd shelf). Moreover, every tree seed in this experiment was found by the educator in nature; and the seeds were soaked for 24 hours in a water-filled glass jar. Prior to the planting phase of this botany study, the teacher washed each planting container with a bleach and water solution to sterilize the inside of it. Once the student investigators had randomly selected their tree seeds to plant and germinate, the instructor supplied each student with a planting container that measured 2.5 inches in depth and 2.25 inches in width. We utilized a portable weigh balance to accurately fill each planting pot with approximately 52 grams of "Black Magic" potting mix composed of forest products, Canadian sphagnum, peat moss and perlite. In addition to the potting mix, the teacher attached to the front of every planting container a strip of masking tape the following information using a black, waterproof marker: the date that the planting of tree seeds occurred; the students' name; the tree seeds planted; and the seedlings' placement and alignment in the growth laboratory. Next, the adolescent researchers were asked to measure the diameter of their respective tree seeds with a ruler. Once the seeds' diameter was calculated, the students then had to multiply this number by three in an attempt to determine the estimated planting depth for the seeds. After the planting depth for the seeds was predicted, the young botanists strategically positioned their randomly selected tree seeds into the soil and maneuvered them down into the predetermined planting hole. The tree seeds were then covered with topsoil, moistened thoroughly with water using a spray mister bottle. Then the students independently placed the seeds into a air-locked, plastic tent-like structure which measured: 18 inches in length; 8 inches in height; and 12 inches in width. It is important to note that each student engaged in the botany experiment planted two seeds into her/his potting hole in an attempt to guarantee the success of germination. Relative to the germination phase of the botany project, the student researchers utilized a spray mister to thoroughly water the topsoil of their planting pots on a dally basis. The scientific data assembled during this phase of the botany study revealed the following information: the average germination period for the Granny Apple seeds was nine days; and 100% of the Granny Apple seeds germinated successfully. The average germination period for the Carolina Cherry seeds

was 19 days; and 72% of the Carolina Cherry seeds germinated successfully. The student researchers concluded from this germination study that the Carolina Cherry seeds took a longer time to sprout up through the topsoil because the construction of their seed coat was thicker and harder than that of the Granny Apple seeds.

2668

Part two: What effect does the reflective backgrounds of aluminum foil and the color of white have on plant growth in an artificially illuminated growth laboratory at room temperature?

School: Clay Middle School. Teacher: Vince Papineau Jr. Student Participants and Coauthors: Devon Barney; Guadalupe Carrillo; Sherleey Cerella; Anthony Chandler; Sam Contreras; Monica Ellis; Chardae Foster; Lennisha Hicks; LaToya Lewis; Vance Lewis; DeMaris Martinez; Dakenya Moore; Michael Pitts; Jose Ramierz; Ronell Ray; Christopher Robertson; and Vermercedes Vaughn.

This is the process followed when the tree seedlings broke the surface of the topsoil, they were immediately placed under artificial illumination in the growth laboratory of the classroom to cultivate at room temperature. At this time, the student researchers were actively engaged in four weeks of observation while they collected data associated with the growth stimulation of their seedlings. While participating in the second phase, the student investigators had to record, compare, and interpret the growth data that they obtained from their daily observations. After the four week cultivation period concluded, the students came together as a group and studied, interpreted, and compared all the growth data. To complete the four week investigation, the student researchers as a team had to summarize their findings relative to the botany study. The tree seedlings were placed in a growth laboratory which utilized a wide spectrum, 33 watt and 25 inch General Electric cool white fluorescent light source. All three lights in the growth laboratory were regulated by a timer that was set to turn the lights on from 6:30 am to 1:30 am. The growth laboratory included a cabinet-like, wooden structure that had three separate shelves. Each shelf was approximately 9 inches from its base to the illumination source. The first shelf was lined entirely with a reflective foil. The walls, the ceiling, and the base for the second shelf of the growth laboratory was painted white. The third wooden shelf of the growth laboratory did not use any reflective device. For this reason, the seedlings that were cultivated on the third shelf are considered to be the control samples in this study. The environmental placement of the seedlings in the growth laboratory was randomly determined by the baseball cap drawing described in the germination phase of this botany experiment. As soon as the tree seedlings sprouted up through the topsoil they were placed on the shelves accordingly. Moreover, every shelf in the growth laboratory supported at least three tree seedlings from each type of plant sample in this study. Once a third leaf developed on the seedling it was fertilized with a commercial product referred to as "Miracle-Gro". The "Miracle-Gro" fertilizer is classified as a water-soluble product concentrated with 15% of nitrogen; 30% of phosphorous; and 15% of potassium. Relative to the growth observation and cultivation period, every plant seedling was fertilized at least once in this botany investigation. Throughout the experiment, the seedlings were daily rotated approximately a quarter turn to vary the angle of illumination that the plants were being exposed to. In addition, the seedlings were watered by the students when the topsoil of their plant felt dry to the touch. At the conclusion of the four week period, the final growth or size of the respective seedlings were recorded. The scientific data collected from this phase of the botany experiment produced the following information: the average height size for the Granny Apple seedlings that were cultivated on the first shelf, the second shelf, and the third shelf of the growth laboratory measured approximately 2.5 inches; approximately 3.16 inches; and approximately 2.6 inches respectively. The average height size for the Carolina Cherry seedlings that were cultivated on the first shelf, the second shelf, and the third shelf of the growth laboratory measured approximately 2.75 inches; approximately 3.5 inches; and approximately 3.0 inches respectively. Although the shelf that exhibited the white reflective background recorded more average height size than the other shelves in the growth laboratory, there was not a significant difference to conclude that the white reflective background is a better growth stimulant for plants than the other two backgrounds utilized in this botany investigation.

2669

INDUCING DORMANT BEHAVIOR IN GOLDFISH (*CARASSIUS AURATUS*).

Siao-Yi Wang and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment, I attempted to induce dormant behavior in goldfish (*Carassius Auratus*). I had 10 fish in the experimental tank and 10 fish in the control tank. I gradually lowered the temperature of the water in the experimental tank to 4°C by surrounding the tank with ice cubes. I was successful in making the fish rest at the bottom of the tank with little movement. I recorded a significantly slower operculum movement rate in the dormant fish (p-value<0.001). This technique can be used as a commercial process to keep live fish fresh while in storage. Three fishes from the experimental tank died while two from the control tank died. This was due to abuse from the bigger and more aggressive fish in the tank.

2670

THE EFFECTS OF 5% SODIUM CHLORIDE SOLUTION ON ONION BULBS.

Kerri Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment I tested to see if a 5% sodium chloride solution had an effect on the lengths of onion roots. This would help determine whether or not saltwater would increase the growing rate of onions. If the onions grow to be healthy and grow at a faster rate in the 5% sodium chloride solution then it would help farmers produce a better crop of onions. The factors such as light and water are important throughout this experiment. The experimental and the control groups should be conducted under the same controlled conditions and environment. If a group receives more light, then its growing rate is expected to increase. Therefore it is important that the groups are rotated daily and equally. Sodium Chloride did have an effect on the root growth of the onion bulbs. The onion bulbs that were placed in the 5% sodium chloride solution produced shorter length roots than those in distilled water. Therefore watering your onions with a 5% sodium chloride solution would decrease the growing rates of onions. Growing onions in salt water may kill the plant if applied to an unbalanced solution. In conclusion, for healthier and faster growing onions, water onions in distilled water.

2671

EFFECT OF TEA-TREE AROMATHERAPY OILS ON THE GROWTH OF *RHIZOPUS STOLONIFER.*

Josephine Lee and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment, I tested whether the growth of the common black bread mold, *Rhizopus stolonifer*, was enhanced by tea-tree aromatherapy oils. Since many vascular plants cannot grow without the symbiotic fungi that inhabit the roots and supply essential nutrients, I suspected an interdependence between the growth of plants and fungi. I hypothesized that fungi grown in potato dextrose agar (PDA) containing plant essences (+oil) would grow at a faster rate than those which were grown in plain (-oil) PDA. I aseptically prepared 10 experimental (+oil) PDA plates and 10 control (-oil) PDA plates. Plates inoculated with *R. stolonifer* were kept at room temperature for a period of three days. I observed the plates every 24 hours and measured the average mycelial growth rate in millimeters. Since the fungus did not grow in a uniform circle, I took the mean of two measurements (the distance that the growth had spread from the point of inoculation) to determine the average mycelial growth. Growth became visible in the -oil plates on the second day and spread to cover the whole plate by the third day. Throughout the three days of observation, no growth was visible on the +oil plates. The data did not support my hypothesis that the plant essences promote fungal growth. Therefore, I concluded that the added oils actively inhibit the growth of the bread mold ($p<0.001$).

2672

SYMBIOSIS BETWEEN *PELOMYXA CAROLINENSIS* AND *CYANOPHORA PARADOXA.*

Darren Lee and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

According to the endosymbiosis theory of evolution, chloroplasts were originally free-living organisms that were absorbed and incorporated into the structure of other cells. In this dual-phase investigation I attempted to create a symbiotic relationship between the amoeba *Pelomyxa carolinensis* (also known as *Chaos carolinensis*) and the blue-green algae *Cyanophora paradoxa.*

In phase I, ten *P. carolinensis* were placed in a *C. paradoxa* culture. At the same time, ten additional amoebae were placed in a standard springwater/wheat seed medium as a control. After seven days, the amoebae were transferred to a near-foodless environment. The number of surviving amoebae was counted twice daily for fourteen days. Had the *P. carolinensis* symbiotically incorporated the *C. paradoxa* they would be able to produce their own food, but at no time did the populations differ by more than one amoeba. Because 55% of the amoebae survived for the full fourteen days, I believe that my near foodless environment still had sufficient food supplies for an amoeba to survive. Additionally, the nine deaths that did occur were evenly spread between the two groups, so I could not conclude that the *C. paradoxa* was symbiotically incorporated into the *P. carolinensis.*

To verify the results of this investigation, the basic procedure was repeated in phase II. In this second trial, however, I measured the area of each amoeba daily using a .05 mm grid. At the end of five days, the average sizes of the control and experimental groups differed by an insignificant amount less than 0.5%. ($t=.27$, $p>>.1$)

2673

WAVELENGTH OF LIGHT AND PHOTOSYNTHETIC BACTERIA.

Jennie Teel and Steve DeGusta (teacher), John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

To test the effects of wavelength of light on photosynthetic bacteria, I constructed a Winogradsky column with pond mud and the necessary carbon and sulfur sources. I wrapped one tube in pink cellophane, one in purple, and the control in clear. After letting the bacteria develop for 3 weeks, I did a plate culture and a test tube culture in a salt medium. From this I estimated the number of bacteria in each soil by multiplying the colonies by the dilution of the soil solution used. There were 162,000 bacteria per gram of soil in the pink tube, 34,200 bacteria per gram of soil in the clear tube and 2,180 bacteria per gram of soil in the purple tube. Using Chi Squared I found the results to be significant ($x2=114949$, $p<0.001$). I concluded that the wavelength of light does affect the growth of photosynthetic bacteria and that pink light promotes the most growth, natural light the next most and purple light the least growth.

2674

YEAST'S PHOTOSENSITIVITY IN THE FERMENTATION PROCESS.

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Temperature is a large factor in the fermentation process but is it the only thing? One idea is that light is a factor. To find out if light affects the fermentation process, a sample of yeast was exposed to light and another sample was kept in the dark and both were fermented. Hypothecating that if the light is a factor it would show it by a change in performance of the yeast. The reasoning for the change in performance is that other sensitive life forms like worms moves much faster if light is on them because they are trying to avoid it yeast might be the same. The test was done by fermenting yeast in graduated centrifuge tubes, the experimental tubes were taped around the transparent plastic so no light could get in. After a significant time the sugar water level in the tubes was recorded by measuring how much ml of sugar water was left out of 15ml. After this was all done, the results showed that there was no significant difference if light was added or not.

2675

EFFECTS OF ULTRAVIOLET RADIATION ON FRUIT FLY REPRODUCTION.

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This study examined the question of the effects of ultraviolet light in the fruit fly life cycle, specifically reproduction. Two tubes of fruit flies consisting of two males and females were left to breed under an ultraviolet light. The results from these two tubes were then compared to the results from another two tubes consisting of two males and two females that were left to breed without ultraviolet radiation in a normal environment. All flies were left to breed for three weeks. During those three weeks, two of the tubes were set under an ultraviolet light for two hours each day. When the three weeks came to an end, the flies were counted and observed for possible abnormalities and physical appearances. The results were inconclusive. For one, no abnormalities were found at the end of the experiment. In the two tubes under the radiation a total of 53 and 87 fruit flies were recorded. In the two tubes not under the radiation a total of 101 and 43 fruit flies were counted. Because the data did not show a clear trend in the results, the experiment is inconclusive.

2676

PLASMID PALS: EXCHANGE BETWEEN *E. COLI* AND *B. CEREUS.*

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In phase one of this experiment, *B. cereus* and *E. coli*/pAMP were cultured for observation. I established distinguishing characteristics of the two species. In phase two, *B. cereus* bacteria were cultured in three ways to test for interspecies conjugation: with *E. coli*/pAMP, with wild *E. coli*, and independently, all in nutrient broth medium. The mixtures were then tested for resistance to ampicillin, gained through the "flag" plasmid pAMP, by aseptically streaking for isolation onto agar containing ampicillin. Multiple samples were analyzed. Overall, only one sample of bacteria concluded to be *B. cereus* was shown to be susceptible to ampicillin. However, the rest of the *B. cereus* appeared to be inherently resistant to the ampicillin. Therefore, the results of phase two were inconclusive. In phase three I tested if the ampicillin was the cause of the unexpected results, due to its age. Fresh ampicillin agar was prepared and samples from the previous phase were streaked onto the agar. Of the thirty-six samples, 5.5 percent were unexpectedly resistant, 2.8 percent were unidentifiable, and the last 91.7 percent grew where expected. In two samples from the growth tube containing *E. coli*/pAMP and previously susceptible *B. cereus* colonies grew on the ampicillin agar from both species. I rejected the idea that the *B.*

cereus only grew on live *E. coli* or on dead bacteria because it spread outside of the original streak and into another unstreaked area in both samples. Therefore, I concluded that interspecies conjugation did indeed occur.

2677

EFFECT OF YEAST ON THE ROTTING OF APPLES.

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Rotting is the leading cause of fruit industry losses. A possible way help fight rotting is the addition of a naturally-occurring organism such as yeast, which can thrive inside fruit and prevent any pathogens from invading and destroying the fruit. To test the effects of yeast on the rotting of apples, a cube was cut out of each apple (wound) and purposely infected with fungi to induce rotting. One experiment involved the addition of baker's yeast (*Saccharomyres cerevisae*) to ten test apples. Red yeast (*Rhodotorula rubra*), a relative to *Rhodotorula glutinis*, a successful biocontrol for pears, was also added to eight apples and were considered the other test group. Both controls groups were left out to rot without the addition of the yeast.

The results show that those apples with red yeast applied had only a small effect on the decay of the apple when compared with their control counterparts ($t > 0.1$). The baker's yeast, on the other hand, had no effect on the rotting of the apples. The red yeast did show that it could slow down the rotting process. A possible reason for the yeast having little effect is that it was outcompeted by the fungi since the fungi came straight from growth on previously rotted apples. Also, the in another test, it was shown that on five plates of potato dextrose agar, fungi from rotted apples grows in a way that will take up more space than red yeast. This means that the fungi will eventually outcompete the yeast for available living space. In order for an effective biocontrol to be found, a strain of yeast that can grow well on apples is needed to test its effectiveness against rotting.

2278

SURVIVAL OF THE FITTEST.

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The purpose of this experiment was to test if deformed wings affect the selection of a mate between flies. To test this, the male homozygous wild flies, male homozygous vestigial (genetically wingless) flies, and the female heterozygous wild flies were placed into one culture. The offspring would determine which types of flies were chosen as a mate. Another combination that I used was male homozygous wild flies, male homozygous vestigial flies, and female homozygous vestigial flies were placed into a culture. In order for my experiment to work, the cultures must be prepared properly. I mixed the Drosophila medium with water and placed it into a culture. I used approximately 5 ml of water and 5 ml of medium. This medium acts like a spoiled fruit in which the flies lay their eggs, which in turn, turns into adult flies. The flies had to be etherized before transferring them into a culture. If not etherized, the wild flies would simply fly away. There were a total of 22 cultures. 11 cultures had 2 male homozygous wild flies, 2 male homozygous vestigial flies, and 2 female heterozygous wild flies in it. The remaining 11 had 2 male homozygous wild flies, 2 male homozygous vestigial flies, and 2 female homozygous vestigial flies in it. There were 10 cultures that the offspring were only wild flies. 3 of the 10 had 2 male homozygous wild flies, 2 male homozygous vestigial flies, and 2 female heterozygous wild flies initially. The remaining 7 had 2 male homozygous wild flies, 2 male homozygous vestigial flies, and 2 female homozygous vestigial flies initially. The other 11 cultures had a mixture of wild and vestigial flies. I look at the phenotype of the flies when determining whether the flies are wild or vestigial. I cannot conclude from this experiment that the wild flies have an advantage over the vestigial flies when the female chooses a mate because only half of the vials have only wild flies for offspring. If this lab were to be done over again, I would have 1 female fly in each culture. This would make it easier when determining which type of fly mated with the female flies. If a male homozygous vestigial fly mate with a female fly and a male homozygous wild fly mate with a female fly in the same culture, then it would be difficult to determine which flies were the parent flies. ($p < 0.001$)

2679

TESTING THE POTENCY OF QUISQUALIC ACID UPON THE RIGHTING REFLEX IN CRICKETS.

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With the ultimate goal of developing a non-toxic (to humans) insecticide targeted at glutamate receptors in the insect nervous system, crickets were first tested to determine whether the control vehicle (0.9% Sodium Chloride Saline) to be used to dilute the insecticide and the injection process (method of drug exposure) had blatant effects on the righting reflex present in crickets. It was hypothesized that neither would inhibit or otherwise effect the righting reflex which is considered an indicator of locomotion. Timed righting reflex tests with weight-adjusted doses of Saline for the experimental group, the actions of injection for the first control group and a control group that received no treatment, showed ultimately no effect on the righting ability of the crickets. Thus it was determined that neither the control vehicle nor the injection process blatantly effects the righting reflex (Using t-tests, $p<0.8$, and $p<0.7$ were found to be statistically significant for the two experimental groups respectively). Crickets were then tested to determine whether Quisqualic Acid (QA) causes permanent neuromuscular damage by permanently contracting the muscles of a subject cricket. The control vehicle (0.9% Sodium Chloride Saline) was used to dilute QA by way of adding 10 ml per exposure. Dilution was used to determine at which exposure the prospective pesticide QA was potent. It was hypothesized that QA would permanently paralyze crickets by binding onto glutamate receptors at neuromuscular junctions in the cricket's nervous system. Timed tests such as those performed earlier were administered at serially diluted concentrations of 0.1% QA, 0.01% QA, and 0.001% QA. At all concentrations the righting ability of the crickets was inhibited. There was 100% inhibition at the 0.1% QA concentration thus upholding the hypothesis.

2680

THE EFFECTS OF HIGH AIR PRESSURE ON THE ACTIVITY OF *ARMADILLIDIUM VULGARE.*

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The effects of low air pressure on humans and other beings (shortness of breath, fatigue, dizziness, etc.) has long been known largely due to the fact that low air pressure is rather common on the earth's surface. The reason behind these symptoms is that, at very low air pressure, a body used to normal air pressure can't get the oxygen it needs so it breathes faster to compensate. When the body of an animal or human begins to breathe like this, it exhales too much carbon dioxide and the blood's pH balance becomes alkaline causing the fatigue, dizziness, nausea, etc. associated with high altitudes. At higher-than-average air pressure, however, not as much information is available because severely high air pressure is not nearly as common on earth as extremely low air pressure. By modifying a microrespirometer (described in the May 1995 edition of *American Biology Teacher*) to allow pressure to be added, I was able to test *Armadillidium vulgare* for changes in activity related to heightened air pressure. The activity of the *Armadillidium* was measured through oxygen consumption. My hypothesis was that if air pressure was heightened, then the activity of the *Armadillidium* would increase due to the fact that more oxygen is available allowing them to absorb more of it with each breath, which could potentially give them more energy. The results of the experiment implied that at 10psi above 1atm, the activity of the *Armadillidium* increased significantly above that of the controls at 1atm, $(0.05>p>0.01)$. However, it also suggested that at the other levels of pressure tested, 5, 15 and 20psi above atmospheric pressure (14.7psi), there was no significant difference between activity of the test and the control *Armadillidium* $(p>.1)$.

2681

FUNGI ON GELATIN.

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In this experiment, I wanted to investigate whether fungi will have a greater number of fungus on unflavored gelatin opposed to sugar free gelatin. Sugar is a good food for fungus to grow on and it will also make it grow faster. To test my hypothesis, I made four containers of unflavored gelatin with two tablespoons of sugar and four containers of sugar free gelatin without sugar. After the gelatin harden, the containers were exposed to open air for ten minutes and then sealed and kept at room temperature. After observing the gelatin for four days, I concluded that fungi will produce a greater number of colonies on gelatin with sugar than gelatin without sugar. Sugar in gelatin served as a growth stimulant for the fungi. It is possible that along with sugar, the moisture sealed within the containers contributed to the growth of the fungi. In this case, fungi will grow more effectively on the surface of gelatin with sugar than gelatin without sugar.

2682

EFFECTS OF BLEACH ON SEA URCHIN FERTILIZATION.

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This study involved the effects of bleach in the process of fertilization of the sea urchin *Strongylocentrotus purpurates*. 0.125 ml of sea urchin egg suspension was placed into a depression slide and a bleach solution that was diluted with distilled water at a 1:900 ratio was added. There was no fertilization as a result of the immediate termination of sperm. The solution was then diluted to a 1:20,000 ratio of bleach. This quantity also killed the sperm before fertilization could be reached. The amount of solute was again decreased to a 1:2,000,000 ratio; however, the solution still killed off the sperm before the fertilization could occur. Instead of the sperm being instantly annihilated they did happen to survive for two minutes, which was an improvement. The bleach appeared to plasmolyze the eggs, which made them appear fertilized. The control experiment had a fertilization rate of 90.3% +/-5%. The fertilization rate with bleach as a solute was 0%. These results indicate that even a small amount of bleach has a harmful effect on the fertilization of sea urchins.

2683

THE EFFECTS OF INDOLEACETIC ACID UPON GRAVITROPICALLY STIMULATED MAIZE SEEDLINGS.

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The purpose of this investigation was to determine if the curvature due to gravitropism in maize seedlings has an effect upon the balance of the auxin indoleacetic acid (IAA) present in the plant's stem. To determine this, I first gravitropically stimulated maize seeds by orienting four maize seeds in a cross shape inside a 8" petri dish, so that each seed faced a different direction. I then repeated this for four more dishes and then placed them all on their sides so that some of the stems of the seedlings would bend naturally to grow against the force of gravity and some would remain straight. After the seeds had germinated, I removed the stems from the rest of the plant and made an incision along the center of each stem, separating it lengthwise into two sides, one being longer than the other. Each pair of stem halves were then placed in petri dishes containing Snyder's agar to determine the IAA level present in each side of the stem. The results of this investigation show that there is more IAA present in the curved plant stems, than of that in the straight plant stems, suggesting that gravitropism does affect the amount of indoleacetic acid present in plant stems. ($p<0.001$)

2684

THE EFFECT OF WATER CONTENT IN SOILS ON PLANT GROWTH.

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Every soil consists of minerals, water, air and organic matter. The amounts of these ingredients differ in the various soils that make up the earth. With three soils: clay, peat and sand, I conducted, in my first experiment, a test to determine the amount of water each soil contained naturally. I concluded that peat soil has the highest water content. The second highest water content was in the clay soil. Also in my first experiment I conducted a test that would determine the amount of water each soil is capable of absorbing. In order for a soil to absorb a sufficient amount of water it must contain organic material, such as carbon and compost, along with clay. When clay and organic matter are blended together, they have a great capacity for absorbing water and is therefore a good soil for planting. The peat soil contained a blend of clay and organic matter, allowing it to absorb the most water, more than the clay and sand soils. With this information I took the experiment one step farther and planted Cowpea seeds in peat soil and clay soil, two soils which contained the most water and were capable of also absorbing the most water. All plants need a soil rich in water because water is essential for all living organisms. This is precisely the reason that the peat soil produced the tallest plants. The peat soil was capable of absorbing more water, critical for a plant to grow, as well as naturally containing more water within it then the clay soil. The peat soil produced plants with more height than the plants grown in the clay soil. The experiment showed that peat soil was the best soil for planting. ($p = 0.01$)

2685

TRANSFERRING MEMORY FROM PRE-CONDITIONED PLANARIA TO UNCONDITIONED PLANARIA.

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The purpose of this study was to determine if preconditioned *Dugesia dorotcephala* planaria retained the knowledge of unconditioned planaria through consumption. A lighted y-maze was built consisting of three transparent tunnels with a light bulb at each end. Six planaria were individually placed in the maze and trained to go towards a negative stimulus of the lighted tunnel by rewarding them with water. They were tested in 15 trials and found that the planaria chose the dark tunnel more readily. My statistical analysis revealed that this discrepancy had a probability of less than 0.001 ($p = 0.001$), indicating that the planaria did not choose randomly, but preferentially towards the dark tunnel. These 6 planaria were then cut up and fed to a group of 16-unconditioned planaria, the "experimental" group. Then 6-unconditioned planaria were also cut up and fed to a group of 16-unconditioned planaria, the "control" group. Each of the 16 planaria in both groups were trained to go towards the lighted tunnel and tested. The "experimental" group approached the lighted tunnel 54% out of the total 15 trials, about 31% higher than the "control" group's. My statistical analysis of the planaria's choice to go towards the light or dark tunnel revealed a probability of less than 0.001 ($p = 0.001$), indicating that the planaria were affected by the two different kinds of planaria each group ate. Therefore, the "experimental" group retained the knowledge from the preconditioned planaria, indicating that planaria were trainable to go towards a negative stimulus of light if given at least 60 trials in the maze. More trials in the maze gave the planaria more knowledge to learn from.

2686

EFFECT OF MAGNETIC FIELDS ON THE PRODUCTION OF CARBON DIOXIDE BY *SACCHAROMYCES CEREVISIAE* DURING FERMENTATION.

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The problem investigated was the effect of magnetic fields on the production of carbon dioxide by *Saccharomyces cerevisiae*, baker's yeast, during fermentation. Magnetic fields have been found by the EMF RAPID program to indirectly promote cancer. I hypothesized that the magnetic fields, produced by standard bar magnets 6"X1/2"X1/4" (Argus WLS-44375-10), will cause cancerous growth, and therefore more yeast cells will be present. Then the volume of carbon dioxide produced by the yeast exposed to magnetic fields will be more than the volume produced by the control. I set up ten trials, each with a 25mL yeast/sugar suspension in a 50mL tube, one with two bar magnets and the other with index card paper of the same size as magnets on each of two sides. The tubes were left for 24 hours. After the elapsed time, using a technique involving water displacement by carbon dioxide, I measured the production of carbon dioxide during a 20 minute period. The results from both the original experiment and a modified one showed that my hypothesis was false because the p-value in both were greater than 0.1. This showed that the magnetic fields had no effect on the carbon dioxide production by yeast.

2687

THE EFFECTS OF AN INCREASE IN VITAMIN B_{12} ON THE PHOTOSYNTHETIC RATE OF *EUGLENA* UNDER DIFFERENT COLOR WAVELENGTHS.

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The purpose of this investigation was to test whether adding an increased dosage of an essential growth vitamin increases the rate of photosynthesis of *euglena* gracilis under different wavelengths; assuming that the growth rate has a direct relationship to the production rate of photosynthesis. 250 mcg each of vitamin B_{12} was added into four 25 ml cultures of *Euglena*. The four cultures with the vitamin B_{12} were then placed in red, blue, green and white light by adding food coloring, with white light having no food coloring. In doing so, we can determine if vitamin B_{12} increases the growth in each color more or less than just the light treatments alone. Four other cultures (controls) were given the same light treatments, but without the vitamin. The cultures were allowed to grow for a couple of days. Random samples from each culture were placed on a hemacytometer and the numbers of cells in 1 sq. mm were recorded for six days. From statistics, the green and white groups had a p value between .2 and .05. Both the red and blue groups had a $.05>p>.01$ therefore rejecting the null hypothesis and stating that the variation between the cultures treated with vitamin B_{12} and those without were due to the vitamin treatment. However, from the data collected, the high dosage of the vitamin treatments did not increase the growth rate of *Euglena*, but rather slowed or decreased it because the total numbers of cells in all the cultures with vitamin B_{12} were less than those without the vitamin. However, this decrease in cells was not necessarily the result of an overdose in the vitamin. It may be that the fillers holding the vitamin affected the growth of *euglena*.

2688

THE EFFECTS OF GIBBERELLIC ACID ON PLANARIANS

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The purpose of this experiment was to determine if increasing the concentration of the GA_3 (gibberellic acid) would increase the regeneration rate of the planarian. For this purpose, two experimental groups, each with concentration of 0.02% and 0.04% GA_3, were set along with a control group containing 100% tab water. Using the dissecting knife, the tail of the planarian in each group was separated from its body. After 25 days, while the control group had the highest regeneration rate of all, tails in the experimental groups never grew into a whole planarian. In fact, tails in the experimental groups died approximately four days before the tails in the control group could complete their regeneration. The difference between the length of the Experimental 1 (0.02% GA_3) and the Control was found to be significant ($t = 4.9$, $P<0.001$), and the difference between the length of the Experimental 2 (0.04% GA_3) and the Control was also found to be significant ($t = 6.5$, $P<0.001$). These differences were based on the data obtained form day 1 to day 15. Rather than increasing the regeneration rate, GA_3 slowed down the process. Therefore, increasing the concentration of the GA_3 would *not* increase the regeneration rate of the planarian.

2689

THE EFFECTS OF GARLIC ON *DAPHNIA*

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The purpose of this lab was to test the short term and long term effects of garlic on *Daphnia*. This lab was to find the positive effects of garlic. This lab was done as a preliminary test to test if garlic had a positive on *Daphnia*, to test if *Daphnia* were valid subject for further experiments. In part one of my experiment three different concentrations of garlic powder and spring water (2.5x10 g/ml, 5x10 g/ml, and 1x10 g/ml) were tested and compared with a control of only spring water by counting their heart rate. After the four day period of data, the *Daphnia's* heart rate measured every twenty-four hours for four days, it was found that there were more deaths of *Daphnia* in higher concentration than in lower concentrations. By using the chi-square statistics test the data was shown to be significant data with $p < .001$. In part two of my experiment *Daphnia* were exposed to garlic extract for short time (1 minute, 5 minutes, 10 minutes) along with a control (0 minutes). One minute of their heart rate was measured after each of the exposure time to the garlic extract. Results from the data showed that the longer the *Daphnia* stayed in the garlic extract the slower their heart rate became. By using the Chi-squared test to analysis the data, with a $p < .001$, it was found that the change in their heart rate was due to the exposure of garlic extract. After these tests of the short term and long term effects of garlic on *Daphnia* the garlic proved to be harmful and sometimes even deadly. Thus, *Daphnia* are definitely not valid subjects to further test the effects of garlic on.

2690

EFFECTS OF CAFFEINE ON SEA URCHIN FERTILIZATION.

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This study tested the possible affects that "Awake," which contains caffeine in combination with dextrose, magnesium stearate, microcrystalline cellulose, silicon dioxide, starch, yellow 6, and yellow 10, has on the fertilization of the eggs in the sea urchin *S. purpuratus*. Eggs and were incubated with or without "Awake" for 10 minutes at 15 C in pH 8.0 calcium and magnesium free sea water. A two hundred-milligram caffeine tablet was first dissolved in one hundred milliliters of distilled water. We then took six slides and put 0.125 milliliters solution of eggs on them. 12.5 microliters of our solution was then put on the slide and finally, we fertilized the eggs by adding sperm. After observing the six slides, we noted that the eggs on five of the slides were one hundred percent fertilized, while the other slide was fertilized ninety-six percent. The sperm had stayed active and the rate of fertilization stayed constant. The control values in this experiment were at 98%±2%. The results of this study show "Awake" having no affect on sea urchin fertilization at this concentration.

2691

THE EFFECT OF COLORED LIGHT ON THE RATE OF PHOTOSYNTHESIS IN *ELODEA.*

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In order for plants to undergo the photosynthetic process, they must be exposed to light. In this investigation I wanted to see if any particular color of light (and therefore any particular wavelength of light) had more of an influence on the process of photosynthesis. To do this, I tested different wavelengths of light on the angiosperm *Elodea*. I took seventeen pieces (the tip) of the plant and subjected each one to four trials, each of a different color: white (control) and blue, green, and red (experimental). In order to change the wavelength of the light, I colored the water with ordinary cooking food coloring. To compare the rates of photosynthesis, I compared the rate of oxygen production. I measured the amount of oxygen produced using a volumeter which is a device that measures the amount of a gas produced, assuming that the amount produced is very small. I put a piece of the plant in the volumeter and took an initial reading and a final reading after fifteen minutes. Using this data, I was able to compare the rates of photosynthesis based on the wavelength of light. At the onset of my experiment, I predicted that the plants in the clear water would have the fastest rate because it has all the wavelengths of the visible spectrum, which is all the wavelengths that plants can absorb. Since plants absorb more energy as the wavelength approaches the extremes of the visible spectrum, I believed that red light would have the next fastest rate as it is close to the longer end of the spectrum. Next would be blue because although it is close to the short extremum, it isn't as close to the end as red is to its end. I predicted that the plant wouldn't be able to conduct photosynthesis in the green light because plants don't absorb green light; that is why they appear to be the color green. However, this didn't appear to be the case. After doing the *t*test, I can conclude that there is no significant difference between the wavelength of light on the effect of photosynthesis. When comparing the results of blue light to that of white light, I got a p value of far more than 0.1. With this results, I can say with great confidence that the difference is to chance alone. When I compared green light to white light, I got a p value of between 0.05 and 0.01, but the result is closer to 0.05. This leads me to again reject my null hypothesis and say that the only difference is due to chance. In comparing red light to white light I got between 0.1 and 0.05 as my p value. With this I am able to reject my null hypothesis and again say that there is no significant difference between white light and a colored light. In my first lab, my results were inconclusive, but now I can say that there is no significant difference. This goes against previous knowledge which says that the wavelength of light does have an effect on the rate of photosynthesis.

2692

EFFECTS OF RAISING PRAYING MANTISES IN A CONTROLLED ENVIRONMENT.

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In order to experiment on praying mantises such as the confrontational behavior between large and small mantises, a sufficient number of adult mantises are required. This experiments purpose was to obtain this large number of adult mantises by raising baby mantises to their adulthood. There were approximately 138 mantises that hatched from one mantis egg cluster. A sufficient number of mantises needed from this egg cluster to survive to their adult stage would be about 69 mantises or 50% of the cluster. The main problem that prevented me from successfully raising the 69 mantises to their adult stage was the caging arrangement. Since mantises are cannibalistic it is important to separate each and every one of them from other mantises. At first I had 5 mantises to a test tube. When the cannibalistic behavior began I had no arrangement for separating them, because I could not construct one. So the mantises continued to eat each other. This went on until there were only 25 left, by then I had one mantis per test tube. It was very difficult to find a proper arrangement for 138 mantises. Other than that only about one or two mantises at most died from other causes such as from starvation because they didn't eat enough. Also many mantises died after their first molt stage because of improper molting. The egg cluster that was to be cared for at home has not hatched yet. ($p<0.00000000000000000001$)

2693

EFFECTS OF CAFFEINE AS A STIMULANT ON *SACCHAROMYCES CERVISIAE.*

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The purpose of this investigation was (1) to study caffeine's effect on eukaryote cells, particularly the implications on human cells, using *Saccharomyces cervisiae* (commonly known as yeast) and (2) to determine if caffeine can stimulate the growth of yeast. In the first phase I attempted to determine if caffeine could have a lethal effect on yeast. A 7×10^{-7} % yeast suspension was plated on Sabouraud dextrose agar; the experimental agar contained a 1% mass-to-volume concentration of caffeine. Caffeine had a highly significant inhibiting effect on the number of yeast colonies that grew (trial 1: $\chi^2=258$, $p < .001$; trial 2: $\chi^2=138$, $p < .001$); yeast growth was not observed on the caffeine plates. I concluded that the 1% caffeine concentration either (1) killed yeast cells outright or (2) prevented them from budding; I attempted to eliminate one of those possibilities in the second phase of this investigation. The concentration of caffeine (1%) and exposure time (24 hours) of the first phase were kept consistent in the second phase, however, the concentration of yeast was much greater. In the first phase, a 7×10^{-7}% suspension enabled me to grow a countable number of colonies, whereas, in the second phase, a 7% yeast suspension produced a measurable amount of CO_2 indirectly measuring the amount of yeast. Caffeine had no significant effect on the amount of CO_2 produced by the 7% yeast suspension ($t = 1.70$, $p > 0.1$), suggesting that caffeine did not effect the amount of yeast. I concluded that the ratio of the concentration of caffeine to the concentration of yeast determines if caffeine has an inhibiting effect on yeast. Furthermore, I concluded that caffeine does not stimulate yeast. In the third phase of this experiment, I attempted to approximate at what concentration of caffeine has a lethal effect on yeast using the same procedure as the first phase, the experimental agar containing a 0.1%, 0.01%, or 0.001% (m/v) concentration of caffeine. There was no significant difference between the number of yeast colonies grown on the different caffeine concentrations and the number of colonies grown without caffeine (0.1 % caffeine: trial 1 $\chi^2= 1.06$, $0.5 < p < 0.2$; trial 2 $\chi^2=2.09$, $0.05 < p < 0.2$; 0.01% caffeine: trial 1 $\chi^2=0.04$, $0.5 < p < 0.9$; trial 2 $\chi^2=0.04$, $0.5 < p < 0.9$; 0.001% caffeine: trial 1 $\chi^2=0.33$, $0.5 < p < 0.9$; trial 2 $\chi^2=0.09$, $0.2 < p < 0.5$). I concluded that a caffeine concentration between 0.1% and 1% inhibits the growth of yeast; the exact concentration that caffeine causes growth inhibition is unknown. Because the mass of humans is much greater than the mass of yeast used, I concluded the human intake of caffeine is harmless.

2694

THE EFFECTS OF THE GROWTH OF YEAST WITH DISSIMILAR TYPES OF WATER.

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This experiment was done to find the growth of yeast with the addition of sugar and water. The experiment compared the effects of plain tap water against the effects of Brita Filtered water. First, 1 teaspoon of sugar, and 1 teaspoon of yeast were mixed into one container, and repeated in another container. Next, I separately warmed up 3 tablespoons of tap water, and 3 tablespoons of Brita Filtered water at 90 degrees Fahrenheit. Simultaneously, I added each different container of water into the mixture of yeast and sugar. I let the containers set in and grow for thirty minutes. My observation was that the tap water had a better effect on the growth of yeast rather than the filtered water. The tap water container produced foam that rose 4 inches in height during the thirty-minute period. The Brita Filtered water container produced foam that rose 3 inches in height. The same procedure was repeated 3 more times, and the results had remained the same. In conclusion, the addition of tap water with yeast and sugar exceed the growth of yeast of filtered water.

2695

THE EFFECTS OF SQUALANE (SHARK LIVER OIL) ON THE GROWTH OF FUNGUS.

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This experiment was designed to test the affects of Squalane (shark liver oil) on the growth of fungus. Squalane has been linked to slowing the growth of blood vessels that feed cancerous tumors and because of this I wanted to test it on the blood vessels of an organism. The hyphal part of the fungus's structure is similar in some ways to blood vessels and capillaries. So if Squalane slows the growth of fungus, it might suggest the hypothesis that Squalane slows the growth of blood vessels? This experiment tested two types of fungus, *Trichoderma viride*, and an unknown fungus. All the fungus was grown on Sabouraud Dextrose Agar. Each fungus had five control plates with just agar and 5 test plates which had a concentration of 5% Squalane in their agar. I inoculated the plates with fungus using an agar core borer. I then measured the diameter of the fungal growths and calculated the growth rates for a period of 10 days. I found that there was no significant difference in growth between the *Trichoderma viride* controls and the *Trichoderma viride* plates with 5% Squalane, because the probability that my results for the *Trichoderma viride* were do to chance alone was greater than .1 ($p = .1$) The data for the unknown fungus however shows otherwise. I found that the Squalane does significantly slow the growth of the unknown fungus, because the probability that my results for the unknown fungus were do to chance alone was between .05 and .01 ($.05>p>.01$) This evidence helps support my hypothesis and suggests that Squalane may slow the growth of blood vessels.

2696

MELATONIN AND ITS EFFECT ON REDWORM S SOIL BURROWING ABILITIES.

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The purpose of this experiment was to accelerate soil aeration by testing the effects of the neurotransmitter Melatonin on the soil burrowing abilities of *Eisenia foetida.* This experiment was based on the premise that the benefits redworms have to offer the soil of plants would be more convenient if they occurred at a faster pace. To test soil burrowing ability the worms were divided into two groups. One group was injected with 0.01cc

"liquid melatonin" while a control was injected similarly with water. Given ten minutes to progress after injection the worm groups were timed to find how long it took them to completely burrow into the soil. The Melatonin and Control groups had burrowing means of 334 and 387 seconds respectively. Although data suggested that Melatonin increased redworm soil burrowing ability, statistics yielded that Melatonin had no significant effects on these abilities. (t=1.47, $p<0.1$)

2697

DOES KINETIN INDUCE SHOOT GROWTH ON THE EXPLANTS OF AFRICAN VIOLETS, CLONED BY TISSUE CULTURE?

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Tissue culture is a mean of propagating plats from tissue pieces, such as from stem, leaf, petiole, and seeds. Since most plants are totipotency, they have the ability to develop into an entire plant from a single plant cell. Each of these plants would be clones and would have the same traits and characteristics as the source plant. This experiment is an attempt to clone African violets with different concentrations of plant hormone Kinetin (plant growth regulators that regulates growth and cell division) to see if the increase in plant hormone would increase the number of shoots grown on the explant. The explants were taken from African violets, which were cut into 5mm squares. Six explants were placed into three petri dish, each containing a growth medium and three different concentrations of plant hormone 0ml, 0.5ml, 1ml. The African violets were allowed to grow under the same condition (temperature and light intensity) for four weeks. As a result the number of shoots was greater in the 1ml concentration of Kinetin than those of the 0.5ml concentration ($p<0.001$). There was no growth in the control. Which suggest that the hormone Kinetin encouraged shoot development on the explant.

2698

THE EFFECTS OF ALLICIN ON *RHIZOPUS STOLONIFER.*

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Allicin is thought to be the active component of garlic that may stop cancer growth in humans. The primary objective of these two labs was to find whether or not Allicin would inhibit or prevent the growth of *Rhizopus stolonifer* (*R. stolonifer*). To see if Allicin can inhibit the growth of *R. stolonifer*, I used an Allicin solution to "fence" initial fungus growth and observed for possible further growth beyond the fence. I hypothesized that if there is no further growth beyond the Allicin fence then Allicin can inhibit the growth of *R. stolonifer*. Twenty standard-sized petri dishes of Potatoe Dextrose Agar (P.D.A.) were made and *R. stolonifer* was aseptically transferred to each individual dish. The experiment consisted of ten dishes of Allicin solution circles imprinted on the agar after initial growth of the fungus. The intention for the fence was to see if Allicin could obstruct fungal growth beyond the fence. The other ten dishes (control) were applied with distilled water "fences." All of these dishes were left at room temperature (approx. 22 degrees Celsius) and observed for two days for signs of fungus growth. Growth did take place on all petri dishes beyond the Allicin fence, which leads to the conclusion that the Allicin "fencing" method does not stop the growth of *R. stolonifer* beyond the barrier. My second lab ventured to see if Allicin slows down the uncontrollable growth of *R. stolonifer*. I hypothesized that if there is no fungus growth then Allicin prevents the growth of *R. stolonifer*. Eighteen petri dishes were prepared with varying concentrations of Allicin. I then calculated the proportional weights between Allicin and P.D.A.. I calculated the different Allicin proportions (1/2, 1/4, and 1/8) by multiplying the desired weight proportion of Allicin to the standard weight of the agar for each batch of agar (5.85g). I mixed the different proportions of Allicin with P.D.A. to make the different experimental petri dishes. The control consisted of six plates of plain P.D.A., which was used to insure the growth of *R. stolonifer*. Growth did take place on all plates at significant varying rates. Using the t-test, a p-value less than 0.001 was found which strongly

voids the null hypothesis; the results are not due by chance. Therefore, this lead to my conclusion that the higher the concentration of the Allicin, the slower the growth of *R. stolonifer*. Overall, from these two experiments I've concluded that Allicin does not inhibit the growth of *R. stolonifer* using a fencing method. However, a high concentration of Allicin can slow the initial growth rate of *R. stolonifer*.

2699

THE EFFECTS OF TUBIFEX WORMS ON THE REPRODUCTION RATE OF ZEBRAFISH.

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The purpose of this investigation is to determine if *Danio rerio's*, also know as Zebrafish or Zebra Danios, reproduction would be effected by a live Tubifex worm diet. The control group, consisting of four male and four female Zebra Danios, was fed flake food two times daily. The experimental group, consisting also of four male and four female Zebra Danios, was fed live Tubifex worms two times daily. The two groups were then subjected to breeding conditions. Within 30 hours of the beginning of the breeding cycle, eggs were laid and collected. Trial 1: the control group produced 166 eggs; the experimental group produced 109 eggs. Trial 2: the control group produced 125 eggs; the experimental group produced only 30 eggs. The number of eggs produced by the fish that were fed Tubifex worms was significantly less than the number of eggs produced by the fish that were fed flake food (trial 1: $\chi = 11.8$, $p<0.001$; trial 2: $\chi = 65.8$, $p<0.001$). Therefore, the conclusion that a Tubifex worm diet has an negative effect on the reproduction rate of Zebra Danios can be made. The reason for the imbalance of egg production by the experimental group could be due to the high concentration of only one nutrient found in the live Tubifex worms. On the other hand, the control group that was fed flake food received a variety of nutrients that are factory produced to keep the fish healthy.

2700

pH VARIATION OF AN AGAR MEDIUM AS A RESULT OF *E. COLI* GROWTH.

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The purpose of this lab is to determine if *E.coli* (*escherichia coli*) growth will affect the pH of an agar medium. Bacto-brom thymol blue was added to the medium of every petri dish to indicate whether there was any pH variation within the agar medium. Bacto-brom thymol blue indicates pH change at 6.0-7.6 by turning from yellow to blue. The agar medium of the control and experimental dishes were set at pH 5 because I hypothesized that *E.coli* growth will raise the pH level of the agar medium. There was a significant difference between the control (agar medium set at pH 5 w/no *E.coli*) and the experimental (agar medium set at pH 5 w/*E.coli*). There were five control dishes and each showed no sign of pH variation within the agar medium. There were five experimental dishes and each showed signs of pH variation within the agar medium due to *E.coli* growth. The difference between the control and experimental, shows that *E.coli* does affect the pH of the agar medium. Because bacto-brom thymol blue indicated a pH change from 5 to 6.0-7.6 in the experimental dishes, the data proves that *E.coli* does raise the pH value of the agar medium.

2701

THE EFFECTS OF VITAMIN C ON THE RATE OF REGENERATION OF PLANARIA.

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I tested whether vitamin C has any effect on the rates at which planaria tails regenerate. Vitamin C has a kind of special "glue" that holds cells together in humans, therefore it plays a role in every tissue and organ in the body. Since vitamin C has such positive results on the immune system in humans, a question came about as to whether it would have a positive effect on the regeneration of planarians. Concentrations 12.5 mg/ml, 1.25 mg/ml, 1 mg/ml, and .83 mg/ml of vitamin C were tested to determine if it has any effect on the planaria. Vitamin C did have an effect on the planaria since a few of them were killed from an overdose of vitamin C. The concentration of 1 mg of vitamin C per 20 ml of water was determined to be used because it didn't kill the planarians. The experimental group consisted of 10 planarians which were placed in vitamin C concentrated water for 24 hours. The control group consisted of 10 planarians which remained in dechlorinated tap water for 24 hours. Each planarian was then cut in half just above the pharynx. Only the posterior ends of the planarians were used in the experimental and control groups. Each tail of the experimental group was then placed in the vitamin C concentrated water in individual dishes. Each tail of the control group was placed in separate petri dishes with tap water. The length was measured daily for 14 days. The growth was compared by proportions of daily growth to the original size. The final growth proportion of the control group was 2.22 while the proportion of the experimental was 2.52. I found that vitamin C does not increase the rate at which planarians regenerate. ($t=1.607$, $p<0.1$)

2702

CARBON DIOXIDE EMISSION BY PLANT RESPIRATION.

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In this experiment, I wanted to see if the carbon dioxide given off by plants during respiration can me measured. The ten plants that I used were schiffelara. I took the ten plants and put them in a jar with a phenol red solution as my experimental sample. My control samples were jars containing the phenol red solution and a pot of soil without a plant. I sealed all the jars air tight and placed them in the dark. After twenty four hours, the phenol red changed color in my experimental group (from red to yellow) and there was no change of color in my control group. This means that there was nothing in the soil that might have produced a significant amount of carbon dioxide. Then I took the yellow colored phenol red solution from the experimental group and titrated the solution with a 0.1% (2.5μM) of NaOH solution. Then I measured the volume of the plants by water displacement and calculated that they gave off an average of $2.4x10^{-3}\mu M/cm^3$ of carbon dioxide in an hour ($P<0.001$). Measuring the carbon dioxide given off by plant respiration can show how healthy the plant is, the fertility of the soil, or how effective fertilizers can be.

2703

DOES SUCROSE SOLUTION INCREASE THE HEARTBEAT RATE OF *DAPHNIA MAGNA*?

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In this investigation, I tested whether sucrose solution with a concentration of 3.33 mg/ml was related to the increase of the heartbeat rate of *Daphnia magna*. I predicted *Daphnia magna* would have an increase of heart-

beat rate after sucrose solution was added to the *Daphnia magna's* surrounding, because digestive system functions similar to human's. Since the human digestive system is able to break sucrose down to glucose and fructose, I expected the *Daphnia magna's* digestive system to do the same. The glucose would then cause the heartbeat rate to increase. I counted one *Daphnia's* heartbeats for seconds. After I added a drop of sucrose solution with concentration of 3.33 mg/ml to the *Daphnia's* surrounding, I counted its heartbeats again for 15 seconds. I experimented with 20 *Daphnia magna* in the sucrose solution, and the results were that all 20 *Daphnia magna* had increases of heartbeat rates after the sucrose solution was added. The results supported my hypothesis, and the increase of heart rate was due to the sucrose. Statistics showed the P-value was less than 0.001. I concluded that sucrose increased the heartbeat rate of *Daphnia magna.*

2704

TOXICITY OF ALCOHOL.

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Our experiment tested to see the toxic capabilities of alcohol on humans. Sea Urchin fertilization was used to test the toxicity of methyl alcohol, an alcohol commonly found in most alcoholic beverages. Sea urchin sperm were introduced into 100%, 10%, 1%, and 0.1% solutions of methyl alcohol and left for a period of ten minutes. After this ten minute period, sea urchin eggs were introduced and left to incubate for another period of ten minutes. The 100% and 10% solution had 0% fertilization; the 1% solution had 10% fertilization; and the 0.1% solution had a 57% fertilization rate. Artificial seawater made with deionized water was used as a control and had a 92% fertilization rate. In each case the sample size was 70 eggs. In conclusion, our findings show that if methyl alcohol in a 0.1% solution can take the fertilization rate down from 92% to 57%, alcohol is toxic.

2705

PRECONDITIONED LEARNING IN PLANARIA.

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To determine if planaria regenerated from preconditioned planaria learn more quickly, a Y-shaped maze was hooked up to a 6-volt battery with clamp wires, then, ten planaria (group A) were trained to move along the tray with a wall on their left side. The left side was chosen by random. If the planaria moved to an arm of the maze while the wall was on its right side, it was given a shock lasting no longer than one second. This continued until all ten planaria moved with the left wall at least 75% of the time. Group (B) consisted of another ten planaria who were kept in a finger bowl until the time when they were cut. The average number of trials before the planaria in Group A learned was 15 which would set a measuring stick for the experimental and control groups. Group A was then cut and allowed to regenerate (creating Group C ~ experimental). The same was done for Group B (creating Group D ~ control). Out of the ten planaria from Group A, two did not live reducing the combined population for Groups C and D to sixteen. Then, both the experimental and control groups were trained as A had been, except if these individual planarians had not learned by fifteen trials, I moved on to the next one and deduced that the planaria had not learned any faster than group A had. After the two groups were trained, their averages were taken. Experimental: 8 tries; Control: 13. It was found that there was no significant difference between the expected and observed averages. The planaria regenerated from preconditioned planaria did not learn at a faster rate. Any difference is due to chance; $x^2 = 1.19$, df = 1, p = 0.2.

2706

THE EFFECTS OF OXYGEN AND RADIATION ON THE VITAMIN C CONTENT OF VARIOUS FRUIT JUICES.

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This experiment is based on the vitamin C (ascorbic acid) concentration of seven fruit juices in their natural form, under the conditions of microwave radiation and by the oxygen in the air, then compared to each other by their nutritional value. The juices selected were Sunny Delight, Crystal Orange Juice, Capri Sun, V-8, lemon, lime, and pure orange juice. Results were obtained by recording the number of drops it took to reduce an indicator, 2,6-dicholorindophenol. The indicator solution will change to an intermediate pink/purple color, then to a colorless, faint amber endpoint with the addition of pure ascorbic acid and that from fruit juices. The fruit juices tested were compared to the control of a 100mg/100mL concentration of pure ascorbic acid. Radiation and heat by means of microwaving on high power for 45 seconds reduced the concentration of ascorbic acid in the fruit juices by 20 percent. Air exposure for a time factor ranging from 7 to 8 hours reduced the concentrations ranging by 10 to 20 percent. The juice with the highest vitamin C content of the seven juices was Sunny Delight in its natural form (80.74mg/100mL compared to the second highest at 45.70mg/100mL). It was also the highest in air exposure of 7 hours and 15 minutes (69.23mg/100mL compared to 36.90mg/100mL) and in radiation (56.79mg/100mL compared to 3 5.24mg/10M1).

2707

EFFECTS OF PAINT ON SEA URCHIN FERTILIZATION.

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In this study, the effect of water-based paint on sperm-egg interaction of the sea urchin, *Strongylocentrotus Purpuratus*, was examined. To begin, 0.125 ml of sea urchin egg suspension was placed on a slide and studied under a microscope. Using a micro-pipette, 12.5 ul of paint solution that had a dilution with distilled water 100 times, was placed on the egg solution. The final step was using the blunt end of a toothpick to place sperm onto the paint/egg solution. After the sperm was placed, 50 eggs were randomly counted. The process was repeated 3 times. The results of the egg count were as follows: first, 30 fertilized eggs out of 50 eggs yielding a 60% fertilization rate; second, 28 out of the 50 eggs were fertilized yielding a 56% fertilization rate; and the third time, 30 out of the 50 eggs were fertilized yielding a 60% fertilization rate. The control value of fertilization was at 90.3% (+/-) 5%. These results show that the effect of waterbased paint on sperm-egg interaction reduces fertilization to a 58.7% fertilization rate. Sea life can be exposed to the harmful effects of paint through human error. Improper disposal of paint or cleansing of painting materials may cause the paint to go down a drain that leads to the ocean. These such acts may cause a reduction of sea life population, as revealed through the preceding experiment.

2708

BIOLUMINESCENT MARINE DINOFLAGELLATES AS AN INDICATOR OF OCEAN POLLUTION.

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The purpose of my investigation was to determine whether car wash detergent that enters the ocean through storm drains is harmful to the health of marine life. I used *Pyrocystis lunula*, a bioluminescent marine dinofla-

gellate, to represent marine life. I hypothesized that if car wash detergent is harmful to the health of marine life, then the colony of *Pyrocystis lunula* to which the car wash detergent is added will produce less intense blue-green bioluminescence when agitated than a colony to which plain salt water is added. To answer my question, I prepared a 150 ml solution of salt water containing two drops of car wash detergent. This solution served as the polluted water and simulated the concentration of car wash detergent that can be found in parts of the ocean. The experiment was then carried out in a dark room at 8:30 a.m., two hours into the dinoflagellate's night cycle when bioluminescence is at its peak. I filled each of the wells of the microwell plate with equal volumes of dinoflagellates. I then placed two drops of plain salt water (control) into twelve of the wells and two drops of the polluted salt water (experimental) into the other twelve wells. Each microwell was then stirred to agitate the dinoflagellates. I recorded the brightness of each well's bioluminescence on a scale from 0 (no bioluminescence produced) to 5 (bright blue-green bioluminescence produced). The average measured bioluminescence for the dinoflagellates in the plain salt water was 4.83, compared to 3.29 for the dinoflagellates in the polluted salt water. I then ran the *t*-test, which resulted in a *t* value of 7.7 and probability of less than 0.1% that my results were due to chance variation alone. This allowed me to reject the Null Hypothesis and conclude that the brightness of blue-green bioluminescence produced by the dinoflagellates in the car wash water was significantly less than the brightness of blue-green bioluminescence produced by the dinoflagellates in the plain salt water. Furthermore, since the rule regarding the health of dinoflagellates is brighter bioluminescence is better and dinoflagellates are a representation of marine life, I concluded that car wash detergent is harmful to the health of marine life.

2709

THE EFFECTS OF THE LICHEN *CLADINA RANGIFERINA* UPON *E. COLI* AND *B. CERUES.*

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The principle objective of this experiment was to determine if the lichen *Cladina rangiferina* produces an antibiotic that effectively inhibits the growth of the bacteria ***E. coli*** and *B. cereus*. Lichen contains a fungus; and fungus are known to produce antibiotics. This experiment tested whether the fungus in the lichen *Cladina rangiferina* produces an effective antibiotic against the growth of *B. cereus* and *E. coli*. The effective diameter for inhibition of bacterial growth is five millimeters for the radius, or 12 millimeters for the diameter of circle of inhibition surrounding the lichen-extract disks. The lichen extract was made from a 0.5-gram portion from the body of the lichen that was then ground using a mortar and pestle, and finally added to 10 ml of methyl alcohol (100%). The extract was added to filter paper disks, made using a standard hole punch; and methanol was added to control filter paper disks as a control. *B. cereus* was aseptically transferred to a nutrient agar test tube, then spread onto a petri dish. The dish was separated into four equal sections by using a permanent marker to draw four quadrants. Two control disks were added to two quadrants, and the two experimental disks were added to the two remaining quadrants. The same process was repeated using *E. coli*. The lichen-extract disks consistently exhibited circles of inhibition, in both *E. coli* and *B. cereus*, that were 12 millimeters in diameter. After using the t-test, I confirmed that any methanol remaining on the control disks did not inhibit either *E. coli* or *B. cereus* ($p<0.001$). The average diameter of inhibition for 36 disks is 12 millimeters; which is consistent enough to consider *C. rangiferina* an effective antibiotic against both *E. coli* and *B. cereus*.

2710

FUNGAL ASSAY OF SODIUM SACCHARIN AND SODIUM CHLORIDE.

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Saccharin is an artificial sweetener used in various food and beverage products and consumed by millions of people every year. It is considered a possible carcinogen and there is a lot of conflicting data about the health risks of its consumption. In this investigation, I used a fungal assay to determine whether sodium saccharin is toxic to fungus by comparing the average mycelial growth rates of *Rhizopus stolonifer* in unamended (control) SDA and amended SDA with concentrations of 820 mg/L, 1640 mg/L, and 2460 mg/L. Since growth rate is a summation of many cellular processes, it reflects toxic effects of many biological functions. I found that the mean average mycelial growth rate over two days was 65.75 mm/day for the control group, 25.3 mm/day for 820 mg/L, 9.4 mm/day for 1640 mg/L, and 9.29 mm/day for 2460 mg/L. The data shows that sodium saccharin is toxic to the average growth rate of *Rhizopus stolonifer* (820 mg/L: $.001<p<.01$, 1640 mg/L & 2460 mg/L: $p<.001$). Since studies of male rats indicate that it is the sodium salt form of sodium saccharin which causes its negative effects and that the same effects will be induced by other sodium salts, I used the fungal assay to compare the effects of sodium saccharin and sodium chloride. I had three groups: unamended (control) Potato Dextrose Agar (PDA), PDA amended with sodium saccharin (1640 mg/L), and PDA amended with sodium chloride (1640 mg/L). The average mycelial growth rate was 51.9 mm/day in unamended PDA, 0.0 mm/day in sodium saccharin, and 53.3 mm/day in NaCl. The growth rate of *Rhizopus stolonifer* in NaCl was significantly faster than that in saccharin ($p<.001$) and there was no substantial difference between the growth rates of fungus in PDA amended with NaCl and unamended PDA ($p>.01$). Also, it was highly likely that saccharin is toxic to fungus ($p<.001$). I concluded that sodium was not solely responsible for the toxicity of sodium saccharin.

2711

THE EFFECT OF TEMPERATURE ON THE GERMINATION OF WILD OAT SEEDS.

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This study examined the question of the germination of wild oat, *Avena fatua*, in different temperatures. Wild oat seeds were placed into groups that were heated for thirty minutes at three different temperatures. One group was not heated and kept in room temperature, the next was placed in the oven under 200°F, the last was placed under 300°F. This experiment was repeated two times. The seeds that were heated did not sprout at all. The results suggest that wild oat seeds will not germinate under much heat. It is more of a moderate temperature germination plant.

2712

THE IMPACT OF LYSOZYME AND AMPICILLIN ON THE GROWTH OF *BACILLUS CEREUS.*

Lindsay A. Onodera and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

I performed this experiment to determine if the combination of the enzyme lysozyme (found in human phagocytal cells) and the antibiotic ampicillin (a synthetic penicillin) is more effective in preventing the growth of bacteria than lysozyme and ampicillin are by themselves. I reasoned that the combination would be more effective since lysozyme works by destroying existing bacterial cell wall and penicillins prevent its creation. I

placed different combinations of lysozyme disks and ampicillin disks on the surface of agar inoculated with *Bacillus cereus* and waited for the bacteria to grow. I then measured the radii of the areas around the disks with no bacterial growth. The combination of lysozyme disk+ampicillin disk was ineffective; like the water control, it consistently did not produce a clear area. The lysozyme+lysozyme and ampicillin+ampicillin combinations were effective; they produced clear areas that averaged 0.6 and 0.8 cm in radius. Ampicillin+ampicillin was more effective than lysozyme+lysozyme, however ($t=2.681$, $0.02<p<0.01$). Also, tests of lysozyme and ampicillin disks placed side-by-side with a small space between them showed bacterial growth inhibiting the clear areas of ampicillin but not of lysozyme. I concluded that lysozyme may work against ampicillin and its fellow penicillins and have a greater affinity for them than for bacterial cell walls.

2713

EFFECTS OF, VITAMIN A ON REGENERATION OF PLANARIA

Yuliya Mulina and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

In this investigation I studied the effects of Vitamin A on regeneration of planaria. The initial experiment contained two groups of ten, planaria, each cut in half horizontally. Before cutting, the experimental group was fed egg yolk mixed with Vitamin A while the control group was fed egg yoke with no addition of the vitamin. I hypothesized that overdose of Vitamin A on planaria will cause an increase in length since the vitamin promotes growth, but also lead to deformations of the regenerated half. After being cut, all planaria were placed in petri dishes with dechlorinated water. During a period of thirteen days measurements were taken of the planaria's "stretching length" and observations of the shape and appearance of the regenerated parts were made. The results of this experiment showed that there was no significant difference in length and appearance of the two groups ($t=0.99$, $p>0.1$.) The follow-up experiment concentrated on accuracy in retesting the effects of overdose of Vitamin A. This experiment contained eight planaria in both, the control and the experimental, groups. All planaria were fed egg yolk following the same procedure as in the first experiment except for an addition of green food coloring to egg yolk of both groups in order to detect the presence of the vitamin in the bodies of the planaria. The rest of the procedure was not altered. After eleven days of measurements of the "stretching length" and observations of the appearance, the results showed that there was a significant difference between the two groups ($t=3.86$, $0.05 > p > 0.01$.) It was observed that some experimental planaria developed a swelling and in some cases even a wound at the aid of the regenerated tail part. Such swelling appears to be caused by a rapid division of these new growing cells that was possibly triggered by the presence of the vitamin.

2714

SMOKIN' SHRIMP: THE EFFECTS OF CIGARETTE SMOKE ON THE BREATHING RATE OF *ARTEMIA SALINA* (BRINE SHRIMP).

Shirley B. Hwang and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, CA 95831.

Cigarette smoke is widely known as the cause of various respiratory aliments. This two part investigation determined the effects of cigarette smoke on the breathing rate of *Artemia salina.* In the first part, two groups of 10 *Artemia* were used. A 60cc syringe was used to inhale air containing unfiltered CAMEL cigarette smoke. The smoke was then introduced into 250mL of water containing the experimental *Artemia.* A similar syringe was used to inhale smoke-free air. The smoke-free air was introduced to 250mL of water containing the control group of *Artemia.* This process was repeated once a day for five days. At the end of the fifth day, the gill movements of the *Artemia* were observed and the inflation of the gills (breaths) counted per minute. The *Artemia* in the experimental group showed an average of 12.5% increase in breathing rate. The data show, and the t-test value of 10.2 with $p<0.001$ supports, that the hypothesis that cigarette smoke significantly increases the breathing rate of *Artemia salina* can be accepted. In the second part of this investigation, two groups of 10 *Artemia* were also used. The same procedures were used to introduce cigarette smoke. However, the testing

period was extended to 14 days. Each day, the breathing rates of the *Artemia* in both groups were measured. At the end of 14 days, 8 out of 10 *Artemia* had died in the experimental group and 1 out of 10 died in the control group. The average breathing rate increased as exposure to cigarette smoke was prolonged. The breathing rate then leveled out at about 139 breaths per minute. The results show, and the t-test value of 10.8 with $p<0.001$ supports, that the hypothesis that long-term exposure to cigarette smoke leads to premature death in *Artemia* can be accepted. It can also be concluded that cigarette smoking can cause respiratory problems and may ultimately lead to death.

2715

EFFECTS OF WINDEX ON SEA URCHIN FERTILIZATION.

K. M. Hawkins, M. L. de Leon and B. Van Duzee (teacher). Saugus High School, 21900 West Centurion Way, Saugus, CA 91350.

This study examined the question of possible effects of Windex, a cleaning solution, on sperm-egg interaction in the sea urchin *Strongylocentrotus purpurantus*. Eggs and sperm were incubated without Windex for five minutes in artificial sea water and percent fertilization was recorded. Then eggs and sperm were then incubated with Windex that was diluted that was mixed with 99 parts of distilled water for five minutes in artificial sea water and percent fertilization was recorded. The experiment involving Windex was repeated three times. While the control value was at 90.3%+5%; 0.01 ml solution of Windex reduced the fertilization rate to 38%, 24%, and 28%. An interesting observation recorded was that along with reducing fertilization rates by up to 60%. Windex also dehydrated over 50% of the non-fertilized eggs. Dehydration took place as the alcohol in the 0.01 ml solution drew out the water in this percentile of the cells. The results suggest that Windex reduces fertilization by dehydrating many of the eggs present in the sperm egg interaction in *Strongylocentrotus purpurantus*.

2716

THE EFFECTS OF VARYING PHOTOPERIODS ON THE HEIGHT OF COWPEA PLANTS

Michael B. Chu and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment, I tested if changing the photoperiods of plants changed their growth rate. I germinated 200 California Blackeye Cowpea seeds for four days. While germinating the seeds, I built 3 cardboard boxes, lined with electrical tape to block out extra light, to house the plants. Each box contained a 3 watt fluorescent light to give the plants light. Each lights was on a timer set for 12 hours of light and 12 hours of darkness each day. Each timers was set for a different photoperiod. The control group (m=15) was set for one photoperiod of 12 hours each day. Experimental group 1 (m=14) was set for twelve 1 hour photoperiods a day. Experimental group 2 (m=14) was set for two 6 hour photoperiods a day. I planted 15 seeds for each group. One plant was accidentally killed by my error in each experimental group, these were not counted in my statistics because the plants died by my error, not from the different photoperiods. When the plants broke through the soil, I placed each group in their box for a 5 day period. Each day I watered and measured the height of the plants. After day 5 I took the change in height from day 1 to day 5. I used the change in height of each plant from day 1 to day 5 to do my statistics. The results revealed that Experimental Group 1 had significant gains in growth over the Control Group ($.01>p>.001$) and over Experimental Group 2 ($.001>p$). There was no significant difference however between Experimental Group 2 and the Control Group ($p>.1$). This experiment shows that the photoperiod of a plant has a significant effect on the growth of cowpea plants ($.001>p$)

2717

CAFFEINE AND IT'S EFFECT ON *EUGLENA GRACILIS.*

Andrea M. Gilmore and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this series of investigations *Euglena Gracilis* was used to test the effects of caffeine on a living organism. I conducted two approaches to the first experiment; the first a blind experiment where I did not know which culture was exposed to caffeine, and the second where the two cultures were clearly labeled. Knowing that *Euglena* are photo synthetic and in turn phototrophic I used light to attract the *Euglena* to a starting point. When the concentration of *Euglena* reached a predetermined color I measured the amount of time it took the *Euglena* to travel across a 5.5cm x 1.5cm petri dish. In the blind experiment the two cultures were easily distinguished by simply looking at the data. I found that the *Euglena* that had been exposed to a .06% caffeine solution moved at an increased rate, while the unexposed *Euglena* moved at a much more lethargic pace. ($p<.001$) Using the knowledge gained from the first experiment, a second was designed to determine if *Euglena Gracilis* could build up a tolerance to caffeine. Caffeine was regularly added to the experimental cultures (3 day intervals) and the time it took to travel across the petri dish was graphed daily. If the *Euglena* built up a tolerance to caffeine then the graph of the experimental cultures time's would gradually even out into a straight line. Upon statistical analysis of the collected data it was found that the *Euglena Gracilis* did not build up a tolerance to caffeine.($p>.01$)

2718

PASSING OF THE GENES FROM DEAD TO LIVE *ESCHERICHIA COLI.*

Olivia Hung and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment investigated the ability of *Escherichia coli* to incorporate the plasmids that contained the ampicillin resistance gene (pAMP) from dead, ampicillin-resistant *E. coli.* Based on the results of Griffith and Avery's experiments with pneumococcus in mice, I hypothesized that "wild" *E. coli* would take up the plasmids from dead *E. coli*/pAMP and thus become resistant to ampicillin. Using aseptic techniques, I transferred "wild" *E. coli* and *E. coli*/pAMP into two separate test tubes labeled EC and EC/pAMP, respectively. After splitting EC/pAMP into two other sterile tubes, I placed one of them in a boiling water bath for ten minutes. After making sure that all the *E. coli* had been killed, I then transferred half the amount of the dead bacteria to live, "wild" *E. coli* and incubated it overnight at 37°C. I then spreaded the culture onto petri dishes containing agar or agar with ampicillin. *E. coli*/pAMP grew in both dishes. There was no growth in the dishes with the dead *E. coli*/pAMP on the agar and agar with ampicillin. This meant that I had successfully killed all the *E. coli* in the broth. These were expected results. As I had hypothesized, there was also growth of *E. coli* with dead *E. coli*/pAMP in both dishes. What was surprising was that "wild" *E. coli* grew in both plates. However, as there were distinct bacterial colonies, I was able to use chi-square to conclude that *E. coli* transformed and therefore became resistant to ampicillin ($p<0.001$). In an attempt to answer my questions about my Control plates, I tried a different antibiotic, kanamycin, to see if my ampicillin was simply ineffective. As "wild" *E. coli* grew on agar with kanamycin, I concluded that either both of my antibiotics were ineffective or that some other factor was causing *E. coli* to grow. Thus I investigated the possibility of promoting kanamycin-resistant *Escherichia coli* through the use of lower levels of Kanamycin. I found that if "wild" *E. coli* was exposed to lower levels of Kanamycin, then the resulting *E. coli* populations would be more resistant to "full strength" (0.1%) kanamycin ($p<0.001$). However, this could not be main reason, as *E. coli* grew on full strength antibiotic without prior exposure. As yet, I have not discovered the reason for the growth of *E. coli* on my Control plates.

2719

THE EFFECT OF PRECIPITATION ON THE PH OF RUSTIC CANYON CREEK.

Heather Sheppard, Mr. Engelmann (teacher). Pacific Palisades High School, 15777 Bowdoin St., Pacific Palisades, CA 90272.

This study examined the effect of certain amounts of rain water on the pH of Rustic Canyon creek. Ten samples of about 10 mL were taken along the length of the stream; from near its source to where it meets the ocean. Four sets of samples were taken, two sets of samples from the creek within one day of rain and two sets of samples following a week of no rain. Note that in this project, only one set of non rain samples were taken. Each sample was tested with a calibrated pH meter, with and accuracy level of about 0.1, then recorded. The readings during the rain samples averaged from about pH 8.3 to 7.8. The non rain samples averaged from about pH 8.6 to 9.1. These results suggested that there was more acidic content in the creek after it had rained, where as the non rain samples tended to be more basic.

2720

THE EFFECTS OF MAGNESIUM SULFATE ON THE NUMBER OF CHLOROPLASTS IN *ELODEA CANADENSIS.*

Raymond Lee and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to discover if an increase in the number of chloroplasts in *Elodea canadensis* could be triggered by adding magnesium to the plant's environment. Three trials were done with the first having two groups of ten *Elodea* with one group exposed to a magnesium sulfate ($MgSO_4$) solution at a concentration of 0.02 M, the second being similar except for a lower concentration of $MgSO_4$ at 0.002 M, and the third similar to the first except for only two groups of eight and the containers being sealed. The plants in the first trial died after seven days resulting from a concentration that was too high. This led to the second trial, which had instances where the control had more chloroplasts. Assuming that fluctuating concentrations due to evaporation and counting error were the cause of the odd results, the third trial was designed to alleviate the problems by covering the containers and measuring the counting error. After four separate countings spanning the course of two weeks, there was no significant difference between the control and the experimental (statistics: avg. of $\chi^2 = 1.27$; $0.5 < p < 0.2$). A doubt from the earlier experiment, counting error, was examined and was shown to have no effect (standard deviation of ±7 chloroplasts per cell). Improving the procedures to control evaporation to provide for a more controlled environment did not help the experimental in that there was still no significant difference. Concentrations above 0.002 M of $MgSO_4$ killed the plants in the experimental, yellowing the green chloroplasts and causing plasmolysis—the shrinking of the cell membrane due to osmosis. The$MgSO_4$, at a concentration where it would not harm the plant, showed no signs of increasing the number of chloroplasts.

2721

THE ANTIVIRAL EFFECTS OF ZINC IN PINTO BEAN PLANTS.

Kevin Mateo Lim, and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

To verify the recently publicized antiviral effects of zinc, this investigation measured a 5 ppm zinc nitrate solution's effects against tobacco mosaic virus infection. Sixty seeds were germinated in two groups, 30 in zinc solution, 30 in distilled water. After 2 days, 15 seeds from each group were grown in a mini-greenhouse and watered with the same solution that they germinated in. A tobacco mosaic virus inoculum was prepared by grinding 5g cigarette tobacco with 5 mL of .05M sodium phosphate solution, to make the dormant virions

within the dead tobacco infectious. A similar control solution was made without the buffer. After 3 weeks of growth, the plants were infected with TMV with a sterile brushing of the inoculum on the leaves. TMV causes quantifiable lesions in pinto (*Phaseolus vulgaris*). Lesion counts were daily taken, and while significant differences appeared initially, after complete virus propagation, no significant differences existed in the number of lesions per square centimeter. Zinc seems to slow viral attack, but at this concentration does not stop the virus. Subsequently, to see if more slowing would occur with more zinc, a similar trial was done with varying zinc nitrate concentrations. With an identical technique, 3 groups were grown with either distilled water, 5 ppm zinc nitrate or 50 ppm zinc nitrate. After infection, the higher zinc concentration showed much slower symptom emergence than the water and 5 ppm zinc groups. But in the end results showed no significant difference. Thus, according to this data, zinc's presence slows the propagation of TMV in pinto plants.

2722

THE EFFECT OF VITAMIN K ON THE LEARNING RATE OF PLANARIA.

Michelle Thomas, and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment was done to determine if vitamin K made planaria learn faster. This experiment compared the learning rate of planaria exposed to 0.0012% vitamin K solute with a control group of normal planaria. The planarian training consisted of exposure to a brief pulse of light followed by an electric shock. This process was repeated 25 times daily until the planaria reacted to the light as it would to shock 75% of the time. After the planarian responded correctly 75% in one test consisting of 25 light shock repetitions it was said to have learned the condition. No significant differences were found in the learning rates of the two groups of planaria ($0.9>P>0.5$). This investigation found that vitamin K did not increase the learning rate in which planaria learn.

2723

NUTRITION STUDIES WITH RED WORMS.

Ryan Sunahara, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, CA 95831.

In my lab, I tested Red worms and their diets to see if it affected their growth rate. I gathered forty worms and placed them in forty different petri dishes. Each dish contained peat moss for their bedding and their assigned diet. There are three different diets: fish food, corn starch, and fish food plus corn starch. I also had one petri dish with only peat moss for my control. Before placing the worms in the dish, I measured their initial lengths by carefully laying them against a ruler. After ten days of living in their petri dish environment, I measured the new lengths of the worms. After another seven days, I measured the worms once again. I found that the fish food plus corn starch group had the greatest growth rate among the four groups. The fish food group, corn starch, and control group were in descending order of growth rates respectively. The results that I received were as expected. The fish food plus corn starch diet was the most balanced of the three other diets and, therefore, it had the largest growth rates among the worms. A few worms in each group did die and were disregarded when doing the statistics. All the worms that were alive at the end of the two and half week period had grown between 0.4 cm and 1.1 cm. Using statistics, I found that my measurements in lengths of the worms had no significant difference between the groups. Although all the worms did grow, the difference between the groups were found to be insignificant.

2724

THE EFFECTS OF ACID RAIN ON THE GROWTH OF BEAN PLANTS.

Kimberly Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831

This experiment was designed in attempt to observe the effects of acid rain on the growth of bean plants. In this experiment, a total group of 36 bean plants were sprouted. After a 3 day germination process, vinegar was added to water to simulate acid rain which has a pH level of 5.6. The solutions were measured with pH paper and pH color indicator. This vinegar water solution of pH level 5 was sprayed over a group of 18 bean plants while the control group was sprayed with water of pH level 7. The two groups of plants received the same amount solution, but with different acidity. Each plant was watered and measured for four consecutive days. After measuring the plants from soil level to top of the plant, calculations were used to determine overall growth. Calculations showed the control group on average grew 7.34 cm taller than the experimental group. The t-test value of 4.48 and $p<0.001$ showed the difference between the two groups was not due to chance alone. In addition the overall appearance of the experimental group was different, the leaves were discolored (yellow, brown, and light green) and withered. These results suggest that the acid rain inhibits the growth of bean plants.

2725

EFFECTS OF PROPYLENE GLYCOL ON SEA URCHIN FERTILIZATION VERSUS THE EFFECTS OF ETHYLENE GLYCOL ON SEA URCHIN FERTILIZATION.

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Ethylene Glycol is a compound found in commonly used anti-freezes. It is known to be an environmental pollutant, hazardous to the digestive systems of many animals. Propylene Glycol is a compound found in "environmentally safer" anti-freezes. This experiment will be testing if propylene glycol is safer for simpler organisms, such as sea urchin sperm and ova. We will use the eggs and sperm of the sea urchin *Strongylocentrotus purpuratus*. We tested the fertilization success rate under normal environmental conditions, using Calcium Magnesium free sea water, repeating the experiment six times. Under these conditions, there was a 98%±2% fertilization success rate. When we experimented using a 0.1% solution of ethylene glycol in purified water, approximately 81%±3% of the eggs were fertilized successfully. We repeated this experiment with these conditions six times. When we experimented using a 0.1% solution of propylene glycol in purified water, approximately 80%±4% of the eggs were fertilized successfully. We repeated this experiment with these conditions six times. Due to the fact that both the ethylene glycol solution and the propylene glycol solution reduced fertilization rate down to approximately 80%, it is suggested that propylene glycol is just as hazardous to simpler organisms as ethylene glycol.

2726

THE ISOLATION OF *AGROBACTERIUM* IN THE GALLS OF INFECTED SUNFLOWER PLANTS.

Bradley Yoshio Menda and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment has two main objectives, to see if *Agrobacterium tumefaciens* can be located and isolated from the galls of infected sunflower plants and, to see if Beta Carotene inhibits the growth of *A. tumefaciens* in nutrient agar. Ten sunflower plants infected with *Agrobacterium tumefaciens* containing galls were obtained.

A. tumefaciens should be pricked into the plants using a sterile needle. The galls were cut off the sunflower stem with a sterilized scalpel and forceps. The gall was then divided into two sections, the inner (1-2 mm) and outer (2-4 mm). The internal tissue of each divided section was removed by scraping the tissue with a scalpel. The scrapings were aseptically placed in a sterile petri dish with a drop of sterilized water and set out overnight. The water, with the diffused bacteria, was collected, spread over nutrient agar, and incubated. Dishes containing the outer scrapings contained about 1600 small colonies of *A. tumefaciens*. Dishes containing inner scrapings contained about 50 large colonies. It can be concluded that there was more *Agrobacterium tumefaciens* on the outer scrapings not due to chance but due to the location of the bacterium ($p<0.001$). The second experiment was conducted to see if beta carotene could inhibit the growth of *A. tumefaciens* in nutrient agar. *A. tumefaciens* was streaked on petri dishes of nutrient agar. Filter paper disks soaked in a beta carotene solution were then placed on the petri dishes. A control disk with no solution was placed in dishes containing streaked *A. tumefaciens*. All six experimental sections contained growth throughout the dish. Since there was no zone of inhibition, statistics could not be used to analyze the results. Thus the beta carotene had no effect on the inhibition of *A. tumefaciens*.

2727

SHORT AND LONG TERM EFFECTS OF ETHANOL ON PLANARIANS.

Terry Lee and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

I performed two successive experiments on the effects of ethanol, the form of alcohol that people drink, on a planarian's ability to regenerate. For my first experiment, I tested the short term effects of ethanol on planarians. Based on the fact that mothers who drink alcohol during pregnancy give birth to smaller babies, I hypothesized that planarians exposed to ethanol would regenerate smaller planarians. I cut and measured twenty planarians; half of the pieces were put in dechlorinated tap water and the other half were put in a 1.5% ethanol solution. After giving the cut pieces one week to regenerate, I measured them and compared the growth of each group. The experimental group didn't regenerate as much as the control group and with a p-value of less than .001, I am able to state that ethanol does negatively affect the growth of planarians while regenerating. For my second experiment, I tested if ethanol had long term effects on a planarian's ability to regenerate and I hypothesized that it would effects and that planarians that regenerated in ethanol would regenerate smaller planarians. In my experimental group, I had planarians regenerate in a 1.5% ethanol solution and then I had those planarians regenerate again in water. These planarians were able to regenerate normally and I got a p-value that was greater than 0.1, which means that the ethanol didn't have any long term effects.

2728

DOES PSEUDOPHEDRINE HYDROCHLORIDE DECREASE THE RESPIRATION OF CRICKETS?

Adrian Carrera and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

In my preceding experiment I determined that pseudophedrine hydrochloride has an affect on the respiration of crickets. I found that the crickets' respiration was decreased by the drug pseudophedrine; I had expected to see an increase in respiration. After the Olympic games in Nagano I learned that the drug Sudafed whose main ingredient is pseudophedrine hydrochloride was banned for use by the athletes. The substance is related to the stimulant adrenaline. Thus I hypothesized that the crickets respiration would be increased. I would like to have used vertebrate animals such as mice since they would show effects of the drug that would be more similar to humans than crickets, but due to high school restrictions, such work with vertebrate animals isn't permitted. So 40 crickets were maintained in both control and experimental groups. Both groups of crickets were given ground up oat cereal for food. For their water source, the control group received a 30% sugar solu-

tion and the experimental group received a 30% sugar solution with 0.6% pseudophedrine hydrochloride. After allowing the crickets one day to take up the pseudophedrine hydrochloride, microrespirometers and thermobarometers were used to measure the respiration of each cricket over a 24 minute period. In total, 18 trials were measured from each group. Using t-test and rejecting any trials determined to be errors, the probability of chance variation was less than (0.001) 1 in a thousand. Based on the averages of the respiration of the control and experimental group, the experimental crickets exhibited a smaller respiration rate. Therefore pseudophedrine hydrochloride does have an effect on the respiration rate of crickets. Pseudophedrine hydrochloride decreases respiration in crickets.

2729

EFFECT OF POTASSIUM PHOSPHATE ON THE VERTICAL GROWTH OF LITTLE MARVEL PEA PLANTS.

Julie Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

Frequently soil is deficient in potassium and phosphorus. Plants grown in soil deficient in any of these nutrients will grow slower than normal, and sometimes plant growth is stunted. Since the deficiencies of potassium and phosphorus cause stunted growth, I wanted to find out if the addition of these nutrients to the soil would encourage plants to grow greater in height than what is normal. I treated Little Marvel Pea plants with a 5% potassium phosphate (K_2HPO_4) solution. In both the control group and the group treated with K_2HPO_4, I planted 18 germinated seeds in potting soil. In the control group, only 14 seeds (77.8%) grew into plants, whereas in the experimental group, 17 seeds (94.4%) grew into plants. Fifteen days after planting the seeds, I measured and compared the heights of the plants in each group. The average height of the plants in the control group was 9.5 cm; the average height of the plants in the experimental group was 8.8 cm. I found that there is no significant difference between the heights of the plants in the control group and the plants treated with K_2HPO_4 ($t=0.3$, $p<0.1$). According to the data I obtained, a 5% K_2HPO_4 solution does not encourage greater growth in height of Little Marvel Pea plants.

2730

THE AMOUNT OF GULLS ON CAMPUS.

Valezka Roman, Shara, Guadalupe and Mr. S. Engelmann (teacher). Palisades Charter High School, 15777 Bowdoin St., Pacific Palisades, CA 90272.

In this study we examined the numbers of seagulls on our campus, and their behavior. We wanted to find out if seagulls know when students are around. What we did first was to set a schedule of times to observe the quad area. We monitored the quad during different time periods: 8:46 a.m. (few students on the quad); 11:00 a.m. and 1:20 p.m. (many students on the quad at meal times). We repeated the process three times, including weekends. We took pictures and observed and recorded how many gulls there were on campus. Our results showed that we do affect their presence by bringing food and leaving our trash on campus that they also eat. At 8:46 a.m., there were fewer gulls observed than later, at 11:00 a.m. and 1:20 p.m. Our conclusion is that seagulls do know when students are around, and that they are attracted by the availability of food. Scavenging food can be detrimental to the gulls and their environment—they take trash to the ocean and sometimes they become entangled with plastic wrappers.

2731

THE EFFECTS OF ENVIRONMENTAL POLLUTANTS ON PLANTS.

Erica Lorraine Hooper and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA, 95831.

This experiment was conducted to show the effects of environmental pollutants on plants and to answer the question, "*Does chlorine, an environmental pollutant, disrupt the growth of plants?*" Chlorine was used as the pollutant and onion bulbs were used as a sample of plants.

Twenty small, white onion bulbs were placed on twenty test tubes. Ten tubes were filled with tap water, the control group, and ten tubes were filled with chlorinated water at three PPM. Each root of each bulb was measured and recorded daily for four days.

I had assumed that the chlorine would have a negative effect on the plants because of it's effect on humans. Chlorine irritates human's sinuses and skin on contact. Chlorine tends to have a lower pH making it more acidic which dries out the skin and sinus cavities. I thought the plants would have a similar reaction. This led me to the hypothetical conclusion that *if chlorine is harmful to the onion plants then the treated bulbs will have shorter roots and less roots than those grown in tap water.*

My hypothesis was not correct. According to my data the onion group grown in chlorinated water grew better than the control grown in tap water. Each day the roots of the experimental group grew longer and faster than the control group. Probability is less than 0.005. There were no other physical differences between the two groups. Neither group changed color or shape.

The only explanation I have for this outcome is that the chlorine killed all of the bacteria making it easier for the plants to grow but the concentration was not strong enough to do any harm to the plant itself.

2732

EFFECTS OF SALT WATER ON THE GERMINATION AND INCIPIENT GROWTH OF MUSTARD SEEDS AND BLACK BEANS

E. Kim. Teacher: W.P. Van Duzee. Saugus High School, 21900 Centurion Way, Saugus, CA 91350.

The purpose of this experiment was to examine the effects of table salt, sodium chloride, on the germination and development of mustard seeds, *B. Juncea*, and black beans, genus *Glycine*. Two containers each holding soil and 100 mustard seeds were set in the same room in order to provide a constant temperature. Another set of two containers each holding soil and 100 black beans were set in the same room as the mustard seeds. Two containers containing the control plants—one container with mustard seeds and the other with black beans—were watered without table salt once a day for 10 days. The remaining two containers containing the experimental plants—one container with mustard seeds the other with black beans—were watered with a 10% solution of salt once a day for 10 days. On the 10th day, the control group containing mustard seeds and black beans were measured to have an average height of 1.09 inch and 1.38 inches, respectively. The experimental group containing mustard seeds and black beans both showed no signs of growth. These results show that the use of 10% salt water on mustard seeds and black beans prevents germination and growth.

2733

ACID RAIN: FRIEND OR FOE?

Ryan Opgenorth, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In my experiment, I tested how 4.0 pH acetic acid rain would effect the germination of Little Marvel pea seeds. I ran two trials, one with a sample size of 100 pea seeds and another with a sample size of 90 pea seeds. To each control group I added tap water which I measured (with a pH meter) at a pH of 6.7, and to each experimental group I added acetic acid rain with a pH of 4.0. I then monitored the pea seed germination at least once every 24 hours for a week, keeping track of the number of seeds germinated at the separate intervals. At each interval in both trials the germination ratios between the tap water (pH 6.7) and the acetic acid rain (pH 4.0), didn't differ more than six pea seeds (93/100 tap water to 99/100 acetic acid rain). Also the rate at which the pea seeds germinated constantly changed from day to day in both trials. One day the pea seeds in tap water would be germinating faster and the next the pea seeds in acetic acid rain would be germinating faster. The data in both my trials and my greatest P value of 0.1 or 10%, lead me to be confident that any difference in the speed of germination is due to chance alone, and that acetic acid rain has little or no effect on the germination of pea seeds.

2734

THE EFFECT OF *ANABAENA* ON THE GROWTH OF PEA PLANTS.

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The supply of nitrogen can be the greatest limitation on the growth of an organism since only a few bacteria can fix nitrogen for use for higher organisms. In addition these bacteria stop producing fixed nitrogen when too much is in its environment. Legumes, such as peas, compensate for this fact by forming symbiotic relationships with specific species of nitrogen fixing bacteria. It seems reasonable that in a low nitrogen environment without its special species of bacteria, a pea would grow taller in the presence of any nitrogen-fixing bacteria. In this experiment peas were grown floating on chips of perlite, a fluffy volcanic rock, in an organic, low nitrogen, hydroponic solution. In half of the plants 3 ml of a mixture of well water and *Anabaena*, a free living blue-green algae that fixes nitrogen, were added to the low nitrogen solution that the plants were living on. The growth of the two groups of plants in terms of height was recorded in two different trials of 24 plants each. The first trial was inconclusive because 17 of the plants drowned. In the second trial 9 plants from each of the groups survived, but after eight days of growth the *Anabaena* had no effect on the growth of the peas ($t=.92$ $p>0.1$). Apparently free living nitrogen-fixing bacteria do not effect plant growth, though it seems likely that this is because nitrogen fixation is highly regulated. If this was the case not enough *Anabaena* were introduced and not enough time was allowed for a significant amount of nitrogen to be fixed.

2735

THE EFFECTS OF 409 CLEANER ON SEA URCHIN FERTILIZATION.

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This experiment was performed to study the effects of 409 cleaner on the fertilization rate of the *Stronglocentrotus Purpuratus* Sea Urchins. The 409 cleaner was reduced to a 1/1000 dilution with distilled water and then added to the experimental group of eggs. .125 ml of eggs was mixed with 12.5 *u*l of the 409 dilution and then sperm was introduced. The fertilization rate of the control group was 90.3% plus or minus 5%. The fertilization rate of the experimental group was 82%. These results show that the cleaner had very little effect, even in such a great dilution. If this substance was dumped into the ocean, it would seem to have very little effect on the sea urchin population.

2736

THE ACTIONS OF RENU MULTIPLUS MULTI-PURPOSE SOLUTION ON *B. CEREUS*

Bryan James Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this investigation, I tried to show if contact lens solution (Renu Multiplus Multi-purpose solution) inhibits the growth of bacteria (*B. cereus*). The Renu Multiplus Multi-purpose solution contains the ingredient Dymed that is supposed to kill microorganisms on contact lenses. *B. cereus* is grown on agar containing contact lens solution. I used the pour-plating method to transfer the bacteria to the agar. I wanted no bacteria grown on the agar when it is incubating. I used twenty-one petri dishes. I used different concentrations for these petri dishes. I labeled these concentrations as agar #1, 2, 3, 4. Each agar contained different concentrations. # 1 agar contained 50 ml of water for 1.15g of nutrient agar. #2 agar contained 5 ml of contact lens solution and 45 ml of water for 1.15g of nutrient agar. #3 agar contained 25 ml of contact lens solution and 25 ml of water for 1.15g of nutrient agar. #4 agar contained 50 ml of contact lens solution for 1.15g of nutrient agar. Five petri dishes were used for each group of agar. In addition, a single petri dish contained *B. cereus* grown on agar with paper filter disks containing contact lens solution. This is called the additional experiment. After this the petri dishes were incubated at room temperature. My results showed that the contact lens solution is effective in inhibiting the growth of bacteria. Agar #2, 3, 4 inhibited the growth of bacteria. The paper filter disks containing contact lens solution in the additional experiment, also showed effectiveness. Around each paper filter disk (except water) were zones of inhibition.

2737

THE EFFECT OF NEOSPORIN OINTMENT ON *ESCHERICHIA COLI.*

Matthew Henry Lum and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment, I am trying to find out if Neosporin ointment will inhibit the growth of *E. coli*. Using aseptic methods, I streaked *E. coli* on ten petri dishes containing nutrient agar. Five of the petri dishes were used as the experiment and the remaining five petri dishes were used as the control. In the each experiment dish, I placed four self-made antibiotic disks in a straight line, evenly spaced from each other. The self-made antibiotic disks were plain paper disks that were covered with a thin layer of Neosporin ointment. In each control dish, I placed four plain paper disks in a straight line even spaced from each other. Then all ten dishes were placed in the incubator. After incubating the ten dishes at 37°C for 24 hours, the results were that 18 out of the 20 experimental antibiotic disks had a zone of inhibition around them and 20 out of the 20 plain control disks had no zone of inhibition around them. Results indicated that 18 out of the 20 experimental antibiotic disks inhibited the growth of *E. coli*, while 20 out of the 20 plain control disks did not inhibit the growth of *E. coli*. Therefore, I conclude Neosporin does inhibit the growth of *E. coli*. After statistical analysis, my p-value was less than 0.001, so my conclusion was not due to chance.

2738

EFFECTS OF SUGARLESS GUM ON THE ACIDITY LEVEL IN THE HUMAN MOUTH.

Kathy Quach, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment is to determine if sugarless gum, which contains xylitol, effectively neutralizes the acids in the human mouth. The active ingredient, xylitol, accomplishes this by eliminating *Streptococcus mutans*, a bacteria, from the mouth. *Streptococcus mutans* digests the carbohydrates or sugars and starches in food and produces pyruvic and lactic acid. These harmful acids, which are a by-product of their metabolism eat away at the enamel of teeth. This deterioration of the enamel causes tooth decay. This experiment used Snyder's Agar, a medium which indicates the presence of an acid by changing from a bromcresol green to yellow. This experiment was performed by chewing on a rubber band to produce saliva and then drooling into ten separate test tubes, each containing 5 ml of Snyder's Agar (control group). This procedure was repeated after chewing on a stick of sugarless gum (experimental group). The results of this investigation are that there is no significant difference between the level of acidity in the mouth before or after chewing on a piece of sugarless gum ($p > 0.1$). The amount of agar that changed to yellow in both groups were relatively the same. From my data, I conclude that any difference in the acidity level after chewing sugarless gum is due to chance.

2739

THE EFFECTS OF ULTRAVIOLET LIGHT ON *EUGLENA GRACILIS.*

Courtney S. Onodera and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

I performed this experiment to determine if ultra-violet light can be used in photosynthesis by *Euglena*. Using a hemacytometer, the number of *Euglena* per square millimeter in a sample exposed to ultraviolet light treatments was compared with samples kept in normal light (visible white light). I hypothesized that if *Euglena* could use ultra-violet light in photosynthesis, then more *Euglena* would grow when treated with ultraviolet light than when given solely visible light. *Euglena* were treated approximately every twenty-four hours with either thirty minutes of ultraviolet light or visible light. When not being treated, the samples were kept in visible light. I conducted two trials in this experiment, with strikingly different results. Trial 1 data showed that after six treatments, there were significantly more experimental *Euglena* than there were control (=41.8, $p<0.001$). However, trial 2 data showed that ultraviolet treatment has no significant effect on the reproductive rate of *Euglena* (=1.34, $p>0.2$). I believe the different results of trial 2 are due to genetically mutated microorganisms in the experimental culture medium which were capable of withstanding ultraviolet radiation, thus creating competition for nutrients for the experimental *Euglena*. I hypothesized that the heavy growth in the control group of trial 2 is due to the late disintegration of the pea in the culture medium. It seems likely that the disintegration of the pea may correspond to the consumption of the nitrogenous substances within the pea which *Euglena* require for division. Though I have hypotheses which may explain the differences between the trials, I believe that this experiment should be repeated for verification of results. Also, attempts should be made to grow *Euglena* in an environment free of other microorganisms; an increased rate of reproduction after irradiation with ultraviolet light in the first trial of this experiment may be due to the fact that the microorganisms were killed, providing the experimental *Euglena* with less competition for nutrients in the culture medium.

2740

THE EFFECTS OF CITRUS OIL ON THE REPRODUCTION OF *DROSOPHILA MELANOGASTER.*

Jason Poon and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The main objective of this investigation was to determine whether or not citrus oil, specifically orange citrus oil, was toxic to the reproduction of fruit flies *Drosophila melanogaster*. Therefore, a control group, four culture tubes filled with 10 ml of instant *drosophila* medium, and an experimental group, four other culture tubes filled with 10 ml of instant *drosophila* medium as well as 2.5 g of finely diced orange peels, were used. The orange peels provided the tubes with the citrus oils needed to combine with the medium. Three female and three male *VS Drosophila* were added to each tube. After three weeks a count of the offspring was made to see if the citrus oils killed off some of the offspring, and the count resulted with 444 flies for the control group and 85 flies for the experimental group. There was a highly significant difference between the control and the experimental ($\chi^2 = 243.6$, $p < 0.001$), thus proving that orange citrus oil was toxic to the reproduction of fruit flies.

2741

THE EFFECT OF BREAD MOLD'S GROWTH ON THE pH VALUE OF THE MEDIUM

Eric Yeung and Steve DeGusta (teacher), John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment is to test if bread mold's (*Rhizopus nigricans*) growth will cause an increase in the pH value of the medium that it grows on. I mixed Brom Thymol Blue indicator and vinegar with nutrient agar and used it as the medium for the bread mold to grow on. The vinegar gave the agar an initial color of yellow, indicating a pH value of about 6. Then I transferred bread mold aseptically to the agar for the experimental group of 20 petri dishes, while nothing was transferred to the 20 petri dishes of the control group. The petri dishes were observed for the next four days and the color of the agar in each petri dish was recorded. The color of agar in all of the control plates remained yellow indicating a pH value of about 6, while the color of agar in all of the experimental plates changed to blue indicating a pH value of about 7. According to the results of this investigation, I conclude that the growth of bread mold causes an increase in the pH value of the medium that it grows on.

2742

EFFECTS OF CONCENTRATION ON THE pH OF A PHOSPHATE BUFFER.

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A phosphate buffer with neutral pH is one of the most commonly used reagents in biological studies. Proper preparation of such buffer with defined pH is essential for accurate and reproducible measurement for biological acitivities. To understand the concept of acid-base equilibration and how changes in concentration affects the pH of a buffer, we measured the pH of a series of increasingly diluted potassium phosphate buffer and compared the observed pH values to the calculated values. We prepared a 400 mM pH 6.8 solution and then diluted to 300, 200, 100, 50, 25 and 10 mM, respectively, with water. It was found that the pH of these serially diluted phosphate buffers are pH 6.80, 6.83, 6.89, 6.94, 7.02 and 6.99, respectively. In contrast, a calculation based on dilution alone predicts the pH to be 6.92, 7.10, 7.40, 7.70, 8.00, and 8.4 respectively. The slower than expected increase in the measured pH indicates that dilution of phosphate causes increases in proton concentration as the result of a shift in the acid-base equilibration towards the dissociation and release proton ions.

2743

THE EFFECTS OF CAFFEINE ON MICE AND *DAPHNIA MAGNA.*

Athena Chan and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This is an experiment on the effect of caffeine on mice. Caffeine was tested on *daphnia* first to see if caffeine would have an effect on living organisms. ($p<.001$ The heart rates of the *Daphnia* rose significantly and by using chi square I reject my null hypothesis that any difference between the *Daphnia* that had caffeine and the ones that didn't were due to chance.) Since the caffeine increased the heart rate of the *Daphnia* then it must also affect mice because the nervous system of *daphnia* and mice are similar. This shows that caffeine may also increase the heart rate of human beings. Caffeine was then tested on mice by using a mouse exercise wheel to determine the amount of activity in the mice. The mice became more active after eating the mix of caffeine and oat cereal. The control mice were fed regular oat cereal. The mice without the caffeine ran at a rate of 7.4 rpms and the mice with caffeine ran at a rate of 9.8 rpms. The mice that ate the caffeine ran an average of 2.4 more rotations per minute than the control mice. By using chi square I was able to show that the difference between the mice that had caffeine and the mice that didn't was significant. ($p<.01$) This shows that caffeine does increase the amount of activity in people because the internal systems of mice and humans are very similar.

2744

THE EFFECTS OF PURELL® BRAND INSTANT HAND SANITIZERS ON *BACILLUS CEREUS.*

Melissa K. Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This investigation tested the effects of Purell® brand instant hand sanitizer on *Bacillus cereus*. Four different methods were used to test this. In one method paper disks were dipped in Purell® and then applied to a pour plate of *B. cereus*. The Purell® quickly evaporated and the growth of *B. cereus* were not inhibited. In the second method Purell® was added to a solution containing *B. cereus* and Tryptic Soy Broth. In this method the bacteria grew in lawns and there were no colonies to count. In third method Purell® was mixed into a *B. cereus* and nutrient agar solution. Once again the bacteria grew in lawns and there were not any colonies to count. In order to produce colonies the last method was repeated using a diluted solution of the bacteria. However, the bacteria continued to grow in lawns or not at all. In the fourth method *B. cereus* was grown onto nutrient agar plates and then covered with Purell. The bacteria were then inoculated on to a nutrient agar plate. The Purell® did not kill any of the bacteria, yielding 100% growth. The long-term goal of my experiment was to test the effects of hand sanitizers and other antibacterial products on the course of natural selection. Unfortunately, the hand sanitizers that I chose to test had no effects on the *B. cereus*. From the methods and techniques used to test Purell® brand instant hand sanitizers effect on *Bacillus cereus*, it is conclusive that Purell® is ineffective in eliminating the growth of *B. cereus*.

2745

RELATIONSHIPS BETWEEN TEMPERATURE AND RESPIRATION RATE OF *ELODEA DENSA.*

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This was a three-time trail for testing on the effect of temperature on the respiration rate of *elodea*. Light was blocked to prevent photosynthesis and the carbon dioxide the *elodea* released through respiration was

absorbed by sodium hydroxide. 5mL of *elodea* was put in a volumeter, an apparatus to measure the volume of oxygen intake. The experiment was set at two different temperatures, 19°C and 34°C, and the oxygen intake by *elodea* was measured. With the use of t-test, the result showed that at 34°C, there was more oxygen intake by the *elodea* than at 19°C. The result supported the hypothesis that a higher temperature would lead to a higher respiration rate of *elodea*. It also supported the idea that a higher temperature would lead to a faster metabolism due to a higher enzyme activity.

2746

EFFECT OF VITAMIN C ON FUNGAL GROWTH.

Heather Kadani and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This is one in a series of experiments to determine if Vitamin C can help cells resist a harmful element, as it has been speculated that Vitamin C helps resistance to the common cold. The subject used is fungus (*Phycomyces blakesleeanus*) and the harmful element is fungicide. The effect of Vitamin C on the growth is unknown. It could halt the growth. If so, this must be determined before further experiments can be done using Vitamin C and fungus.

In this experiment, the effects of Vitamin C on fungal growth were tested. One group of fungus was grown on nutrient agar with .0034 mg/ ml Vitamin C. The control was grown on agar without Vitamin C. For two days the colonies' diameters were compared. For both days, the means of the diameters were equal for the experimental and control groups ($t=o$, $p> .1$), indicating that Vitamin C has no effect on *Phycomyces blakesleeanus* growth. This is excellent news because now future experiments can be carried out using *Phycomyces blakesleeanus* and Vitamin C.

2747

THE EFFECTS OF RADIATION ON THE PREFERENCE OF FOOD FOR COMMON GARDEN SNAILS.

Ken Kurahara and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

The purpose of this experiment was to test snails to see if they have any preference between lettuce leaves that have been subjected to microwave radiation and normal lettuce leaves. First, I microwaved lettuce leaves on low power to minimize heat but allow radiation. I did this to show that microwaving kills the majority of microorganisms on the leaf's surface. This confirmed that the lettuce leaves were in fact being irradiated. After this preliminary experiment, I went on to test for preference in common garden snails on irradiated lettuce and not irradiated lettuce. I cut two one inch squares out of both the irradiated lettuce and lettuce that was not irradiated. I placed both of the leaves on opposite sides in a sterile finger bowl. I then placed a snail in a neutral position, able to see both leaves, and observed which leaf the snail ate first. After doing this with twenty-two snails two times each, I eliminated the snails that did not move and computed statistic tests on the data. Out of 44 snails, 15 remained neutral, 13 went to the lettuce that was not irradiated and 16 went to the irradiated lettuce. Using this, I found my CHI^2 value to be 0.310 and my probability to be between 0.7 and 0.5. This allowed me to keep my null hypothesis that says all differences in the snails choice are due to chance and nothing else. From this I concluded that the snails have no preference between irradiated lettuce and lettuce that was not irradiated.

2748

THE EFFECT OF CAFFEINE ON THE REGENERATION RATE OF PLANARIA

Dana Fong and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

Caffeine is a stimulant that when taken in large doses leads to health complications. Doses over a certain amount lose stimulant effects and take on depressant effects. Because it affects primarily the brain, the control of all bodily functions, caffeine has a potential influence on growth. In this study I investigated the question, "Does caffeine slow the regeneration rate of planaria?" My hypothesis was that if caffeine slows the regeneration rate of planaria, then the experimental group will regenerate at a rate significantly slower than that of the control group. Planaria were chosen as the subjects for study because of their notable ability to regenerate lost parts. For my experiment twenty planaria were used—10 control and 10 experimental. Each planarian was measured using a half millimeter ruler before its head was dissevered. The control was exposed to dechlorinated tap water, and the experimental to Water Joe caffeinated water (3mg/25ml). The growth was observed by daily measurement over a period of ten days. Along with the measurement, the day, date, and time of the measurement were recorded. After the regeneration rates were calculated [(total amount of growth)/(number of days)], it was determined that the control group regenerated faster than the experimental group. Results of the t-Test yielded a p value less than 0.1, indicating that the results were significant in proving that caffeine does slow the regeneration rate of planaria.

2749

EFFECTS OF COMMERCIAL SOLUTIONS ON BACTERIAL GROWTH.

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This experiment examined the effectiveness of household antibacterial products in inhibiting the growth of bacteria. In the experiment, performed three times, petri dishes were prepared with agar solution. After the agar congealed, it was scraped with a copper wire so bacterial could permeate the agar. Then seven indicator disks were each soaked in one of the following solutions: hand soap, kitchen cleaner, all purpose cleaner, shampoo, anti-bacterial hand gel, dish washing soap, and medical disinfectant (Neosporin). The disks were placed in different petri dishes, along with one disk left clean for control factor purposes. After spending one week in at room temperature, 70 degrees, bacteria had developed on the agar. The control sample clearly had developed the most bacteria, and had no visible ring of inhibition. The ring of inhibition is the area around the disks where the bacteria didn't grow because of the antibacterial product. Therefore, the larger the ring of inhibition, the more antibacterial potency the products contains. The shampoo, hand soap, kitchen cleaner, dish washing soap, and all purpose cleaner all had small rings of inhibition with significant amounts of bacteria not far from the disk. The average diameter of the rings from the three trials, including the diameter of the disk which was 0.4 centimeters (cm), were as follows: 1 cm for the hand soap, 1.2 cm for the kitchen cleaner, 1.25 cm for the all purpose cleaner, 0.8 cm for the shampoo, and for dish washing soap 1.15 cm. The anti-bacterial hand gel and the medicinal disinfectant had relatively large rings of inhibition in relation to the other disinfectants. The average rings of inhibition were as follows: 2.4 cm for the anti-bacterial hand gel and 2.9 cm for the Neosporin. These results show that using commercial solutions does inhibit the growth of bacteria, and anti-bacterial hand gel and medicinal disinfectant are the most effective in blocking this growth.

2750

DOES HYDROPONICS YIELD TALLER CORN PLANTS

James A. Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95931.

For this investigation the heights of two groups of corn plants, one grown in potting soil and the other grown hydroponically in vermiculite, were compared. All of the plants were grown from seeds in individual pots. Each group was comprised of twenty corn kernels. For all the plants that grew, twenty in the hydroponics group and ten in the potting soil group, they were measured daily for a week. Each pot was watered with 3 ml of nutrient solution made from Miracle Grow every day. I thought that the hydroponics group would grow at a faster rate than the other group in the same period of time because a substrate, in this case the vermiculite contains no impurities or soil-borne pest like in soil or dirt. On the last day for recording data the plants in the soil had a greater average growth than the hydroponics group. By using statistics, I discovered that there was no significant growth difference between corn plants grown in potting soil with plants grown in vermiculite ($p>0.1$).

2751

GROWTH INCREASE IN DUCKWEED DUE TO POTASSIUM PHOSPHATE.

Cameron M. Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

I hypothesized that potassium phosphate would increase the growth of the number of leaves in duckweed. I used a concentration of 0.04ppm (parts per million) of potassium phosphate in a 300ml solution of water as the experimental. I also grew a control group in 300ml of water without the 0.04 concentration. Both groups contained 10 duckweed plants. The # of leaves for each plant was recorded and the growth over a two week period of time was compared between the two groups. Water was refilled daily to compensate for evaporation. The control group had a total growth of 5 leaves. The experimental had a total growth of one leaf. The difference in the two groups was compared using chi squared and was equal to 2.667. The p value from the chi squared calculation was between 0.2 and 0.05. The results from this were inconclusive. The results of the chi squared test neither rejected or accepted the null hypothesis, that the two groups were assumed to be the same with any difference due to chance. The p value was in the between range reject and accept so neither was applicable. The inconclusive p value was due to the lack of significant growth. Both groups did not grow as much as I had initially expected. I think that the lack of growth is due to the amount of light that the both groups were exposed to. Neither group had any light directly on them. The light that they got came from skylights and ceiling lights in the room.

2752

MEMORY AND MEMORY TRANSFER ABILITY OF PLANARIANS.

Eric Ho and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment began by testing whether or not planarians could be conditioned to always turn one direction when placed in a two-way maze. Five planarians were randomly chosen to do the maze. One at a time, a planarian was placed in the y-maze. When it reached the end one branch, it had to make a decision to go either left or right. I chose for them to go right. So every time it turned left, I delivered a negative stimulus in the form of an electric shock. A 6v battery hooked up to electrodes on the maze allowed me to do so. If planarians could in fact remember, then next time it should not want to go left and in turn go right. Each planarian ran the maze ten times a day for five days. There was a noticeable increase in the total number of right turns

on the first day and on the fifth which indicated planarians could be conditioned ($p < 0.001$). For my second experiment, I wanted to test if planarians were able to transfer their memory among each other. To do this, I took the five that were previously conditioned and fed them to five untrained planarians. This new experimental group then ran the same y-maze as well as a control group. The experimental group on the first day, started out with more right turns than the control, suggesting that some memory had been transferred. The number of right turns by the experimental group remained higher than the number of right turns by the control. Statistics showed that planarians were able and did transfer their memory among each other ($p < 0.001$). From these two experiments, I can conclude that planarians can be conditioned to do simple tasks and that after they memorize this task, they are able to transfer their memory to other planarians.

2753

EFFECTS OF ULTRAVIOLET RADIATION ON FROG EGG MORTALITY.

Erin Scoggins and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

From Canada to Puerto Rico to Madagascar to Western Europe, there have been reports of diminishing frog populations. Ultraviolet radiation is one of the few theories that scientists have come up with to explain the phenomenon. I tested the effects of ultraviolet radiation on frog eggs to find out if ultraviolet light could be a cause of the worldwide anuran declines. The ultraviolet light (wavelength: 240-400nm) was applied for half an hour, everyday, for 8 days. In the control group (not exposed to UV) 42 out of 50 larvae survived until becoming tadpoles, whereas in the experimental group (exposed to UV) 45 out of 50 larvae survived until becoming tadpoles. No significant effect was found between the eggs/larvae exposed to ultraviolet radiation and those not exposed to ultraviolet radiation ($x^2 = .103$, $p=0.9$). The minor differences between the groups were due to chance alone, not the ultraviolet radiation.

2754

GROWING PLANTS IN SOIL VERSUS GROWING PLANTS HYDROPONICALLY IN NUTRIENT SOLUTION.

Teresa Thongsinthusak and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to determine whether or not dark red bean plants grown hydroponically in a nutrient solution, consisting of water, magnesium sulfate, washing ammonia, and triple 15 fertilizer, would grow as tall as those grown in soil. Two control groups were used: dark red bean plants grown hydroponically in water without nutrient solution and dark red bean plants grown in potting soil. The nutrient solution supply for the experimental group was replenished everyday as was the water for the plants grown hydroponically in water and the plants grown in soil. From the nine days of collected data, I found that there was a significant difference between the heights of the plants grown hydroponically in nutrient solution and the heights of those grown in soil ($t=4.154$, $p<0.01$); likewise, I found that there was a significant difference between the heights of the plants grown hydroponically in nutrient solution and the heights of those grown hydroponically in water ($t=3.087$, $p>0.01$). The average height of the main stem of the plants grown hydroponically in nutrient solution was 24.6 cm, which was less than both the averages of the main stem of the plants grown hydroponically in water without nutrient solution and the main stem of the plants grown in potting soil, which were 32.8 cm and 34.0 cm, respectively. Although the plants grown hydroponically in water had the highest average height, they appeared to be the most unhealthy of the three groups of plants. Some indications of unhealthiness were not having a sturdy and thick stalk and having small leaves.

2755

THE EFFECTS OF GLYPHOSATE ON THE GROWTH OF *BACILLUS CEREUS.*

Steven Wong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to determine what concentration of glyphosate, the active ingredient in the herbicide *Roundup*, is the best in preventing the growth of *Bacillus cereus*, a bacteria found in soil. *B. cereus* was grown in an nutrient agar medium with the addition of the herbicide *Roundup* for one day at room temperature. *Roundup* (0.96% glyphosate) was added to this medium at varying concentrations. With the use of serial dilution, *Roundup* was diluted to 1/10; 1/100; 1/1,000 of the commercial solution. Two agar dishes of *B. cereus* with no *Roundup* added was used as a control and compared statistically with the plates with *Roundup* added. After dilution the *Roundup* was added to the agar medium and pour plated asceptically with *B. cereus*. After one day incubation the number of colonies of individual plates were recorded and examined statistically. The results of this experiment were the plates with pure *Roundup* and *Roundup* diluted to 1/10 of the original solution did not have any *B. cereus* colonies present, while the 1/100 and 1/1,000 plates were not significantly affected by the herbicide. After graphing the concentration of *Roundup* verses the number of colonies present the following relationship was established: As the concentration of *Roundup* increased the number of *B. cereus* bacteria decreased.

2756

EFFECTS OF LAUNDRY DETERGENT ON THE FERTILIZATION OF SEA URCHIN EGGS.

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Pollutants in the ocean can affect *Stronglylocentrotus Purparatus*, the common sea urchin. Using a common household product, detergent (of the Clout brand), we tested this theory. In the controlled experiment, putting egg and sperm together in an artificial sea for 10 minutes, a fertilization rate of 90.35%. In the variable part of the experiment, the detergent was diluted to 1/10,000 per ml of distilled H_20. This solution was added to a small amount of eggs on a slide. Using a micropipette, 0.125 ml of sperm was added to the slide. We then counted 50 eggs, observing and recording the amount of fertilized eggs versus the unfertilized eggs. This process was repeated three times. Our results from the three experiments averaged together came to 38% fertilization rate. This compared to 90.35% shows a drop of 52.3%, which proves that common laundry detergent can affect our ocean. This would lower the population of sea urchins in the ocean because not as many eggs are being fertilized and growing into adult sea urchins.

2757

CAN HYDRA REGENERATE THEMSELVES?

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This experiment was conducted to see if hydra could regenerate themselves when they are cut into small pieces by combining the cut-up pieces together. Hydras were cut into two, three, and four different pieces (different portions such as the base, bud area, upper body tube, and the middle body to see if the various size parts could regenerate.) Fifteen brown hydras (*Pelmatohydra olgaactis*) were used in which five were budding and ten were full size. There were three hydras that were cut at the buds, three hydras cut into four pieces, two hydras cut into three pieces, and two hydras cut into two pieces. The hydra was cut with an exacto knife on a piece of wax. Then each piece was placed in a petri dish filled with fresh water at a temperature of 20°C. After

two days, the cut pieces started to regenerate. All of the cut up pieces were protected by a thin layer of cells that surrounded them (that could be seen under a microscope.) Underneath this layer of cells, new tentacles were formed from most of the cut up pieces. Two pieces did not regenerate. This could be an error in cutting the pieces too small or accidentally damaging the cells, making it impossible for them to regenerate. The cut up pieces of hydra did not combine to regenerate a new hydra. Instead, each individual piece formed a new hydra.

2758

ULTRAVIOLET-A LIGHT AND PHOTOSYNTHESIS.

Kelly Dun and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

Ultraviolet light is always present in the Earth's ecosystem. In this experiment, I tested whether or not ultraviolet-A light would contribute additional energy for photosynthesis, thus excelling the growth of common duckweed plants (*Lemna minor*). The duckweed plants were exposed to ultraviolet-A light for seven minutes every day to approximate the amount of ultraviolet-A light the plants would absorb per day in nature. I assumed that leaf growth counted as plant growth because duckweed is essentially just leaves and stems. Also since duckweed reproduction involved budding new leaves, it seemed logical that leaf growth can be counted as plant growth. There was more total leaf growth in the group exposed to ultraviolet-A light than in the control group. Statistically, the growth is due to the ultraviolet-A light and not due to chance ($0.01 > p > 0.001$). The results support my hypothesis that ultraviolet-A light contributes additional energy for photosynthesis which resulted in increased plant growth.

2759

EFFECTS OF ROYAL JELLY ON THE COMMON MOUSE.

Stacy Spilman and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

I tested the effects of royal jelly on the common mouse to see whether the mice acquired more energy after consumption of the royal jelly over a period of approximately 4 weeks. The experimental group was fed the royal jelly, which is a highly nutritious mixture secreted by the maxillary glands in young honeybee workers. Because the royal jelly came in a mixture with raw honey, I fed raw honey to the control group to cancel out the probability of any increase in energy due to the sugar in the honey and not in the royal jelly. All mice were exercised on the rotarod for 20 minutes at about 20 rpm for eight days. A rotarod is a rotating rod, or a motorized wheel, used to run the mice at a specific speed and at the same time. I recorded every time a mouse clung onto the carpet of the rotarod and went upside-down. For each time the mouse goes upside-down, it's one less "lap" the mouse would run which I took to mean the mouse used less energy. The mice in the control group went upside-down a total of 826 times. The mice in the experimental group went upside-down a total of 49 times. I rejected the null hypothesis ($x = 689.99$, $p < 0.001$). There was a tremendous difference between the expected and observed, the difference between the two groups was due to the royal jelly. According to my results royal jelly does give an increase of energy.

2760

PEAS HATE ONIONS: THE EFFECTS OF ONION JUICE ON GERMINATING PEA SEEDS.

Jennifer S. Ing and Mr. Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

Companion planting has been a pseudo science in our culture; this experiment tests one of its aspects. If planting onions *allium cera* with peas *pisum sativum* in companion planting is detrimental to peas, then similarly, 1% onion juice is harmful to pea seeds and will impede or stop their germination. In the control group, 5 ml of tap water was added to each of the 5 groups with 6 pea seeds. In the experimental group, 5 ml of 1% onion juice was added to each of the 5 groups with 6 pea seeds. Over the course of the 4-day study, all peas were individually scrutinized and checked for germination. An average of 67% pea seeds germinated in the control group. An average of 43% pea seeds germinated in the experimental group. According to chi square calculations, the null hypothesis was rejected [($\chi^2 = 3.3$) and ($0.2 < p < 0.05$)] and there was a significant difference of decrease in the percentage of germinated pea seeds due to the addition of 1% onion juice. Onions and peas are both rich in sulfur. The combination of both plants can be lethal with their combined levels of sulfur. Sulfur is a needed fertilizer, but too much can kill a plant. Therefore the amount of sulfur in onion juice added to sulfur-rich pea seeds caused a detrimental level of sulfur to occur and impede or stop the germination of pea seeds.

2761

CHEMOTAXIS IN *PHYSARUM POLYCEPHALUM* PLASMODIUM.

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I wanted to see if the plasmodial slime mold, *Physarum polycephalum*, would be able to detect and respond to chemical stimuli presented in the form of test food substances. I did so by placing a small sample of *Physarum* in the center of a non-nutrient agar dish. Also in the dish, I placed a test food substance (of sugar, salt, oat flakes, or dead leaves;) and a plain agar block, to serve as a control, on opposite sides of the dish, equidistant from the *Physarum*. After incubating for 23 hours, the *Physarum* left its original position and migrated (either away from or towards the test substance.) The *Physarum* would always move away from the salt (in the plates I tested with salt,) and almost always towards the oat flakes (in the plates I tested with oat flakes.) Its responses to sugar and dead leaves were not consistent. (Using the Chi-Square test, *Physarum's* reaction to salt had a p value less than 0.01; for oat flakes, $p < 0.05$; for sugar, $p > 0.2$; for dead leaves, $p > 0.2$.) Its migrations with respect to salt and oat flakes suggest that the *Physarum* can, in fact, detect the presence of certain chemicals in its surrounding environment, and is able to respond to those chemicals positively or negatively by migrating towards or away from the source.

2762

EFFECTS OF BODY SPRAY ON SEA URCHIN FERTILIZATION.

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This study examined the question of possible body spray involvement in sperm-egg interaction in the sea urchin *Strongylocentrotus purpuratus*. The body spray consists of purified water, SD alcohol 40, fragrance, glycerine, tocopheryl acetate, comfrey extract, chamomile extract, mallow extract, ivy extract, birch extract, PEG-40 hydrogenated castor oil, blue #1, and yellow #10. The ratio of body spray to water was 1ml:99ml. A sea urchin egg suspension of 0.125 ml was placed on a depression slide. The 12.5 ul of body spray was placed

in a micro-pipette and injected into the egg suspension. Then sperm was placed in the egg suspension with the blunt end of a toothpick. The fertilized eggs were then counted and the procedure was repeated three more times. The body spray reduced the fertilization rate to 40% + or -4%, while the control values were at 90.3% + or -5%. The results suggest that even a body care product such as body spray can have an effect on the fertilization rate of the sea urchin *Strongylocentrotus purpuratus*. Therefore, we should be continually of what we put into the drainage systems since such substances can pollute the oceans and lead to the mutation or destruction of marine life.

2763

EFFECTS OF MULTI-VITAMINS ON THE GROWTH OF PEA PLANTS

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This study examined the question of possible involvement of multi-vitamins in the growth rate of pea plants. The peas were germinated in a solution of one vitamin to thirty nine milliliters of water. The vitamins were Sav-on brand multi-vitamins with Beta Carotene. The experimental pea plants were watered with the solution once daily, while the controlled pea plants were watered with normal tap water. The results of the experimental pea plants' growth rate over one month was compared to the growth rate of the controlled peas. It was found to have no effect on the pea plants because they grew at the same growth rate. We set up two controlled groups and two experimental groups each containing six pea plants and both experiments obtained the same results.

2764

THE EFFECTS OF ACID RAIN ON THE HEIGHT OF BEAN PLANTS.

Bao Zhen (Anna) Guan and Steve DeGusta (teacher). John F. Kennedy, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to determine if acid rain containing nitric acid (pH 3) would act as a bean plant growth enhancer. A rain of nitric acid, component of acid rain, into tree's roots has been known to act as a fertilizer to the tree. Nitrogen is one of the three major nutrients for trees and plants. In soil, ammonium and nitrate are the principal forms of nitrogen available to plants. Nitric acid is a strong acid that is completely dissociated to hydrogen and nitrate ions in dilute water solution. This means plants can get one of the principal forms of nitrogen available to them from a mixture of nitric acid and tap water. In this experiment I test the effects of acid rain with a pH of three on Burpee's stringless green pod beans (*Phasolus vulgaris*). To test the effects, two groups of ten bean plants were grown in containers filled with solution. This way of growing plants is called hydroponics, the raising of plants in nutrient mineral solution without earth around the roots. The experimental group of bean plants was grown in containers filled with acid rain solution (pH 3), a mixture of tap water and nitric acid, and the control group was grown in containers filled with tap water (pH 8.7). The heights of both groups of bean plants were measured daily and the average daily net growth of the experimental group was compared to the average daily net growth of the control to see if acid rain had any effect on the height of bean plants. Even when the absolute difference between the two groups' daily net growth was at maximum, the T-test still produced a $p > 0.1$. This meant that any difference that did exist between the net growth of the experimental and the control groups of bean plants was due to chance alone. Acid rain at a pH level of three had no effect on the height of bean plants.

2765

NUKIN' FLIES! (THE EFFECTS OF MICROWAVE RADIATION ON THE NUMBER OF OFFSPRING OF *DROSOPHILA MELANOGASTER*).

Jason Dot Kwong and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

In this experiment I attempted to test microwave radiation on male *Drosophila Melanogaster* to test its significance on the number of offspring, as compared to a group where the males had not been radiated. Wild *Drosophila Melanogaster* were bred over the span of 8 days to produce F1 generation flies. Males and virgin females of the F1 generation were removed from the original group and separated into marked vials. Six F1 generation males were selected and microwaved in a Litton "Go Anywhere" microwave oven for 15 seconds at 30% power and allowed to breed with a non-microwaved female. There were 4 flies placed per vial: 2 males and 2 females. These vials were placed in an incubator at 77°F and the flies were allowed to breed for 6 days. A second group of F1 generation flies were also bred without having microwaved the males as a control group. After the 6 days, all F2 generation flies from both groups were counted over 4 days. Data and statistical analysis ($X2=32.34$, $p<0.001$) showed that there was a significance in the deviation in number of resulting offspring. The group with radiated males resulted in less offspring. It was thus concluded that there could be one of two solutions: 1) the microwave radiation only temporarily affects the gametes of the male *Drosophila* and causes temporary sterility or 2) the radiation does damage to the sperm of the male permanently, but only to a certain degree, and the number of offspring will then always be less and never reach the normal amount.

2766

GROWTH COMPETITION OF CORN SEEDS.

Michael Yu, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

This experiment was set up to determine if population density affects the heights of jubilee hybrid sweet corn plants (*zea mays saccharata*). I grew 36 corn plants, 18 individual plants with 1 seed in each and 18 individual plants with 8 seeds in each for 14 days. The amounts of soil, water and sunlight were kept constant between each plants in order to receive accurate results. Some of the plants didn't grow at all and were not considered part of the sample size. The tallest point on the plants were used as the gauge for the plants' height growth. For each plant sample with more than 1 seed, the mean of their heights were used for the height of the sample. There was a sample size of 15 plants with 1 seed in each and a sample size of 18 for the plants with 8 seeds. Using the t-test, it was found that there was no significant difference between the heights of the plants with 1 seed and the heights plants with 8 seeds ($t=0.26$, $p>0.1$). The population density is not related to height growth of corn plants.

2767

THE EFFECTS OF POTASSIUM NITRATE ON *LEMNACEAE*.

Timothy Lee and Steven DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this laboratory investigation, I attempted to discover whether or not $KN0_3$, potassium nitrate, increases the growth of duckweed. 10 containers were filled with 200ml of tap water. In the five experimental containers, 2g. of potassium nitrate was added to create a 1% potassium nitrate solution within the tray. Regular tap water was added to the five control trays. In all trays, 5 healthy (green and un-damaged) duckweed plants were added. The level of the water in each tray was marked off with a pen. Every three days, tap water was added to the experimental and control trays to compensate for any evaporation. Measurements consisting, number of

leaves, number of bunches, discolored leaves, and physical observations were taken. Results such as length of leaves were not taken. This is mainly because there would be no significant growth since the duckweed were already full-grown when obtained. Following approximately two weeks of observations and measurements, I found that the potassium did not increase the multiplication or growth. It actually killed a large population of duckweed in each experimental tray. After a statistical analysis of the data, I concluded that the 1% solution of potassium nitrate, $KN0_3$, decreased the rate at which duckweed multiplied. ($P < 0.01$)

2768

THE EFFECTS OF LIGHT INTENSITY ON THE EATING HABITS OF BROWN GARDEN SNAILS.

Jackson Thach and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

In this experiment, I wanted to find out if light intensity affected the amount of food eaten by *Helix aspera*, or the brown garden snail. To do this, I took twenty snails and separated half of them into two different categories: light and dark. Each category was named for the light intensity chosen. The snails were placed into two containers, with ten snails in each. In the dark category, the container was placed in a paper bag to encourage low light intensity. In the light category, no bag was placed over the container so that all the light would be able to pass through. I fed the snails in each category lettuce. I weighed the lettuce before and after I fed the snails to see how much they ate. My results suggested that the snails in light ate more than the snails in the dark. On average, the amount of lettuce ate by the snails in light was 7.47 grams per day. For the ones in the dark, it was 5.89 grams per day. But after using the t-test, I resolved that my data collected was due to chance ($p>0.1$). Therfore, I conclude that light intensity does not affect the amount of food eaten by *Helix aspera.*

2769

THE EFFECTS OF EGG YOLK AND CITRIC ACID ON THE BEHAVIOR OF *DUGESIA TIGRINA*

Ryan D. Fong, Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this investigation, I completed a series of labs to test the effects of egg yolk and citric acid on the approach and avoidance patterns of the planarian, *Dugesia tigrina*. I hypothesized that the planaria would respond to egg yolk, a food source, with an approach behavior, and respond to the citric acid, a toxic substance, with an avoidance behavior. Placing planarians in a y-maze with egg yolk and citric acid in left branch in two separate tests measured this. The left and right decisions made by the planarians were recorded. A left decision would indicate approach behavior, whereas a right decision would indicate avoidance behavior. The data showed that there was no significant difference between the number of left and right decisions when egg yolk was present, but it also showed that there were significantly more right decisions compared to left when citric acid was present ($\chi^2=9.8$, $p=.01$). This suggested avoidance behavior. The second experiment was to test the effects of citric acid on planarians conditioned with electric shock. They were conditioned to go left in a y-maze, by shocking them every time they chose right. Citric acid was then placed on the left. The number of left and right decisions were recorded and statistically analyzed. The data showed that there were significantly more right decisions ($\chi^2=5.0$, $p=.05$). This showed that the avoidance behavior to citric acid was stronger than to electric shock.

2770

THE EFFECTS OF CALCIUM ON THE GROWTH OF PEA PLANTS

Alice Lee and Steve DeGusta (teacher), John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to find out if the growth of pea plants is related to the amount of calcium it absorbs. It was done by using a control group and an experimental group. The control group had ten pea seeds and was only given water for their growth. The experimental group also had ten pea seeds but was given water with calcium (80ml of water and 1500mg of calcium) for their growth. Both groups were grown on cotton puffs. The calcium was first in powder form but was diluted so that the pea plants can absorb them easily. After fifteen days, the average height for the group without calcium was 33.7cm and the average height for the group with calcium was 43.3cm. The difference between the height of two groups was found to be significant ($t = 8.63$, $P < 0.001$). Therefore, calcium does effect the growth of pea plants.

2771

THE EFFECTS OF POTASSIUM PHOSPHATE ON CHLORELLA POPULATION SIZE.

Zebadiah Lee and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

Bodies of water have a natural aging process and a natural life expectancy dependent upon their size, depth, and surrounding terrain. When man discharges waste into his lakes, he dumps both toxic materials and life-supporting nutrients. The accumulation of nutrients in lakes causes the rapid growth of algae. However, after a time, the algae die and sink to the bottom of the lake. Eventually a lake in this condition becomes a swamp; this process is known as eutrophication. Two macronutrients that are both known to be essential to the lives of plants are potassium and phosphate. Phosphate could possibly be used to produce more rapidly growing mature chlorella cells while potassium could be used as a cofactor to increase the rate of cell division. For these reasons, I believed that if I grew chlorella cells in a 1% potassium phosphate solution a larger number of cells would be produced compared to the number grown in a filtered water solution. Every 2 days, the number of chlorella cells per cubic millimeter was monitored through the use of a microscope and hemacytometer. It was observed that a larger number of cells was not produced in the 1% potassium phosphate solution; more cells were observed per cubic millimeter from the filtered water. From my data and t-test, I determined that $p<0.01$, which indicated there was a significant difference between the number of cells produced in the 1% solution and filtered water. Therefore the 1% solution did play a role in the difference in number; however, instead of helping the maturation process and rate of cell division, the solution did the opposite.

2772

THE EFFECTS OF WATER CONTAINING AMMONIA ON COWPEA PLANTS.

Christopher M. Leong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this investigation, I attempted to see if ammonia from broken down goldfish waste caused cowpea plants to grow taller. I raised 4 feeder goldfish and collected their waste. I then performed an ammonia test with an ammonia test kit to make sure that there was ammonia in the water. I then germinated 48 cowpea plant seeds and planted them into soil. I watered 24 of the plants daily with the water containing between 1 ppm and 8ppm of ammonia and I watered the other 24 plants daily with tap water. I took each plant's measurements for five straight days. At the end of five days, I compared the final heights of each plant and found that the average height of my control plants (the plants watered with tap water) was greater than the average height of my exper-

imental plants (the plants watered with water containing ammonia). I found that there is no significant difference in the plant heights between the plants watered with the water containing ammonia and the plants watered with tap water. Therefore I can conclude that water, containing ammonia, does not cause cowpea plants to grow taller. ($p>0.1$)

2773

EFFECTS OF NITROGEN-FIXING BACTERIA ON CHLORELLA.

Beijia Zhang and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This study examined if the nitrogen-fixing bacteria *Rhizobium* could increase the growth of the single-celled algae *Chlorella* by providing *Chlorella* with a steady source of nitrogen. *Chlorella* was grown for 13 days with a sheep manure medium in test tubes under two conditions: (1) inoculated with *Rhizobium* bacteria (experimental), and (2) without any added *Rhizobium* (control). The cultures in each test tube were subcultures of one single *Chlorella* culture and had uniform cell density at the beginning of the investigation. All test tubes were shaken by hand for 1 minute daily. The density of *Chlorella* cells in each culture was measured by counting the number of cells visible within a 0.4 mm microscope field at 600X of a wet mount made from a drop of the *Chlorella* culture. Readings were taken daily. Each culture experienced steady growth. As determined by the Chi-square test, the cultures inoculated with *Rhizobium* did not have significantly more *Chlorella* cells in a given volume than the control cultures. ($p > 0.9$) It was concluded that the addition of *Rhizobium* does not help to increase the growth of *Chlorella* in terms of cells population.

2774

EFFECTS OF ALLELOPATHIC RADISH SEEDS ON LETTUCE SEED GERMINATION.

Julienne Kwong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

The purpose of this experiment was to test if radish seeds (*Raphanus cruciferae*), which are allelopathic, inhibit the germination of lettuce seeds (*Lactuca saliva*). I used petri dishes with moist paper towels to germinate 100 lettuce seeds and 50 radish seeds. This was a larger sample in comparison with my previous experiment, which tested the same problem with only 20 lettuce seeds and 10 radish seeds. In this experiment I found that 94% of the lettuce seeds in the control group germinated while only 34% of the lettuce seeds in the experimental group (with radish seeds) germinated. After checking these results with statistics ($x^2 = 14.06$, $p < 0.001$), I concluded that this investigation supported my hypothesis that lettuce seeds in the same group as radish seeds would have a significantly lower percentage of germination than the lettuce seeds by themselves.

2775

USING PAPER CHROMATOGRAPHY TO IDENTIFY THE CHLOROPHYLLS IN *PRUNUS VESUVIUS* LEAVES.

Donna Lee and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

The objective of this investigation was to determine if visibly non-green leaves have the same chlorophylls *a* and *b* as green leaves. Two extracts were created by bleaching green leaves and *Prunus vesuvius* leaves (non-green) with alcohol. Paper chromatography was used to separate the pigments of each extract. Color, sequence, and R_f values were compared. The green leaves' chromatograms showed chlorophyll *b* (yellow-green), chlorophyll *a* (bluish green), xanthophyll (yellow), and carotene (pale yellow) pigments. The non-green leaves' chro-

matograms showed: magenta, bluish green, yellow, and pale yellow pigments. Statistical analysis of the R_f values yielded; bluish green ($p<0.001$), yellow ($p<0.001$), and pale yellow ($p=0$). However, R_f values are difficult to reproduce due to the crude methods of control and measurement. Color and sequence are more reliable means of identification. Therefore, I concluded the pigments of the *Prunus vesuvius* leaves to be: anthocyanin (an accessory pigment), chlorophyll *a*, xanthophyll, and carotene. Although chlorophyll *a* and chlorophyll *b* are usually found together, no chlorophyll *b* was detected. The *Prunus vesuvius* extract was taken from a tree freshly in bloom. It is possible that the young age of the leaves resulted in a small amount of chlorophyll *b* which did not appear on the chromatogram. Since there is a very slight difference in structure of the chlorophylls, it is possible that a small band of chlorophyll *b* was masked by the chlorophyll *a*. I have found that the presence of chlorophyll *a* in a leaf is not dependent on the visible color of the leaf.

2776

WILL *EUGLENA* SHOW CHLOROPLAST REGRESSION IF KEPT IN THE DARK?

Alyssa Hockenson and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to find out if *Euglena gracilis* will show chloroplast regression if kept in the dark. To accomplish this, I cultured *Euglena* and placed half in the dark and half in the light. After waiting several days for the *Euglena* to acclimatize to their conditions, I made chromatograms of the *Euglena* by centrifuging and decanting the tubes until I had a *Euglena* "paste," which I applied in a line across a piece of chromatogram paper which was then placed in solvent. In statistically analyzing the data, I found that there is a significant difference in the intensity of color of the *Euglena* from the light and the *Euglena* from the dark, showing that *Euglena* can go into chloroplast regression if kept in the dark ($p < .05$).

2777

THE EFFECT OF CHINESE HERBAL SOUP ON *BACILLUS CEREUS*

Ut Kuong Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this investigation is to test the effects of a particular Chinese herbal soup with *Bacillus cereus*. This soup was described in an herbal medical journal that was published in China 1984. This soup was used to cure the Bronchitis. Bronchitis is an infection of the windpipe cause by the bacterium *Hemophilus pertussis*. To cure Bronchitis is to decrease the growth rate of *H. pertussis* so that the white blood cells can easily eliminate the bacterium. Since there were a little scientific information about this herbal soup, I hoped to find out how does this soup reacts when it is directly contact with the bacteria. The method I used to test this problem is the disc method. In this method filter paper discs were dipped in the pre-cooked herbal soup. Then the discs were placed in an agar dish fill with the bacteria *Bacillus cereus*. The reason I made this substitution is that *H. pertussis* is hazardous for me to obtain. By the reason that *Bacillus cereus* is neither harmful nor difficult to obtain; it is encourage using this bacterium. Then the agar dish was incubated under 34° for one day. After the incubation the agar dish was observed and I recorded the diameter of the area around the discs with no bacterial growth. I got 0cm of clear area around all discs. That means that the soup did not stop any bacteria from growing. Since I had 0cm for all data, the use of statistic is not needed to prove the significance the results. With these results I concluded that the soup did not decrease the bacterial growth rate of *Bacillus cereus*. Therefore the soup does not act directly to cure the inflection of *H. pertussis*.

2778

THE EFFECTS OF CARROT JUICE ON *E. COLI* BACTERIA.

Stanley Wong and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to test if carrot juice can be a growth inhibitor for a non-pathogenic strain *Escherichia coli*. Carrots contain complex sugars which interferes with the binding of pathogenic bacteria to the intestinal lining. Carrots have been used for centuries in the treatment and prevention of diarrhea. Pathogenic strains of *E. coli* have been known to cause severe diarrhea. Non-pathogenic strains of *E. coli* aids the intestines in digestion. In my experiment, I isolated carrot juice in filter disks and placed these disks into a nutrient agar media containing *E. coli*. I attempted to see if there were any difference between the disks containing the carrot juice and the control, disks containing ordinary filter paper. To my surprise, the carrot juice seems to aid the growth of non-pathogenic *E. coli* although it affects the binding of pathogenic *E. coli* to the intestinal lining. When observing the dishes, I found more colonies of *E. coli* surrounding the disks containing the carrot juice than the control. This method of testing led me to conclude that carrot juice not only aids treating pathogenic bacteria in the intestines, but also encourages the growth of non-pathogenic *E. coli*.

2779

VARIANCE OF ROOTS GROWN IN DIFFERENT FIELD CAPACITIES.

Lisa Ann Gregory, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95813.

The primary purpose of this experiment was to see if the field capacity of a soil has a direct effect on the root growth of bean plants. The field capacity is defined as the ability of a soil to retain water (Schultz, 1960). The conditions set to test my problem were to grow 10 bean plants in potting soil and 10 bean plants in sand. I chose these soils I because potting soil has an almost four times higher field capacity than sand (Gregory, 1998). Both groups were given the same amount of water over a period of 11 days. After four days I didn't water the plants for three days so that the plants would have to survive on the water retained by the soils.

After 11 days I took the plants out of their pots and measured the lengths of the primary roots of each plant, their heights, and counted the number of roots of each plant. The mean of the lengths of the primary roots of each plant grown in potting soil was 13.8 cm, and for the plants grown in sand was 5.3 cm. The mean of the heights of the bean plants grown in potting soil was 7.85 cm, and in sand was 3.86 cm. The mean of the number of roots of each plant grown in potting soil was 39, and in sand was 18.7.

I conclude that the bean plants grown in potting soil adapted much better to their environment than those grown in sand. This was due to the lack of water due to the low field capacity of sand. Also, sand is inoraganic so nutrients were scarce to those bean plants. The bean plants grown in potting soil were taller ($p<.001$, $t=4.24$), had greater root extension ($p<.001$, $t=4.58$), and had a more plentiful number of roots ($p<.001$, $t=3.68$). I thought that if a plant were put in an environment where water is scarce (a decrease in field capacity), then the roots would have to extend for the plant to have a better chance to survive. My results aren't in agreement with my hypothesis, but statistically are highly significant. The decreace of a soil does have a direct effect on the growth of roots of bean plants, but a decrease in field capacity retards growth of bean plant roots, rather than being a catalyst to growth.

2780

DROSOPHILA AND THE RAYS OF A GE® ULTRAVIOLET LIGHT IN SPECIFIC RELATION TO SEX RATIO OF OFFSPRING PER EXPOSED PARENT GENERATION.

Timothy Daniel Schroepfer, Steve DeGusta (teacher). John F. Kennedy Senior High School, 6715 Gloria Drive, Sacramento, CA 95831.

What environmental factors account for the imbalance of male and females with in the human population? It was the opinion of the study that ultraviolet light, a known mutagen, could cause this imbalance in the sex ratio. The study used *Drosophila melonagaster* (the common fruit fly) due to it quick reproduction rate. A virgin parent generation was exposed to 5 minutes of full spectrum ultraviolet light. They were then paired off and left to breed. The resulting offspring of the exposed flies were then compared to control sample of normally bred flies kept under the same conditions. The result indicated that there was not significant difference with a chi squared calculation resulting in a p value of almost one. This indicates that the results were due to chance variation and not due to the ultraviolet light. While ultraviolet light cannot be ruled out as a sex determinate it can be said that the probability that it has anything to do with sex outcome is very limited.

2781

MOLD GROWTH AND ITS EFFECTS WITH WATER ON SOURDOUGH, WHITE AND WHEAT BREAD

Brian Chan, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment I tested to see if water had an effect on the amount of mold growth on sourdough, white and wheat bread. I hypothesized that all the bread that was watered would have more mold growth than the dry control breads. To do this I took 10 pieces each of white, wheat and sourdough broad and cut each slice into four inch by four inch squares. I added 20 drops of water on each piece of bread and placed each piece of bread in its own individual plastic zip lock bag. Almost any nutrient-rich material such as bread will go mouldy if the environmental conditions like temperature and moisture level are suitable for mould growth. For my control I took 10 pieces of each kind of bread and placed them in the plastic bags minus the water. After four days mold started to grow on the bread. After seven days I took each individual piece of bread, placed a piece of transparent graph paper over it and counted the number of squares the mold covered. I then found the area of bread the mold covered and concluded that mold on bread with water added to it would grow faster than bread without water. None of my control breads had any mold growth, while the watered sourdough bread had mold growth on 1.54 cm^2 of bread, the watered white bread had mold growth on 14.21 cm^2 of bread, and the watered wheat bread had mold growth on 19.36 cm^2 of bread. With a p-value $<.001$, I can conclude that water has a significant effect on the amount of mold that grows on white, wheat and sourdough bread.

2782

THE EFFECTS OF COBALAMIN ON *PHASEOLUS LIMENSIS.*

Jonathan Fung and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

I investigated the effects of vitamin B12 on lima beans to determine whether it effects the growth rate. Lima beans were used because they are large bean plants and provided more drastic results. I used two groups of lima beans, each consisting of 18 beans, which grew over a duration of nineteen days. During the period of growth, one group was given tap water that was enriched with vitamin B12. The other group was designated

as the Control and was given tap water. Throughout the duration of the investigation, the Control group grew considerably more and faster than the Experimental group. At the end of the nineteen-day period, the plants forming the Control group had a combined height measuring 732.4cm, averaging a height of 40.7cm per plant. The Experimental group had a combined height of 40.7cm, averaging 29.1cm per plant. Through statistics, I have confirmed that these results are valid since they could only occur by chance in less than five out of one hundred times ($t=2.39$; $d.f.=34$; $p<.05$). Therefore, I have concluded that cobalamin effects lima beans by slowing the rate of growth.

2783

THE EFFECTIVENESS OF SUNSCREEN PROTECTION AGAINST ULTRAVIOLET LIGHT ON YEAST, *SACCHAROMYCES CEREVISIAE.*

Sally Chow and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment, the effectiveness of sunscreen was tested. Yeast, *Saccharomyces cerevisiae*, equivalent to our skin cells and the black light equivalent to the sun. The result of this experiment should give an idea on how effective sunscreen is. Although some deaths of the cells were prevented by the protection of sunscreen, but statistics showed that the differences were not significant, suggesting sunscreen is not an effective protection against the ultraviolet radiation from the sun ($t=1.65$, $p<0.1$). There were two groups in this experiment, one control and one experimental. The control group was covered by saran wrap without sunscreen on top of it while exposed to black light, the experimental group was covered by saran wrap with sunscreen on top while being exposed. Both of these groups were exposed to UV radiation for 60 seconds, and incubate at room temperature, 18 degrees Celsius for 3 days. The number of colonies were counted after the 3-day period, the results showed that the group that was protected by sunscreen had on an average of 100 more colonies than the one not protected. T-test results suggested that null hypothesis should be kept, which means all differences between the two data were due to chance. Therefore, I conclude that sunscreen is not an effective protection against UV radiation.

2784

AQUAPONICS: AN INTEGRATED AQUACULTURE AND HYDROPONICS SYSTEM.

Edmund To and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The science of aquaponics (an integrated fish culture and plants system) is only at its infancy, but it promises to be useful to society. Aquaponics is 100% natural and does not require much maintenance to run. There are many benefits to this natural system in growing plants and in raising fish. In this investigation, three (3) leaf lettuce plants were grown in a tank of fish to test if they will reduce the nitrate and nitrite levels of the water. Both nitrate and nitrite can be hazardous if allowed to reach unacceptable levels. In another tank fish alone were kept and plants were kept in a third as controls. Water samples from the joint fish/plants tank and the fish-only tank were taken to be compared for their respective levels in nitrate and nitrite. The water samples were taken every Monday and Thursday throughout a three-week period, and tests were run on the samples to show the level of total nitrate and nitrite in the water. The results did show a difference in the amount of pollutants in the water. Both tests used a color chart to determine the level of nitrates, so the numerical results are not fully accurate. Comparing the color of the results from each tank did show that the nitrate and nitrite level in the tank with plants and fish was lower than the tank with only fish. This concludes that the plants did reduce the amount of pollutants in the water of a fish tank, showing that aquaponics systems are effective.

2785

CLEANING UP OIL SPILLS; THE EFFICIENCY OF OIL EATING BACTERIA.

Mark Alan Wong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

An oil spill is one of the most destructive environmental disasters known to man. It destroys the entire ecosystem, in which it occurs, and prohibits life from developing in that region, for years to come. A technique, called bioremediation, uses naturally occurring bacteria to clean up these oil disasters on both the land and sea. The purpose of this experiment was to observe the efficiency of the oil-eating bacteria *Acinetobacter calcoaceticus* RAG-1. Over a span of eleven days, I measured the volume of motor oil that the bacteria consumed daily. I used a micrometer to measure the thickness of the oil left in each container after each day. Then, using the formula Volume = 2 x π x Radius (of the container) x thickness (of the oil), I was able to calculate the volume of oil that was remaining. The result of my experiment was a significant decrease in the amount of oil that was left in the experimental groups, containing oil-eating bacteria. According to statistical analysis, there is less than one chance out of a thousand that this significant reduction in the volume of oil was due to chance. ($p<.001$) From this experiment, I was able to conclude that the oil-eating capabilities of *Acinetobacter calcoaceticus* RAG-1 will be quite helpful in our society. It's effectiveness in the degradation of oil was astounding.

2786

THE EFFECT OF CLOUD COVER ON THE EATING HABITS OF BIRDS.

D.H. Heller and S. Engelmann (teacher). Palisades Charter High School, 15777 Bowdoin Street, Pacific Palisades, CA 90272.

The purpose of this study was to find out how the percent cloud effects the eating habits of perching birds feeding on a household tube bird feeder. A household tube bird feeder was set up in an open area. The number of birds and the percent cloud cover was recorded for 15 minutes 2 days a week for 5 weeks. Observations were made the same days and times each week. As the percent cloud cover increased, the number of birds feeding decreased. The number of birds feeding ranged from 6 on a clear day to 2 on an overcast day. Percent cloud cover does have effect on the eating habits of perching on a household tube bird feeder.

2787

RADIATED PLANARIANS AT DIFFERENT WATER DEPTHS.

Nataniel Tecpatl Vásquez and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

Since the ozone layer is getting thinner due to ultraviolet radiation and pollution, it may cause a decrease in the animal population; or it may fail to protect organisms that may also be protected by water. This investigation was designed to determine if planarian fatalities from ultraviolet radiation are related to the depth of water. Four small bowls of dechlorinated water were set up in two categories with different water levels; two at 1/4 cm of water, and two at 1 1/4 cm of water. Ten healthy planarians were transferred into each container with a large dropper. One category of each water level was labeled "Control" and it was kept in the dark under a box where the animals like the dark. The other category was labeled "Radiated" and each dish was radiated for 35 minutes with an ultraviolet light-and-a coffee can set up where no other light was a factor. Each planarian was examined with a compound microscope at low power for fatalities by using the large dropper to transfer the animal to a microscope slide; and up to 3 planarians were spread out along the slide for examination. After 2 days, all but one planarian died in the "Radiated 1/4" dish, but no other planarian died from any

other dish. This indicates that at such a low water depth (1/4 cm), the planarians were extremely vulnerable to ultraviolet radiation compared to the larger depth (1 1/4 cm). It was found that there was a significant difference ($p>.001$) between planarian deaths from ultraviolet radiation at a low water depth (1/4 cm) and at a greater depth (1 1/4 cm). Also, at the same water depths ("Control 1/4" & "Radiated 1/4" and "Radiated 1 1/4" & "Control 1 1/4") there was a significant difference ($p>.001$) between deaths of the "Radiated" planarians and the "Control" planarians. This means that the fatalities were caused by only the radiation and not by any other factor.

2788

SNAIL TRAILS: WILL A SNAIL FOLLOW ANOTHER SNAIL'S MUCUS TRAIL?

Robert S. Dong, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr. , Sacramento, CA 95831.

I investigated the behavior of the common land snail, *Cepaea nemoralis*, when presented with a mucus trail created by another snail. To do this, I obtained a "T" shaped maze and built a zigzag shaped maze. Using these mazes, I set up tests to determine if snails would follow the trails. The 1st test used the "T" maze. A snail would leave a mucus trail leading towards one direction. A 2nd snail would then be placed at the beginning of the trail to see if it would follow it. ON all the trials, the snails followed the trails direction. From this portion of my experiment, it was proven that snails would follow another mucus trail when given a choice between no trail and a trail.

The zigzag maze was used next as further proof that they will follow the trail. To do this, one snail would be placed at the beginning of the maze. The snail then made a trail in a zigzag shape. A 2nd snail was then placed at the starting point without a maze to guide it. This way, the snail has an unlimited choice as to where to go. This also proved successful, as the snails followed each other's mucus trails. They would not follow the trail however, if there was an extreme source of heat or light upon the trail.

2789

EFFECTS OF *STEINERNEMA NEMATODES* ON TOBACCO HORNWORMS.

Rudy Buehler and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This study was conducted to find out if the nematodes *Steinernema* were effective as pest control on tobacco hornworms (*Manduca sexta*) and on their cocoons. I tested the hornworms in their larval stage first. The nematodes were placed in the soil. In nature, the nematodes are able to make their way into the bodies of their victims and kill them within 48 hours. In this study, they did not. All 20 experimental hornworms survived. The second study was testing the nematodes on the cocoon stage of the hornworms. I injected the nematodes directly into the cocoons by way of a 26G needle tip on a 1 cc syringe. The 12 experimental cocoons were dead within 48 hours while the 12 control cocoons, which were not injected with nematodes, survived. The controls were stuck with a needle but received no injection. The control cocoons later hatched into tobacco moths while the experimental cocoons did not. The nematodes effectively killed the cocoons of the hornworm.

2790

THE EFFECT OF TRIHALOMETHANES ON THE MORTALITY RATE OF JAPANESE MEDAKA EGGS.

Bethany Lum and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

High levels of trihalomethanes (THMs) may be linked to high miscarriage rates in humans. The common byproduct of chlorine in tap water is also suspected of causing cancer in mice. This investigation further explores the effects THM's have on the embryonic development of *Oryzias latipes*, commonly known as Japanese medaka. The mortality rate of *Oryzias latipes* eggs was assessed to determine if THM's had a negative effect on the embryonic development of the fish. Harvested egg clusters (which included 64 eggs) were separated into two groups with 32 eggs each. One group was placed in a THM rearing solution, which possibly contained a high level of THM's. The other group was placed in a rearing solution free of THM contamination. Mortality rate was tabulated after three weeks from when the egg clusters were harvested. The egg group exposed to THMs had a mortality rate of 12.5% and the other group which was not exposed to THMs had a mortality rate of 11%. In this study, trihalomethanes did not increase the mortality rate of Japanese medaka eggs ($p<0.9$). Results are questionable, however, because the level of trihalomethanes could not be measured. There is a possibility that THMs were not formed, and therefore could not have an effect on the mortality rate.

2791

EFFECTS OF HIGH AND LOW CONCENTRATIONS OF ORGANIC NITROGEN FERTILIZERS IN LEGUMES (SUGAR SNAP PEA PLANTS).

Jennifer Louie and Steve DeGusta (teacher). John. F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This investigation took a look at the effects of an organic nitrogen fertilizer (N2) on the growth rate of legumes. The control group in this investigation was a set of pea plants that grew in sterile soil and maintained with only tap water. The two tests groups of plants had a nitrogen fertilizer applied at either a high concentration of 1.42g or a low concentration of 0.65g. The fertilizer used in this investigation was derived from an organic all nitrogen fertilizer called Blood Meal. The Blood Meal fertilizer had an analysis 13-0-0. The other two components of the typical fertilizer phosphorous and potassium were not present in the Blood Meal. Nitrogen in fertilizer is used to help increase plant height. According to the law of minimum the increase in plant height greatly depends on the percentage of nitrogen the fertilizer contains. The law of minimum states that the yield of the plants is determined by the factor that is most limiting nutrients in the plants. In this investigation the law of minimum did not occur because there was no significance in growth. I believe the reason that no significant growth occurred is that legumes produce high quantities of nitrogen through the air and water. Thus, an additional application of nitrogen made no significant difference in growth. The low concentrated fertilized pea plants did not have a significant amount of growth according to my t-test calculations ($t=0.442$; $P< 0.1$). The high concentration variable had no significant results according to my t-test calculations ($t = 0.226$; $P< 0.1$).

2792

THE EFFECTS OF SODIUM NITRATE ON *EUGLENA.*

Natalie Bonjoc and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Dr., Sacramento, CA 95831.

In this lab experiment the effects of 2% sodium nitrate on the population growth of *Euglena* were tested. Over a period of five days the number of *Euglena* were counted in random samples taken from cultures that contained 2% sodium nitrate solution and cultures that did not contain any nitrates. The data collected suggested that sodium nitrate does increase the population growth rate of *Euglena*, which also means that it increases the rate of cell division of *Euglena*. From statistical calculations, t=2.652, and p 0.01, which meant that the null hypothesis could be rejected. There was a significantly greater number of *Euglena* in the culture containing sodium nitrate than in the culture containing only water.

2793

EFFECTS OF GASOLINE ON SEA URCHIN FERTILIZATION.

M. Sierze, A. Satanapong and B. Vanduzee (teacher). Suagus High School, 21900 Centurion Way, Saugus CA 91350.

This study examined the question of whether or not gasoline would interfere with the sperm-egg fertilization of the *Stronglyocentrotus purpuratus*, a common sea urchin of the west coast. The control for this experiment was the percent fertilization of sea urchins under normal circumstances, which were that the eggs and sperm were incubated for 15 minutes in artificial sea water set at 8.0 pH. Under these controlled conditions, we achieved a 90.3% plus or minus 5%, of fertilization through multiple experiments. We prepared a solution of water and gasoline in a 1 to 500 ratio. We mixed the gas/water solution with .125 milliliters of eggs by way of a pipet set at 12.5 microliters. We waited a short time before adding sperm to the mixture. Unexpectedly, we reached a fertilization rate of 33%. We assumed that a solution this strong would kill all of the sperm or eggs before fertilization could occur; we found that at this level of concentration gas did not completely stop fertilization.

2794

EFFECTS OF BETA CAROTENE ON CAUDAL FIN REGENERATION OF *BETTA SPLENDENS.*

Allen Wong, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

Bettas are one in many kinds of fish that have the ability to regenerate their fins. In my lab, I tested the rate of regeneration of a normal fin versus the rate of regeneration of a fin treated with beta carotene. I first acquired 8 bettas and 10 glass bowls to put them in. Next I cut out a piece of tagboard and arranged it so that the fish could not see each other from their bowls. This helped because the fish could no longer see each other. This lowered their activity rate and allowed them to save their energy. The fish were allowed to live in room temperature (68°F). A fish was then taken out of its' bowl and placed in a sterile petri dish. After a few seconds, the betta would lie still in the dish. I measured the full length of the tail. Then I measured 1 cm from the end of the tail to the middle. After sterilizing the razor in alcohol and letting it air dry, I cut the fin. When doing the experiment section, I used the same methods with the experimental fish. However, after I sterilized the razor, I dipped it in beta carotene and then made my cut. Then I spent every other day placing a fish in a petri dish and taking measurements. Unfortunately, my hypothesis was incorrect. Beta carotene does not have an effect on the regeneration rate of the tail fin of the *betta splendens*. The average rate of growth for every two days was 0.2 cm. For the untreated fish, the average total regenerated growth was 0.6 cm. The fish treated with beta carotene yielded an average total growth of 0.58 cm. The minor difference in the average tail lengths show that beta carotene is ineffective for regeneration.

2795

COLOR PREFERENCE OF *DROSOPHILA.*

Kevin Chan and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This lab was designed to test if *Drosophila* had color preference, either as a whole or individually. The colors of light used to test the preference where red, blue, green, and clear. When testing color preference as a whole the *Drosophila* were placed under a petri dish that was divided into four quadrants each covered with cellophane of one of the selected colors. The *Drosophila* where allowed to roam for 2 minutes and then the quadrant it ended up in was recorded. After 60 trials the. data was analyzed using statistics. The statistics showed that *Drosophila* prefered green and clear light the most ($p < 0.001$). When testing individual color preference the same method was used but instead of testing random *Drosophila* picked from a sample, single *Drosophila* were tested separately. Each individual *Drosophila* was tested 10 times. The statistics were not clear in showing if *Drosophila* had individual color preferences but when compared as a whole it showed that they once again preferred green light ($p = 0.05$) In conclusion, I can state that *Drosophila* prefer green light, they also are attracted to clear light but that is probably because it has green light in it.

2796

THE ENVIRONMENTAL FACTORS AFFECTING THE HEALTH OF JONES CREEK

M.K. Baker, K.S. Marois, and M.C. Barlow (teacher). Smithfield High School, 14171 Turner Drive, Smithfield, VA 23430.

The purpose of this project is to determine the environmental health of Jones Creek at the Nike Park pier and establish a set of data for comparisons for future Environmental Science classes. The methods we used are once a month from September 1998 to January 1999, using chemical water tests, we took samples of and analyzed them to determine dissolved oxygen, carbon dioxide, salinity, pH, phosphates, nitrates, turbidity, and silica. We also observed surrounding land use and noted its impact on the quality of Jones Creek. Weather observations were made and recorded as well as visible flora and fauna. Surrounding land use was observed, as well as river use. A set of data was established showing water quality for fall months. Weather conditions were recorded and plant and animal species were taken note of. Surrounding land use was recorded. Ninety-eight percent of the data was collected. We established a better understanding of the surrounding land use. The water appears to be in a state of health based on the apparent presence of plant and animal species and also on observations made of the river.

2797

EFFECTS OF *AGROBACTERIUM TUMEFACIENS* ON TISSUE OF TOMATO PLANTS.

Xuan (Diana) Yu and Steve DeGusta (teacher). John F. Kennedy High, 6715 Gloria Dr., Sacramento, CA 95831.

The principle objective of this experiment was to test the effects of *A. tumefaciens*, a tumor inducing bacterium, on the tissue of tomato plants. Since the bacteria affects dicotoledon plants, I used 20 tomato plants. Wounding their stems with a sterile needle, I infected the 14 plants of the experimental group with *A. tumefaciens* at their wounds. Over 41 days, 7 plants of the experimental group died. Of the remaining 7, 5 showed signs of tumor growth: brown stains, lumps that swelled the stem, and tissue protubering out from the surface of the stem. From my control group, 2 plants died. The wounds of the rest healed during the experimental period. I measured then calculated the differences between the original and final circumference of the plants' stems at the wound sites. Comparing the differences obtained in the experimental group vs. that of the control group,

t-test showed a significant difference, t = 3.88 p = 0.01, indicating *A. tumefaciens* had a significant effect on the tissue growth of the tomato plants. However, statistical comparison between the areas of the wounded sites on the two groups showed no significant difference, t = 1.12 p = 0.1, indicating *A. tumefaciens* didn't affect the healing rate of tomato plants. After taking into consideration the distortion presented to my statistical calculation by the 2 experimental plants that didn't react to *A. tumefaciens*, I conclude that *A. tumefaciens* had an effect on the tissue growth of tomato plants.

2798

EFFECTS OF BORIC ACID AND AMMONIUM SULFATE AS A GROWTH STIMULANT FOR PEA PLANTS.

Brandon Shibata and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This series of experiments tested the effects of boric acid and ammonium sulfate on *pisum sativum*, or the common pea plant. Trace amounts of boron found in the form of boric acid as well as small amounts of nitrogen found in the form of ammonium sulfate are necessary for plant growth. Vermiculite was used as a soil substitute as it does not contain the nutrients plants need to grow. To test the hypothesis that boron and nitrogen will increase the height of pea plants, control plants were watered with tap water and one group of experimental plants was watered with a 3ppm boric acid solution while two other groups were watered with 7ppm and 1 g/gal ammonium sulfate solutions. Observations were taken over a ten day period, and it appeared that the experimental groups were healthier and taller than the control group. The experimental groups appeared to have greener leaves and stronger stems than the control group. The t-test showed that the 3ppm solution and 7ppm solution did not significantly increase the growth of pea plants (t=1.832 p=.1 & t=1.250 p=.1 respectively). The difference in growth between the experimental groups and control group was due only to chance. However, the 1 g/gal solution did significantly increase the height (2.845 p=.01). The results showed that only the 1 g/gal solution significantly increased the height of pea plants.

2799

EFFECTS OF SODIUM CHLORIDE ON *ALLIUM CEPA* AND WANDO PEA SEEDS.

Rebecca Fong and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

As ocean saltwater slowly makes its way into subterranean freshwater supplies (the result of overpumping water for agriculture), the land becomes salt-affected: resulting in lower production. To directly observe the effects of saltwater encroachment, implement hydroponics to reduce tangent factors such as soil salinity. Grow the onion bulbs (*Allium cepa*) and wando pea seeds in a 0.03 M NaCl solution (half the ocean's salt content) to simulate a saltwater-encroached estuary. Measure data by counting the number of roots growing from bulbs and seeds as well as the length of those roots. It was confirmed that both bulbs and seeds growing in distilled water grew more roots than the bulbs and seeds growing in NaCl solution (t=1.19, p=0.10). In addition, the bulbs and seeds in distilled water grew deeper roots than the bulbs and seeds growing in NaCl solution (t=2.60, p=0.05). The concentration of sodium and chloride molecules outside the bulb and seed cells exposed to 0.03 M NaCl solution is higher than the concentration inside the cells. So water diffuses out of the cells, causing shrinkage. The same phenomenon occurs in every cell to create a chain reaction and retard root growth. But the universal conclusion is that both the onion bulbs (*Allium cepa*) and the wando pea seeds are still viable.

2800

DO DIFFERENT WAVELENGTHS AFFECT THE HEIGHT OF COWPEA PLANTS?

Greg Fujii, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this study was to determine if different wavelengths would cause a difference in the height of *California Black-eye Cowpea* plants. Four boxes, each containing ten planted seeds, were covered with a different colored cellophane. The colors used were: red, blue, green, and clear. Plants most commonly absorb the red and violet wavelengths, while the green wavelengths are reflected back into the air. The wavelengths (light) provide the plants with energy to carry out the growth process through photosynthesis. Since the green light would be reflected back into the air, the plants covered by the green cellophane should have the least amount of growth, and should appear the smallest in height. The group under the clear cellophane (control group) grew the tallest because it was exposed to the full spectrum of light, while the blue and red covered plants were slightly shorter because they were exposed to only one specific frequency wavelength. There was a significant height difference between the green covered plants and the others due to the lack of energy being provided for the photosynthetic process and because this process occurred less frequently.

2801

EFFECTS OF ACIDIC WATER AND SOIL TYPES ON COWPEA PLANTS.

Jonathan Quok and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

One of the many ways acidic water can harm plants is through the soil system. Once the soil pH reaches a certain level, metals are released from the soil system that are poisonous to most plant life. Every soil has a different buffering capacity, or the ability to resist changes in pH. In this investigation, the relationship between acidic water, soil types, and their effects on the growth of California Blackeye Cowpeas was observed. Sixty plants were grown all together, and were split into a control group that was watered only with ten milliliters of distilled water, and into a second group that was treated with ten ml of an vinegar/water solution of pH 4. Each group contained ten plants planted in three soil types: Sacramento clay, Columbia sandy loam, and potting soil for a total of thirty plants in each group. Every other day, each plant was treated with either ten ml of distilled water or pH 4 solution, depending on which group it was in. After 9 days of growth and treatment, I found that the difference in growth between the Columbia sand loam plants and the potting soil plants was due to chance ($p<0.1$), and the difference between the growth of the Sacramento clay and the potting soil was significant ($p<0.01$). The plants in the Sacramento clay had the highest average growth rate in the acid group, just as I had hypothesized.

2802

THE EFFECTS OF CAFFEINE ON *DUGESIA TIGRINA*.

Yuki Yamamura and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this lab, the effects of caffeine were tested on *Dugesia tigrina*, a species of planarians, to see what alterations caffeine made on the regeneration rate of planarians. First I made two groups which consisted of ten planarians each. In the control group, each of the ten planarians was placed in an individual petri dish which contained 10ml of dechlorinated water (tap water that had been left alone for two to three days to allow the chlorine to evaporate). Correspondingly, in the experimental group each of the ten planarians was placed in an individual petri dish. Each of the ten petri dishes in the experimental group contained 10ml of water with a caffeine concentration of 0.01 mg/ml. The planarians in both groups were cut horizontally above the pharynx after

a period of two days. This time was needed for the experimental group to allow the caffeine to settle in their bodies. The control group was observed and measured for eleven days; the experimental group was observed and measured for nine days. The regeneration rate of a planarian was determined by, dividing the total length the planarian grew from the day it was cut to the day it regenerated completely, by the number of days the planarians took to regenerate completely. This calculation was done for each planarian and the average was taken for each group: the control and the experimental. Statistical calculations showed that caffeine did not create any effect on the regeneration rate of planarians ($t = 1.74$, $p>0.1$). The caffeine did not increase or decrease the regeneration rate of planarians as I expected.

2803

THE IMPORTANCE OF DECOMPOSITION IN PLANT GROWTH.

Jeffrey Lai and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment examines the importance of decomposition by bacteria in providing nutrients for Violet plants. Two groups of twelve Violet plants were formed. They were initially kept in separate 8X8 cm pots with standard potting soil. Each group was grown with and without a special compost mixture. Both groups shared the same basic soil base, which consisted of an even mix of gravel and wood chips. The first group of plants, which served as a control, were grown in this soil base. Experimental plants were grown in an even mix of the soil base and a compost. The compost was largely a mixture of leaves, dried plants, hay, and fresh grass. A small amount of rice, shreds of turkey, and diced orange peels were mixed in as well. Both experimental and control soils were watered daily and allowed to decompose for six days. The Violet plants were then removed from standard potting soil, washed to remove any remaining soil particles, and finally planted in the control and experimental soils. The plants were then watered every other day with 1/4 cup of water. After twelve days the final differences in the number of live plants favored the experimental side with eleven alive versus only one alive in the control group. These results were determined to be significant according to X^2 test ($X^2= 16.67$, $p<0.001$). This suggests that bacterial decomposition plays a key role in providing nutrients for plants.

2804

EFFECTS OF ULTRAVIOLET RADIATION ON BEAN SEED GERMINATION.

Maximilian Y. Moy and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to see if the seed coat and cotyledons protected the embryo of a bean seed (specifically the plumule, hypocotyl, and radicle) from ultraviolet radiation. A total of 360 bean seeds were used in this experiment. They were separated into groups of 10 seeds over 36 plates (18 experimental, 18 control). The control and experimental plates were then separated into 3 subgroups consisted of: one with the seed coat removed, one with the cotyledons and seed coat removed, and both the seed coat and cotyledons intact. The experimental plates were exposed to UV radiation for 1 minute at ≈250nm. The seeds were let to germinate for 3 days. Successful germination was defined as 15mm of radicle growth. Of the experimental plates, 70% of the seeds with the seed coat removed germinated, 63% with the seed coat and cotyledons removed, and only 30% of the intact seeds germinated ($\chi^2 = 28.6$, $p<0.001$). For the control plates, 93% with the seed coat removed germinated, 88% with the seed coat and cotyledons removed, and 70% of the intact seeds germinated ($\chi^2 = 209$, $p<0.001$). These results suggest that that seed coat and cotyledons did not have a significant effect in protecting the embryo from UV radiation. The results also imply that the seed coat itself is somehow affected by UV radiation.

2805

HALTING THE HEIGHT OF THE HEDERA IVY VINE.

Sheryl Christina Chow and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment, I used Roundup Ready-To-Use and applied it to the soil of Hedera Ivy, hoping for effects of restricted height growth while keeping the plant healthy and alive. The Hedera Ivy Vine, along with many other vines are often overgrown and tend to choke trees once turning arborescent. Glyphosate, a nonselective herbicide kills plants when applied to the foliage. I wanted to test whether Roundup would stunt the vine's height when applied to the soil. Each day, Roundup was added to three groups of three plants at different concentrations. Two control plants were given only tap water. After nine days, the dosage of Roundup was increased in the experimental plants as no significant height change resulted. After nine more days of the increased dosage, once again no significant height difference resulted between the control plants and those to which Roundup was applied. In the experimental plants to which the highest concentration of Roundup was added, a slight health decline was noted but was not significant. I can therefore conclude that no significant height difference results due to the addition of Roundup in the soil of a plant. Additional plants were used in the middle of the lab to test extremely high dosages of Ready Roundup and Roundup SuperConcentrate. The plants to which these products were applied reacted much more quickly and steadily declined in health. The height did decrease along with the health, but was a direct result of shriveling and droopiness of stems and leaves. Although these plants to which higher concentrations of Roundup was added were affected, the results did not restrict the growth of the vine without harming the health.($P>.1$)

2806

INHIBITING THE GERMINATION OF CHERRY BELLE RADISH SEEDS USING PINE NEEDLES AND PINE NEEDLE ASHES.

Keith Masuda and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This was a two part experiment aimed at proving the benefits of a technique foresters use called prescribed burning. In the first part I investigated the inhibition of germination of radish seeds when exposed to dead pine needles. In five experimental petri dishes I placed 10 seeds and 10 pine needles that were divided into thirds. There were also five control dishes that contained 10 seeds each. The seeds were observed at 24 hour intervals for any signs of germination. After three days I was able to conclude that there existed an unknown variable that did inhibit the germination of the radish seeds ($p<0.001$). In the second part of this experiment I investigated the effect of ashes of dead pine needles on the germination of radish seeds. Ashes were placed in the experimental petri dishes along with 10 seeds. Control dishes were setup as in the first part. The dishes were monitored at 24 hour intervals and I found that the ashes had no effect on the germination of the radish seeds ($0.9<p<0.5$). The unknown variable found in the first part was eliminated in the second part. Therefore prescribed burning is effective. There are some candidates for the unknown variable. The inhibition could be due to tanic acid which is found in the waters of many forests as a result of decomposing vegetation. Also it is possible that the pine needles were not completely dead and took in oxygen and produced harmful carbon dioxide that suffocated the seeds. More accurate tests could be done in a more natural environment where the temperature, amount of water and light, and different seeds could be used.

2807

EFFECT OF THE AERATION OF THE SOIL ON *PISUM SATIVUM* PLANTS.

Marisa Takeuchi and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, California, 95831.

This study tested whether the aeration of the soil affected the height of pea plants. This study had three trials. For two of the trials, I used Little Marvel pea plants. For the last trial, I used Sugar Snap pea plants. From the first two trials, I concluded that the aeration of the soil had no affect on the height. In the third trial, I used Sugar Snap pea seeds because they would grow taller than the other type. A total of 40 seeds (20 experimental and 20 control) were planted in potting soil. The experimental plants had their soil aerated every other school day. The plants were grown for 14 days and were measured every school day. After observing and recording the heights of the plants, I noticed that there was no difference in appearance between the two groups. The leaves and the stems looked the same. It turned out that there was an insignificant difference between the two groups of plants ($t = 0.07$, $p < 0.1$). The aeration of the soil did not cause a noticeable increase in height of the pea plants.

2808

THE EFFECTS OF ZINC ON *RHIZOBIUM* BACTERIUM.

Xiao Feng Shi and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In a series of two experiments, I tested the effects of zinc on *Rhizobium*, a bacterium that can transform nitrogen gas (N_2) into ammonia (NH_3^+), an essential element for the development of protein for plants. Since *Rhizobium* cannot withstand high concentration of metallic ions, I hypothesized that if zinc causes negative effects on *Rhizobium*, then the growth rate of pea plants will decrease. I planted 44 wando pea plants. The control group of 22 pea plants were watered with tap water and the experimental group of 22 pea plants were watered with zinc mixed water (2.0% concentration). The heights of the pea plants were measured for 9 days after they were planted. The pea plants in the experimental group grew significantly shorter than the ones in the control group ($t=2.89$, $0.01>p>0.001$). A second experiment was done to further investigate my hypothesis by testing if zinc decreases the growth rate of *Rhizobium*. Using the pour plate method, the bacterium was grown on a control group of 10 nutrient agar dishes and an experimental group of 10 zinc nutrient agar dishes (2.0% concentration). The number of bacterium colonies on each petri dish was counted for 3 days. The result showed no significant differences between the number of colonies in nutrient agar dishes and that in zinc nutrient agar dishes ($t=0.03$, $p>0.1$). This indicated that the difference in heights of the pea plants was not caused by zinc damaging the growth rate of *Rhizobium*. However, zinc could have altered other biological characteristics of *Rhizobium*. Therefore, I conclude that my hypothesis is subjected to further experimentation.

2809

THE EFFECTS OF ULTRAVIOLET LIGHT ON YEAST CELLS.

Shelley Taketa, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this investigation, I tested if ultraviolet light is lethal to yeast. The yeast that I used was a wild strain (FF18733). Using aseptic techniques, I prepared ten petri dishes of yeast peptone dextrose agar (YPD). Then I made four 1/10 serial dilutions to the suspended yeast. I then spread the yeast onto the plates that I prepared. I covered one side of the dish with a double layered index card. Using an ultraviolet lamp I treated the side that was not covered with thirty seconds of light about twelve and a half centimeters away. I then incubated the yeast at 30°C for two days. The sides that were treated by UV light had 57 colonies and the control sides had 148 colonies. With a p-value of less than .001, I can conclude that ultraviolet light is lethal to yeast.

2810

PHOTOTAXIS IN CELLULAR SLIME MOLD, *DICTYOSTELIUM DISCOIDEUM.*

Sia Cha and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of the study was to test if cellular slime mold, *Dictyostelium discoideum* in its slug stage, or psedoplasmodium stage, could exhibit phototaxis, an organism's responds to light. To test this, I prepared two lactose agar plates with *Dictyostelium* present on one side of each plate; one plate, control, was placed in the dark and the other plate, experimental, was covered by a box with a hole on the top of it. The hole allowed light from a lamp to enter the box onto the half of the plate that did not have *Dictyostelium* present. The slugs in the experimental (light) plates should migrate toward the light and in the control (dark) plates the slugs should stay relatively where they are. To show that the slugs just didn't go to the other side by chance, a line was drawn on the plate dividing it in half, and if the slugs crossed that line in the experimental (light) plates than it was because of the light. In the control (dark) plates the slugs shouldn't cross the line and if they did, it was by chance only. My results showed that there were a total of 67 slugs in the experimental (light) plates that cross the line dividing the plate to just 14 slugs in the control (dark) plates, therefore I conclude that *Dictyostelium* in its slug stage is phototacic.

2811

EFFECT OF *SERRATIA MARCESCENS* ON THE GROWTH OF *BACILLUS CEREUS.*

Jenn Y. Ogata and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

Allelopathy is defined as any direct or indirect harmful effect by one organism upon the other (Rice 1974). Allelopathy has been observed between different types of plants. I designed this experiment to see if *Serratia marcescens* could inhibit the growth of *Bacillus cereus* and demonstrate allelopathy between organisms. I began by aseptically streaking three control plates of nutrient agar with *S. marcescens* as well as three control plates of nutrient agar with *B. cereus*. Three experimental plates were streaked with both *S. marcescens* and *B. cereus* according to a grid of squares placed under each dish. These dishes were observed and recorded for five days. At the end of the fifth day I checked each square and determined which bacteria was dominant. Measurements were taken and compared. My results revealed that eleven out of twenty-four squares were dominated by *B. cereus* while thirteen out of twenty-four squares were dominated by *S. marcescens*. It was concluded that there was no significant difference in the growth of *Bacillus cereus* when streaked in the same vicinity of *Serratia marcescens* ($p > 0.9$). *Serratia marcescens* did not inhibit the growth of *Bacillus cereus*.

2812

THE EFFECTS OF GREEN TEA ON BACTERIA.

Craig Randall Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment tested the effects of green tea on bacteria. Green tea is known to contain a small amount of catechin, an antibacterial agent, in it. Paper discs were allowed to sit in green tea for 24 hours before applying them to plates of *E. coli* in nutrient agar. The bacteria were allowed 24 hours to incubate. After observing the bacteria, it was found that regular strength green tea has no significant effects on *E. coli*. To determine whether errors in technique affected the outcome of my results, the experiment was repeated with double strength green tea and *B. cereus* instead of *E. coli*. After repeating the experiment, however, it was found that double strength green tea does not have antibiotic effects on *B. cereus* ($T=1.48$; $P=1.48<2.074$).

2813

THE EFFECTS OF WAVELENGTHS ON PLANT GROWTH.

Elaine M. Wong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to determine if the *Gymnospermae* (pea plants) grown under white light would attain greater heights in comparison to those grown under red or blue light. I believed that *Gymnospermae* would grow best under white light because they would benefit from both the effective red and blue wavelengths. I grew a group of ten *Gymnospermae* under white light, red light, and blue light. I grew these plants in an enclosed chamber to reduce variables such as temperature. I created red and blue lights by covering a light bulb with a sheet of red cellophane and by covering another bulb with a sheet of blue cellophane. I found that white light did not produce a significant increase (chi square test: $p>0.1$) in the heights of the plants grown under white light. The minor difference in these heights was due to chance alone. I performed a second experiment to check the results of my first experiment. I once again found that white light did not produce a significant increase in the heights of the plants. While the three groups of *Gymnospermae* attained similar heights, the average height of a plant grown under red light was greater than the average height of a plant under white or blue light. By performing these investigations, I conclude that plants do not grow significantly better under white light; plants grown under red or blue light are not deprived of effective wavelengths. While white light benefits from both red and blue wavelengths, red or blue light benefits from a concentrated amount of a single effective wavelength.

2814

THE EFFECTS OF AMINO ACIDS ON PEA PLANT GROWTH.

Jared Ahmad Lee and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this investigation I tested whether the addition of arginine to a plant's water supply would precipitate a significant increase in the height of wando pea plants. I planted a total of 24 plants (12 experimental, 12 control) in potting soil. Unfortunately, eight of the plants never sprouted and one plant eventually died, so I was left with a sample size of seven experimental plants and eight control plants. I grew the plants for 21 days and measured them daily. I gave the control-group plants 2.5-ml of water per day, and the experimental group received 2.5 ml of water with a concentration of 500 mg per liter of arginine. The experimental plants seemed to be taller, thicker, and leafier than the control plants. It turned out that there was a significant difference between the two groups of plants ($t=3.4$, $p<0.01$). The average height of the experimental group plants was 156.4 mm, while the average height of the control group plants was 119.4 mm. From the results it can be said that the arginine caused a notable increase in the growth of the pea plants. Arginine causes the release of growth hormones within an organism. In this case, the arginine probably caused an increase in the amount of the growth hormone that was released. In addition, it probably promoted individual cell growth within the plant.

2815

AMYLASE PRODUCTION: BACTERIA VS. FUNGI.

Lani A. W. Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In the first of two experiments, I studied whether the amount of amylase produced by bacteria and molds is related to their biological classification. I aseptically prepared nutrient agar dishes + 2% starch. I scraped the surface of a decaying orange with an inoculating loop and streaked the loop onto nutrient agar + 2% starch dishes. As a control, I spotted *Bacillus subtilis*, a known amylase producer on a separate dish of nutrient agar

+ 2% starch. I observed the bacteria growth and the surrounding halos after two days of incubation at 37°C. I observed the fungi growth and the surrounding halos after four days of incubation at 37°C. Since the area of the halo surrounding the bacteria colonies and molds is proportional to the amount of amylase produced, I measured the diameter of the halo that surrounded the bacteria colonies and molds. There were halos, which ranged in diameters, surrounding 13 colonies of bacteria but there were no halos surrounding 2 molds. My prediction that bacteria would produce more amylase than molds was supported by the results of the investigation ($0.01<p<0.05$). I concluded that amylase production is most likely related to the biological classification of the organism. In the second experiment, I investigated whether glucose would inhibit the amount of amylase produced by *Bacillus subtilis*. I aseptically prepared 4 nutrient agar tubes + 2% starch. I added 0.5 grams of glucose to 2 of the tubes. I poured the contents of the tubes into 4 separate petri dishes and streaked each with *B. subtilis*. I measured the length of the radiuses of the halos surrounding the bacteria after 2 days of incubation at 37°C. I measured halos, which indicate the amount of amylase produced, surrounding 10 areas on the control plate and 10 areas on the experimental plates. My prediction that glucose would inhibit the amylase production of *B. subtilis* was disproved by the results of the investigation ($p>0.1$). I concluded that glucose does not inhibit the amount of amylase produced by *B. subtilis*.

2816

THE HEALTH OF THE PAGAN RIVER.

G.B. Mercer, J.R. Stagg, M. Barlow (teacher). Smithfield High School, 14171 Turner Drive, Smithfield, VA 23430.

The purpose of our study of the Pagan River was to determine the health of the water from the month of September 1998 to the month of January 1999, to pinpoint any problems that may cause the river to be unhealthy, and to establish a set of data for future comparisons. The research was conducted on several different dates on which we traveled to the Smithfield Boardwalk on the Pagan River. Once we arrived we proceeded to conduct tests on the water. These tests included: water temperature, dissolved oxygen, carbon dioxide, salinity, pH, phosphate and nitrate tests, turbidity readings and silica tests. We also recorded the weather factors at the site on each occasion. We recorded the plant and animal life that we found in and around the river during each visit. We conducted these tests five times over a four month period from September 1998 to January 1999 and then analyzed our data to reach our conclusions. We determined the use of the land around the river as well as the uses of the river, such as boat traffic and recreation. Our physical data was used to determine the health of the river. We established a set of data for future comparisons and determined that the river is in relatively good health.

2817

EFFECTS OF ULTRAVIOLET LIGHT ON THE REPRODUCTION OF *EUGLENA GRACILIS.*

Laurie Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment of two trials, I was investigating if ultraviolet light decreases the amount of green *euglena* reproduced. Two populations of *Euglena gracilis* were used in each trial; one was exposed to ultraviolet light and the other was left unexposed. In the first trial the exposed population was exposed for three hours over an eight day period. After counting and averaging the number of *euglena* per drop in each population, I found that the number of UV-exposed *euglena* per drop was much lower than the number of unexposed *euglena* per drop. This strongly supports my hypothesis that ultraviolet light decreases the amount of reproduced, green *euglena* (chi-square test, $p<0.001$), To verify the results of the first trial, the second trial was conducted, but more care was taken to make the initial population sizes the same and to rule out any other variables. In the second trial, the exposed population was exposed for two and a half hours over a five day period. After

counting and averaging the number of *euglena* per drop, I found that the number of exposed *euglena* was not significantly different from the number of unexposed *euglena* (chi-square test, $0.9<p<0.5$); this shows that ultraviolet light does not decrease the amount of reproduced, green *euglena*. The results of the second trial show that the results of the first trial were due to the difference in size of the populations, and shows that ultraviolet light does not decrease the amount of green *euglena* reproduced.

2818

MEMORY, TRANSFER IN PLANARIANS.

Jonathan B. Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment is the final of three involving planarians and the learning process. In my previous investigation I attempted to train a planarian (*Dugesia dorotcephala*) to turn right at the rate of at least 80% by giving it a negative stimulus of electric shock. I used a Y-shaped maze and a 6V battery to administer the shock. Although the planarian only turned right at the rate of 74%, the training was still considered to be successful. In this experiment I cut the trained planarian from my previous investigation into fragments and fed the fragments to five new planarians. A control group was fed fragments of an untrained planarian. After eating the trained planarian fragments, I ran the new planarians through a Y-shaped maze 100 times each to see if they would retain the trained planarian's memory through cannibalism and turn right at the rate of at least 74%. On average, the five planarians turned right 79% of the time. The observed data was inconsistent with the expected data. The planarians turned right more times than expected. I would not expect to get this type of variation between the observed and expected by chance. Therefore, the variation is due to the eating of the original trained planarian. The planarians retained the memory of the trained planarian through cannibalism.

2819

EFFECTS OF MOTOR OIL ON *VIGNA SINENSIS UNGUICULATA* SEEDLINGS.

Alice B. Chen and Steven DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this experiment, I wanted to investigate the inhibition of growth of *Lawn & Garden* California blackeye cowpea, *Vigna sinensis unguiculata* seedlings when exposed to a mixture of 2% Chevron SAE 10W-30 motor oil and potting soil. Rain causes the motor oil on roadways and parking lots to wash into the soil and eventually ocean. The purpose was to see if low levels of motor oil would effect the vertical growth of the seedlings. The low levels of motor oil would reflect a real case scenario of the run off of motor oil from roadways and parking lots. When oil is exposed to plants it blocks the pores and prevents proper intake of nutrition, therefore preventing proper growth of the seedling. To test my hypothesis I planted cowpea seedlings in a mixture of 2% Chevron SAE 10W-30 motor oil and potting soil and plain potting soil. After measuring the plants from the surface of the soil, along the stem, to the first leaves, for eight days, this experiment showed that the pollution of 2% motor oil in the soil does not effect the height of cowpea seedlings ($p>0.1$).

2820

THE EFFECTS OF CAFFEINE AS A STIMULUS ON THE MOVEMENT OF *EUGLENA.*

Jason Eng and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

My experiment was designed to determine if caffeine has an effect on the movement of *euglena acus*. My basis for this experiment was that caffeine affects people making them more aware of things. So I decided,

along with the consultation from my teacher, to use *euglena*. I coated the bottoms of two petri dishes with samples from the *euglena* culture. I added "Water Joe," a caffeinated water product, to one of the dishes. "Water Joe" contained 60 grams of caffeine to 500 ml of water. *Euglena* are phototropic so I used a lamp to manipulate them to go to from one place to another. I used a piece of 2 x 2" black construction paper and I cut a small slit about 2 mm long and 25 mm wide near the center of the paper. The paper was placed on top of the petri dish. I hypothesized that because *euglena* like light and they have green pigmentation, then would form a green colored band. After a band was obtained, I moved the paper over about 5 mm and recorded the time it took for the *euglena* to move from one place to the other. Between the two dishes there was no noticeable difference in time for the movement of the *euglena*. I was able to conclude that caffeine did not have any observed effects on the *euglena*.

2821

ANGLE OF STEM GROWTH ON RADISH SEEDS INDUCED BY CENTRIFUGATION.

Bruce Chien and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

Early scarlet globe radish seeds were grown on a record player spinning at 33.33 rpm to see the effect of centrifugation on seeds. The seeds were placed at 1.38cm (represents 0.1 G), 5.9cm (0.5 G), and at 13.8 cm (1 G) from the center. The radish seeds that were placed farther from the center experienced greater centrifugal force. The radish seeds experienced vector forces of gravity at a new vector force of angle. The problem is to see if the stems of the radish seeds will grow according to the vector forces generated by the centrifugation. The equation used to find the radius for the amount of G force was $r = 1.41 \times 10^{-2} g$ where g is the gravitation. This tells me the amount of G force the seeds will experience at certain distance. The control was one set of seeds on the counter not spinning with the same amount of light as the experimental. After growing the seeds I measured the angle of the stems toward the center of the record and compared the resulting angle with the predicted angle of growth. The results resembled what I had expected, for the seeds experiencing 1 G to bend at 45° and 30° for 0.5 G. Most of the stems moved towards the angles that I had predicted. The differences of data in control and experimental were not due to chance ($p > 0.1$). I concluded that centrifugation on radish seeds does bent the stems at a predictable angle.

2822

EFFECTS OF CIGARETTE SMOKE ON BRINE SHRIMP.

Tiffany Lieuw and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this investigation I worked with the *Artemia* species, more commonly known as brine shrimp. I subjected the brine shrimp to second hand smoke to see the effects of cigarette smoke on organisms. Using the top part of a 2-liter bottle, taped to an ashtray, with a syringe covering the opening of the 2-liter bottle, I inserted a lit cigarette on the side of the ashtray where there was an untapped opening. The syringe was used to collect the smoke; then I slowly injected the smoke onto a concave microslide where ten experimental brine shrimp swam. Within three minutes, some brine shrimp began to curl up, while other shrimp chased their tails in a circular motion. Other brine shrimp reacted to the cigarette smoke by rapidly twitching and beating their trunk limbs. Eighty-eight out of one hundred shrimp reacted to the smoke in the experimental group, while only twenty-one of the control group reacted. The reaction to the smoke could have been due to the lack of oxygen when the cigarette smoke was placed into the water where the brine shrimp swam. There is a highly significant difference between the brine shrimp exposed to the second hand smoke and those that were not, which could possibly be due to the smoke from the cigarette. ($p \leq 0.001$)

2823

EFFECTS OF COBALAMIN ON THE REGENERATION OF PLANARIANS.

Vincent W. Chan and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this investigation, cobalamin (known also as vitamin B_{12}) was fed to planarians to determine whether or not it has any effects on their body length after regeneration. Planarians were submerged in a solution that consisted of a concentration of 35 mg per 1L of Pond H_20 (3.5% concentration). After 2 days, the planarians were cut in half and allowed to regenerate. The results obtained were interesting. The planarians placed in the vitamin B_{12} solution did not regenerate faster, however they did appear to regenerate shorter. This could possibly imply that the cut wounds were healed faster, not allowing the planarians' bodies to grow. The average difference of length from the first day (the day the planarians were cut) to the final day (the day the planarians were fully regenerated) of regeneration of the posterior ends in the control group was 0.121 mm. The average difference of the length from the first day to the final day of the posterior ends of the experimental group was 0.057 mm. It is possible that the vitamin had closed the cut wounds of the planarians faster, therefore not allowing them to grow longer. From my statistical calculations, a probability (p) value greater than 0.1% was obtained from both the results of the posterior portion of the planarians as well as the anterior portion. From this analysis, I am able to conclude that my results were not do by chance, but there is, in fact, a correlation between vitamin B_{12} and the regeneration of planarians.

2824

AN ALTERNATIVE BACTERIUM PESTICIDE INSTEAD OF BT.

Kenny Inaba, Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of my experiment was to find an alternative bacteria pesticide due to BT resistant insects. I used aseptic techniques to isolate the bacteria *Photorhabdus luminescens*. After I would have fed that bacteria to root worms to see if the bacteria can be used alone as a pesticide. *Photorhabdus luminescens* is a bacteria that come from the gut of a nematode during it's infestation period. However in this experiment I had found that the isolation process was impossible because I could not make an agar with only the bacteria in it. I always got a slant with the bacteria *Photorhabdus luminescens* and an unknown mold, The mold grew faster than the bacteria and would usually consume the agar. I did however manage to identify and obtain a small amount of the bacteria which I used to infect 4 of the 5 root worms I was supposed to infect. The last did not get infected so I just made a bigger control and a smaller sample. Out of the four slants made only two of them had grown the bacteria *photorhabdus luminescens*. The toxin inhibits feeding in addition to being toxic to a broad range of insects, making it a potentially powerful new tool in the fight against crop-destroying insects. After I had applied the bacteria to the root worms diet and recorded the results. All of the worms that were infected had died. That is a 100% killing rate. In the conclusion the bacteria did it's job but I will never know if it was the bacteria or maybe the mold that grew near the *photorhabdus luminescens*.

2825

THE EFFECTS OF MAGNESIUM SULFATE AND MOVEMENT ON DUCKWEED.

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Plants need a variety of nutrients to survive and be healthy. Magnesium plays an important role in photosynthesis and is the central element in the plant structure chlorophyll. Sulfur is important to plant growth, since it acts as a coenzyme. The plant duckweed (*Lemnaceae*) is a small, floating, aquatic plant that reproduces in the number of leaves and plants rapidly. By cultivating duckweed in a 1% magnesium sulfate solution, there should be an increase in the amount of chlorophyll, increasing the rate of photosynthesis, and thus inducing more leaf growth. These plants were compared to a control that was cultivated in distilled water. The remaining factors (light, amount of water/solution, temperature) were all kept equal and monitored. Each day the number of leaves, and plants were counted. Over a period of 17 days, 18 leaves grew in the control and only 1 leaf grew in the magnesium sulfate solution. The amount of change that occurred was not due to chance variation but rather the magnesium sulfate ($p>0.001$). A possibility for this result could be the amount of movement the plants encountered during the experiment. Since the plants are movement sensitive, I tested to see if this was true. With a template of the size of the container, I measured 1 inch above and below the top and bottom of the containers, and shook the containers with the plants for one minute every other day. After about 15 days, the containers that were shaken grew 29 leaves with 2 plants emerging, while the containers that were not shaken grew 28 leaves. The small difference that occurred in the number of plants and leaves were all due to chance ($p<0.5$ for leaves and $p>0.5$ for plants). Possible reasons for the results could be that the plants were not shaken hard enough, or they possibly were not shaken for a long amount of time.

2826

EMF AND CELLULAR REPRODUCTION.

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The purpose of this investigation was to determine if magnetic fields have an effect on the cellular reproduction of *E. coli* bacteria. *E. coli* bacteria colonies were placed under powerful low frequency magnets and allowed to mature for several days. A 1/2 inch paper grid was placed behind each dish and colonies were positioned in squares on the grid that were effected by the magnetic field. After several days the approximate diameter of each colony was measured in millimeters. A control group of colonies were placed under rings of metal to create similar laboratory conditions. Upon statistical analysis of the collected data it was found that there was no significant difference between the control and experimental colonies. ($P>.01$)

2827

THE EFFECTS OF TEMPERATURE ON THE FEEDING BEHAVIOR OF *SERPAE TETRAS.*

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This lab investigated whether *Serpae Tetras* were more aggressive in 20°, 24° or 30°C water tanks. Two *Serpae Tetras* were placed in each of the three tanks, fed flake food and then five Gold Comet feeder fish. Each night *Serpae Tetras* were fed flake food and their reaction towards the five Gold Comets, which were fed afterwards, was charted to test their behavior. The experiment was repeated three times rotating the *Serpae Tetras* from tank to tank. The results showed that the *Serpae Tetras* were more aggressive towards the Gold Comets in the 30°C tank than in the 24 or 20°C tank by attacking, nibbling and harassing them. We found that water temperature does effect how the *Serpae Tetras* behave.

2828

A DEMONSTRATION OF THE EFFECTS OF FEEDBACK INHIBITION ON *ESCHERICHIA COLI* AND *PENICILLIUM NOTATUM.*

Jonathan Wang and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

This experiment was aseptically conducted in two phases. The first phase was intended to test the effectiveness of the branch chain amino acids L-Isoleucine, L-Valine, and L-Threonine in controlling threonine deaminase in *E. coli* through feedback inhibition. The amino acids were dissolved and applied to disks which were in turn applied to pour plates of *E. coli*. The amino acids were completely unable to kill the bacteria off. There was, however, an omnipresence of molds on the plates. The second phase investigated this phenomenon by dissolving amino acids and applying them to disks which were in turn applied to streak plates of *P. notatum*. The amino acids aided the growth of *P. notatum* and possibly *Bacillus cereus*.

2829

THE SHORT TERM EFFECT OF INCREASED TEMPERATURE ON *DAPHNIA MAGNA* TREATED WITH VITAMIN C.

Kimberly May Fong and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

There have been many "heard-of" uses for vitamin C, one which is that vitamin C helps guard against stress to the heart. Testing vitamin C on induced stress to *Daphnia magna* to see if the vitamin C would reduce their heart rates was the purpose of my investigation. In a preliminary experiment, I found that a .01% dosage of vitamin C was not harmful to the *Daphnia* in killing them or slowing down their number of heartbeats per minute, so I then proceeded with my experiment. A group of *Daphnia magna* was placed into a .01% vitamin C solution two days before collecting data on their number of heartbeats per minutes. This group along with a control group living in spring water were heat shocked in 26°C water (a 5°C increase from room temperature) for one minute to stress their hearts. I hypothesized that the group in the .01% vitamin C solution would have lower heart rates than the group in spring water. Another control group confirmed that the 5°C increase made a significant difference in their heart rates. Data of the heart rates of the groups was collected for four consecutive days. There was no significant reduction found in the heart rates of the group in the .01% vitamin C solution and the group in the spring water when the water temperature was increased. (day 4: χ^2=1.104, p=0.2)

2830

THE EFFECT OF ELECTROMAGNETIC FIELDS ON THE SODIUM IONS IN THE NEURON.

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We are exposed to electromagnetic fields (EMF) from many sources, including high voltage transmission lines and distribution lines that bring electricity into our homes, schools, and workplaces. Over the last two decades, concerns about the effects of EMF have increased. It is known that EMF applies a force on ions that have velocity, and that nerve impulses are conducted by moving sodium ions. The purpose of this lab is to find out if EMF have an affect on sodium ions in the neuron. I hypothesized that if EMF disrupts sodium ions by applying a force on them as they travel through a neuron, then the planarians that are exposed to the EMF will travel slower because the disruption in the ion flow causes the nerve impulse to be sent at a slower speed. In my first experiment, I exposed planarians to light in order to stimulate them to move and I timed how long the

planarians took to travel a distance of 10 cm. The five planarians from the experimental group were exposed to an EMF around 2.58*10^-3T(Tesla) when they traveled the 10-cm distance. No EMF was applied to the other five planarians from the control group. After 30 trials, there was no significant difference between the speed of planarians from both groups. (P>0.1) I further tested my hypothesis on my second experiment by increasing my sample size. Instead of using the same five planarians throughout all the trials like my first lab, I used planarians that had never been tested before for every trial to obtain more accurate data. However, the results were the same. The variation was not significant (p >0.1). Therefore, I concluded that EMF did not disrupt the direction of the flow of sodium ions by applying a force on them as they traveled through a neuron and therefore did not cause the planarians to travel slower.

2831

THE ENVIRONMENTAL FACTORS AFFECTING JONES CREEK.

Justin Rhodes, Anita Haydar, M.C. Barlow (teacher). Smithfield High School, 14171 Turner Drive, Smithfield, VA 23430.

The purpose of our research was to determine the quality and health of Jones Creek and to establish a database for the comparison of data collected by future students. The data was collected at the Nike Park site through various methods, which include water tests for: dissolved oxygen, salinity, pH, temperature, phosphates, nitrates, carbon dioxide, turbidity, and silica. Air temperature, air pressure, and other weather factors were also recorded. The various land and water uses and plants and wildlife were noted as well. We were also able to determine the various water and land uses and their effect on the water. From our data and observations the creek appears to be in good health. The dissolved oxygen and pH are at healthy levels and there are nutrients in the water but not enough to allow for any eutrophication. A great deal of wildlife and plant life was observed and seemed to be in good health. We were successful in our collection of data and future students will be able to monitor changes in the river based on our results.

2832

THE EFFECTS OF WAVELENGTHS OF LIGHT ON *EUGLENA GRACILIS.*

Stephen Mar and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In order to find if the rate of photosynthesis is related to wavelengths of light, cultured *Euglena gracilis* was separated into three different solutions; one without food coloring (White), one containing three drops Red food coloring per 50ml cultured *euglena* (Red), and one containing two drops Green food coloring and one drop Yellow food coloring per 50ml cultured *euglena.* (Green). Over the course of eight days, the *euglena* population of each solution was counted. On the eighth day, the Red solution showed a significant decrease in population compared with the *euglena* solution without food coloring (0.01>p>0.001). The Green solution showed a significant decrease in population compared with the *euglena* solution without food coloring (p<0.001). This indicates that Red and Green wavelengths of light decrease the rate of photosynthesis in *Euglena gracilis.* However, earlier *euglena* counts in this investigation indicated that Red food coloring increases the *euglena* population in relation to *euglena* without food coloring. I believe that further investigation is necessary to find if the rate of photosynthesis really is affected by wavelengths of light.

2833

RETENTION OF A CONDITIONED RESPONSE IN *DUGESIA TIGRINA.*

Kendra Steenhoek and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this study is to determine whether or not regenerated planarians, (*Dugesia tigrina*) can remember a conditioned response which they learned before regeneration. Ten planarians were trained to contract when exposed to light. After exposing each planarian to light alone, they were contracting less than 20% of the time, which lead me to believe that the natural response to light was not to contract. Training was accomplished by shining a flashlight on each planarian, followed immediately (within the next second) by a 6-volt electric shock. The control group of planarians was exposed to light only. Each planarian was tested 25 times. After several repetitions, the control group was contracting to light on an average of 1/25 times, while the experimental group was contracting on an average of 5/25 times. This lead me to believe that the planarians had learned a conditioned response (x^2=346.3, $p<0.001$). I next cut each planarian into anterior and posterior parts. After regeneration, I began my testing all over again with both anterior and posterior parts. After several tests, the regenerated planaria in the control group were contracting on an average of 1/25 times, while the experimental group was contracting on an average of 8/25 times. This gave me reason to believe that the regenerated planaria had retained their conditioned response even after regeneration (x^2=237.7, $p<0.001$).

2834

THE EFFECT OF COLOR ON CAPE IVY.

Victoriya Shekhter, and S. Engelmann (teacher). Palisades Charter High School, 15777 Bowdoin Street, Pacific Palisades, CA 90272.

This study examined the effect of color on the growth of Cape Ivy (*Senecio mikanioides*). Twenty, six to seven cm. plants were collected from the Santa Monica mountains. All twenty plants were planted in small cups (8 cm. tall). Ten plants were covered with green, two liter soda bottles which were cut in half, and the other ten were covered with transparent two liter soda bottles which were also cut in half. The plants were watered (20 ml. each) every week for four weeks. The results suggest that *Senicio mikanioides* grows faster in green light.

2835

THE EFFECT OF LIGHT ON THE REPRODUCTION RATE OF ZEBRA DANIO'S.

Fernando Torres and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this investigation was to determine if *Danio rerio's* (a.k.a. Zebra Danio's) breeding is photoperiodic. To test if Zebra Danio's breeding is photoperiodic, I had a experimental and control group, each group with 3 females and 3 males, acclimated to different light regimes. I then attempted to find out if the different light regimes had an impact on the number of eggs a zebra danio produces by comparing the number of eggs produced by the experimental group of fish acclimated to 8 hours of light a day to a control group that had 14 hours of light a day. I controlled the amount of light the fishes recieved by using an electronic light timer and keeping the fish tanks in a box to prevent ambient light from reaching them. I found that the probability of the difference between the number of eggs produced by the control group with a photoperiod of 14:10 hours light/dark ratio, to the experimental group with a photoperiod that had only 8 hours of light a day, being due to chance variation alone was less than one in a thousand ($p<.001$). The data showed conclusively that a photoperiod does have a significant impact on the number of eggs produced by Zebra Danio's.

2836

THE EFFECT OF LIGHT ON THE GROWTH OF GERMAN IVY.

T.F. Jauregui and S. Engelmann (teacher). Palisades Charter High School, 15777 Bowdoin Street, Pacific Palisades, CA 90272.

This experiment was used to observe the effect light has on the growth of German Ivy (*Senecio mikanioides*). Several 3g specimens were placed in 2 different stations. One station allowed German Ivy to receive 5 hours of light. The other station allowed only two hours of light. After 2 1/2 weeks their weight was recorded. The group that received 5 hours of light grew significantly more than the group with only 2 hours of light. My data shows that the quantity of light does affect the growth of German Ivy.

2837

THE EFFECTS OF WALL-SEEKING BEHAVIOR OF MICE.

Stanley Lin and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

In this lab, the effects of light on the wall-seeking behavior of mice were studied. This behavior has been assumed by the general scientific community to be innate and stereotypical. By varying the environment of the mice, I tested to see whether or not this behavior is in fact innate, or just learned, that is, environmentally related. The test involved placing a mouse in a closed arena gridded into 64 squares. Each of the eight mice was tested under a bright light and a dim light. At three-second intervals for six minutes, tallies were made according to which squares the mice were in. The tallies showed that the mice's activity in squares adjacent to the walls decreased when the lighting was decreased, suggesting that light does have an effect on the behavior. The light was the environmental variable, which would suggest that environment does play a role in the behavior. The conclusion drawn was that the wall-seeking behavior is not innate, but rather is learned and is dependent on the environment. ($p<0.001$)

2838

THE EFFECTS OF THE ENVIRONMENT'S SIZE ON FISH.

Albert M. Chu and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of my study was to determine if the size of the fish's environment would affect the growth of the fish in weight. Using three groups (3-gallons of water, 6-gallons of water, and 9-gallons of water) with 15 fishes in each, I tested to see if the fish in the larger water-environment would show a larger rate of increase in weight. Through ten days of weighing and observing the fish, I was able to come to a few conclusions, however not all of my conclusions proved to be significant enough. When comparing the fish in the 3-gallon tank to the fish in the 6-gallon tank, I was able to conclude that the fish in the larger tank had a higher rate of growth in weight ($t = 3.075$, $0.001 < p < 0.01$). When comparing the 3-gallon tank to the 9-gallon tank, I was able to conclude that the larger tank, once again, showed a higher rate of growth in weight, but through statistics my results were not significant enough to prove that my results were not due to chance ($t = 0.769$, $p > 0.1$). Finally when I compared the 6-gallon tank to the 9-gallon tank, I was able to conclude that the larger tank showed the higher rate of growth in weight, but through statistics again my results were questionable ($t = 2.040$, $0.05 < p < 0.01$). Overall I concluded that the 9-gallon tank allowed the fish to grow at the highest rates.

2839

HOW SEA ANEMONES DISTINGUISH POSSIBLE FOOD SOURCES.

J.M. Robbins, K.J. Ector and S. Engelmann (teacher). Palisades Charter High School, 15777 Bowdoin St., Pacific Palisades, CA 90272.

This study examined the question of how sea anemones distinguish possible food sources, organic from inorganic substances. Seven sea anemones of various sizes were offered five different organic substances, such as plastic, Styrofoam, glass, shell, and a copper penny. The objects were drifted by the anemone and allowed to brush the tentacles. If the tentacles attached to the object, it was considered accepted. The acceptance or rejection rate was mostly random, although the Styrofoam was rejected by them all. The penny had an acceptance rate of 29%, the shell had an acceptance rate of 14%, the plastic had an acceptance rate of 29%, and the seaglass had an acceptance rate of 14%. From these results we can conclude that the sense of texture must play an important factor in whether or not a potential food source is accepted or rejected.

2840

EFFECTS OF KNOWLEDGE OF PRIOR ACTIONS ON FORMATION OF STRATEGY.

Joseph M. Dale and Stephen DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

I devised a simple game for two players in which one player attempts to predict a number to be guessed by his opponent. If he is successful, he again tries to predict a number guessed by his opponent. If he is unsuccessful, he guesses a number which his opponent attempts to predict. Each player should attempt to develop a strategy which will enable him to always predict his opponent's guess, and guess a number which his opponent will not be able to predict. In the experimental group, I provided one player in each pair with a written record of his prior guesses and predictions, his opponent's prior guesses and predictions, and who, he or his opponent, won each game. His opponent had no such information. In the control group, neither player had information. I attempted to determine whether the player with more information would be able to win more often than if he had no such information, by forming a successful strategy. For reasons beyond my control, I collected much less data than I had planned to collect. From the data collected, I concluded that there was no significant difference ($\chi^2 = 0.371, 0.057; 0.5 < p < 0.9$) between the number of games won by players who had information (while their opponents did not) and players who did not have information (and whose opponents also had no information). However, I have identified several factors in my experimental setup and in the execution of the game which may suggest that this conclusion is invalid.

2841

THE EFFECTS OF INCREASING WATER ON BEACH EROSION.

Gary Chu, Walter Yuen and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

The purpose of this experiment was to see the effect of increasing water on beach erosion. A wave tank with a wave maker was built for this experiment. Two thousand milliliters of sand was placed on the opposite end of the wave maker in the tank at a sloped angle to simulate a beach and then five thousand milliliters of water was added into the tank. After running the wave machine and taking note on how much sand was displaced and the change in beach profile, 10 percent more water (500 ml) was added into the tank and the wave machine was used again. Comparisons were made between the control group and test group beach profiles and the volume of sand lost when the water was increased. The change in volume of sand showed that the beach was changed significantly and the t-test verified this ($t=22.13$, $p<0.001$). The profile of the beach also showed visually that sand was displaced and lost.

2842

A GOLDFISH'S USE OF ITS OLFACTORY SENSES TO FIND FOOD.

Rachel Monterrubio and Steve DeGusta (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

To test weather a goldfish can use it's olfactory senses to find food I created a maze to run the fish through so as to take away the option of using it's vision. For the first half of my experiment I used a sample group A of five goldfish. I placed three pellets of fish food at the end of one hall of the maze and placed one goldfish from group A in to the starting room of the maze. I gave each fish one chance to find the food under five minutes where I would then change the placement of the food to a different hall of the maze and time them again. Each fish had a total of four runs. For the second part of my experiment I attempted to manipulate the olfactory senses of the goldfish so as to imprint upon the fish the pathway to the food which remained in one stationary position. I did this by leading each of the five fish of group B to the food, four individual times, by using the negative presence of a spoon to discourage the goldfish from going in the wrong direction. I then allowed each fish one trial to find the food under five minutes. Finally I removed the food and allowed each fish one trial of five minutes to reach the spot where the food had previously been placed. For the first part of my experiment the results of the goldfish finding its food under five minutes were below average, as where the results of the imprinting trials, suggesting that a goldfish does not use its olfactory senses to find it's food.

2843

HOW HERMIT CRABS LIVE AND INTERACT IN THEIR ENVIRONMENT WHEN IT IS TIME TO MOVE TO A NEW SHELL.

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From a series of selected shells from different species of snails, which shell is preferred by the hermit crab? Different types of snail shells were placed in front of unshelled crabs. Two larger crabs and two smaller ones. Three out of the four chose the hard dark extremely bumpy shells. The last one, the smallest one, chose a smooth light colored one.

2845

THE EFFECTS OF CAFFEINE ON THE LEARNING AND ABILITES OF MICE.

Steven Fong and Steve DeGusta, (teacher). John F. Kennedy High School, 6715 Gloria Drive, Sacramento, CA 95831.

At the biochemical level, learning still is not completely understood, but it is generally believed that chemcials known as neurotransmitters play an intergal part in our ability to learn. Caffeine is known for its ability to block the action of a chemical known as phosphodiesterase (PDE). This chemical causes the breakdown of secondary neurotransmitters in the body. Because the secondary neurotransmitters are not broken down, the effects of the primary neurotransmitters are greatly amplified, which can cause an increase in physical abilities, alertness, and possibily the an increase in the learning abilities of female mice. The experimental was subjected to 0.15 mg of caffeine (the equivalent of a human drinking 2.5 cups of coffee) 2 hours prior to being run through a maze 4 times. It was found that caffeine does play a significant role in mouse learning, and differences between the control and experimental groups was significant ($p < 0.02$).

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