JOURNAL of STUDENT RESEARCH ABSTRACTS

Volume VII

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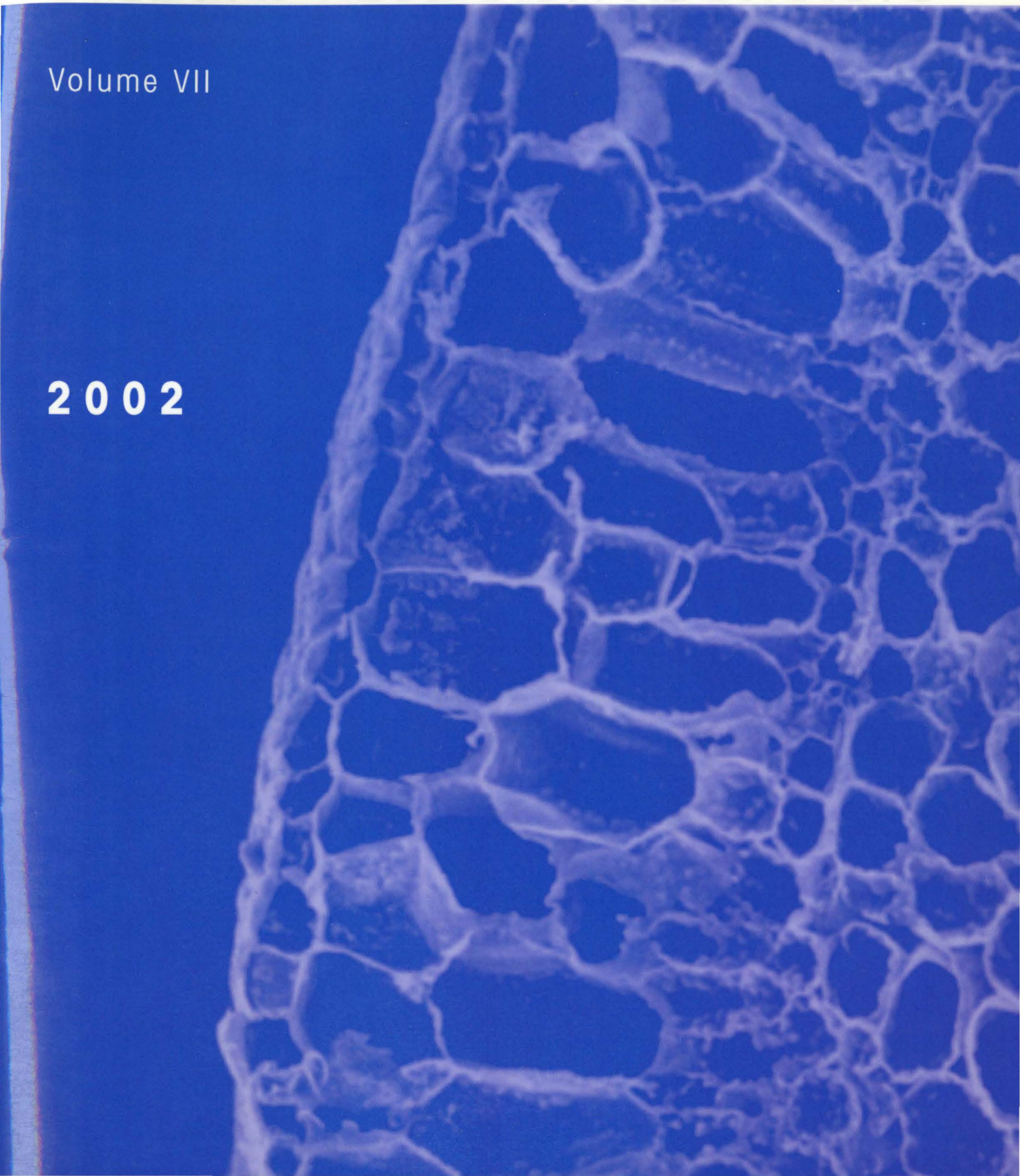

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Steven B. Oppenheimer
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ABOUT THE EDITOR

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 140 publications including 10 books and book editions, was awarded over $6 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."

Editor's e-mail address: *steven.oppenheimer@csun.edu*

ABOUT THE JOURNAL AND SUBMISSION OF ABSTRACTS

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

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, and (3) a volume to disseminate student research discoveries. 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 perfect science. We do not eliminate abstracts that do not demonstrate perfect science. The editor, however,

reviews all abstracts and reserves the right not to publish abstracts that are seriously flawed. Those abstracts were deleted from this issue. Some of the abstracts are experimental plans instead of completed projects. This is especially true in the case of long term, sophisticated research programs that require extensive set-up and planning. The journal encourages abstracts on the planning and progress of such projects. 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, Eisenhower program, the other sponsoring agencies, the university or the journal staff.

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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 neatly, error free. 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 February 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 Foundation, Center for Cancer and Developmental Biology must be mailed along with the abstract.**

STUDENT ABSTRACT INDEX

Number following name refers to abstract number

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Subject Index

Number refers to abstract number

Abstracts

2813

How Does Water Pollution Affect the Heart Rate of Daphnia (Water Flea)?

John Herr, and Judy Luedke (teacher). Valley Presbyterian School, 9200 N. Haskel Ave., North Hills, CA 91343.

Daphnia magna (water flea) is a fresh water crustacean found in lakes and ponds throughout much of North America and is an important element in the aquatic food chain. Experiments were developed to determine how water pollution from common household products affects the heart rate of *Daphnia magna*. Images of the *Daphnia* heart were viewed on a computer connected to a compound video microscope through an analog/digital converter. *Daphnia* were placed in single drops of pond water on depression slides and videotaped twice to record normal resting heart rates. Heart rates were determined by playing the digital videos in slow motion and dividing the number of beats by the elapsed time reported by the software. After an average resting heart rate was determined, one drop of 1.0% pollutant was added to each slide, bringing the final pollutant concentration to 0.5%, and the heartbeats were recorded at one, three, five and thirty minutes from the time of exposure. The procedure was replicated with a second *Daphnia* for all pollutants tested and the results were averaged. All of the pollutants tested made the heart rates decrease during the thirty minutes observed. After thirty minutes the heart rate went down 100% in ammonia and Draino®, but only 51% in ethanol, and 21% in paint thinner. The greatest effect was observed with ammonia which killed *Daphnia* in 3 minutes, followed by Draino® which killed the *Daphnia* 5 minutes. Ethanol reduced the heart rate 51% after thirty minutes while paint thinner reduced the heart rate only 21% during the same period.

2814

IL-6 Family of Cytokines Involvement in Neural Development of Zebra Fish

D. Alexander, M. Chan, T. Haydostian, A. Mendez, R. Moreh, C. Wang, M. Bautista, C. Cho, E. Gonzales, S. Poshneh, A. Scott, H. Vilchez, D. Wu, E. Solomon, A. Sarwary, N. Saadat, N. Olsen, S. Olk, J. Nugent, B. Kim, C. Hurtado, T. Pulley, J. Abell, T. Brooks, E. Del Cid, K. Klint, J. Sutton, C. Schwarzer, D. Moore, C. Acosta, N. Kossayan, V. Burgues, B. Radley, R. Fabrocini, M. Velasquez, J. Torres, C. Reyes., C. Gasaway, J. Morrison and C. Riley (teacher). El Camino Real High School, 5440 Valley Circle Blvd., Woodland Hills, CA 91367.

The purpose of this study is to determine IL-6 family of cytokines involvement in neural development for *Danio rerio* (Zebra fish). We have hypothesized that IL-6 family of cytokines are involved in neural development during early embryogenesis. Their role is to initiate a membrane mediated cytoplasmic signaling for new gene expression and cause changes of cell behavior.

The nuclei in the earliest stages of embryogenesis in most organisms are totipotent and capable of expressing any part of their genome. A very short time later the same nuclei become highly

specialized and express only particular genes: genes appropriate for the next sequence of events in that part of the embryo. As an embryo grows and develops, the embryonic cells become more specialized after gastrulation. Cell specialization promotes and gives rise to diverse receptor-specific families of cytokine genes. These are expressed to maintain specialized cell's survival and differentiation. Henceforth, by identifying the presence of IL-6 cytokines at pre-gastrulation, it serves as an explanation of why we observed overlapping biological activities; extensive redundancy and ambiguity of cytokines actions after gastrulation in the intact organisms.

To detect the presence of IL-6 family of cytokines in tissue specimen, our experimentation include: breeding Zebra fish, SDS-Polyacrylamide gel analysis for identifying, and isolating of IL-6 family of cytokines. Furthermore, other methods include: protein staining and using molecular weight markers for identifying IL-6 family of cytokines by comparing them to molecular weights of IL-6 family of cytokines from other organisms. We expect the results in the gel banding profile of IL-6 family cytokines of Zebra fish to be similar in molecular weights in comparison with IL-6 cytokines from other organisms.

Future experiments are designed for the following methods: to extract RNA from tissue specimen while isolating specific IL-6 family of cytokines messenger RNA with use of a specific primer, to transcribe IL-6 family of cytokines mRNA with the use of a reverse transcriptase, and amplify by way of PCR. We are implementing Amgen's genetically engineered plasmids, (pDRK and pGRN) to insert a cDNA-IL-6 gene segment of IL-6 family of cytokines. Ligation of pDRK/pGRN-cDNA/IL6 cytokine restriction fragments to produce a recombinant plasmid, rpGLO-cDNA/IL6 cytokine segment to be inserted into pGRN. Finally, confirmation of restriction and ligation using agarose gel electrophoresis.

Conclusion: IL-6 family is a typical pleiotropic cytokine. Common features of IL-6 family of cytokines are that they involve ligand binding to the respective receptors that initiates sequential activation of sets of cellular kinases, and subsequent activation of nuclear transcription factors. IL-6 family of cytokines functional receptor complex share glycoprotein-130 as a component critical for signal transduction. It can be argued that who controls the membrane controls the cell. Our study would lead to new ways in determining how pre- and post-embryonic differentiation are regulated in all higher plants and animals. The mechanisms we expect to discover in this work may also be useful in regulating and re-activating cells of adult organisms that are normally unable to regenerate (e.g. nerve tissue). Moreover, the work would provide an insight into the evolutionary development of embryonic systems and methods of transducing environmental signals into cellular information. Knowing what these molecules are and how they trigger cytoplasmic signaling would bridge the current gap between molecular biology (with its understanding of gene expression) and the determination of three-dimensional multicellular growth and development.

2815

PCR AMPLIFICATION OF THE HUMAN VNTR POLYMORPHISM ON THE pMCT118 LOCUS

C. Antekelian, M. Bagsik, W. J. Baier, A. Basch, K. Choi, R. Choi, J. M. Chung, C. K. Dao, L. A. Davis, K. L. Deever, E. I. DeSosa, G. A. Doner, S. Farshadsefat, D. L. Fast, S. A. Fowler, L. A. Fowlks, C. Galindo, M. Guirguis, L. G. Guzman, G. A. Habib, E. Hwang, L. S. Igreda, R. K. Jhaj, D. Kang, S. J. Kang, L. I. Karmirlian, S. M. Kay, T. B. Kharadjian, C. J. Kim, E. J. Kim, G. U. Kim, Hanb. Kim, Hann. Kim, J. H. Kim, R. L. Klein, A. E. Koh, C. S. Kwon, S. Le, A. Lee, J. S. Lee, M. Lee, L. J. Liao, B. L. Macias, J. A. Mc Allister, A. J. Mensch, L. N. Ming, R. F. Petoyan, J. S. Plotin, S. F. Roter, K. Tsao, G. H. Weissberger, V. Y. Yi, S. Zhu and J. McLaughlin (teacher). Granada Hills High School, 10535 Zelzah Ave., Granada Hills, CA 91344.

The purpose of this study was to determine the genotype of every member of our Honors Biology class with respect to the VNTR known as pMCT118 (also known as D1S80). This particular VNTR (Variable Number of Tandem Repeats), is located on chromosome 1 and has a repeat unit of 16 base pairs. It is in a region that does not code for proteins. The target DNA was obtained from student buccal cheek cells by using a saline mouthwash. The cheek cells were collected by centrifugation and resuspended in a Chelex solution. The samples were then placed in a boiling water bath to lyse the cells and allow the Chelex to bind to the cell debris and precipitate it out of solution, leaving behind the chromosomal DNA suspended in the supernatant. An extract of the DNA supernatant was combined with a PCR reaction mixture and placed in a DNA thermal cycler. The mixture was amplified for 35 cycles using the following step file: 30 sec at 92°C for denaturation: 30 sec at 52°C for annealing: 30 sec at 72°C for chain extension. Each student amplification product was loaded into a separate agarose gel lane and separated according to size by gel electrophoresis. The gel was stained with ethidium bromide and viewed under ultra violet light. One or two fluorescent bands should have been present in each gel lane. However, the results were poor. Many of the bands could not be analyzed because they appeared as fuzzy streaks or smears. Perhaps this problem occurred because 52°C is too low of an annealing temperature and therefore, allowed the primers to anneal to numerous non-specific regions of the genome. This may have caused the amplification of many unwanted regions, thus, a smear. In conclusion, further investigation would be required to identify the best annealing temperature to amplify only the target region.

2816

EFFECTS OF SUGARS ON SEA URCHINS FERTILIZATION

Adam Yassaman, Matthew Underwood, and Mr. VanDuzee (teacher). Saugus High School, 21900 Centurion Way, Saugus, CA 91350.

This experiment was conducted in order to find the effects of simple sugars on the fertilization of the sea urchin, *S. purpuratus.* Eggs and sperm were tested with or without 1M Dextrose, 1M Sucrose, and 10% Corn Syrup solutions. Each of the solutions was combined with eggs and sperm in artificial seawater. The mixtures were allowed to sit for five minutes at room temperature. Each experiment was repeated three times. Compared to a controlled fertilization rate of about 98% ± 2%, all three sugars inhibited this process. The Dextrose solution reduced the fertilization rate to 52% ± 14%, the Sucrose solution reduced it to 25% ± 15%, and the Corn Syrup lowered it to 71% ± 5%. These results suggest that certain types of sugars can act as an inhibitor in sea urchin egg fertilization.

2817

THE EFFECTS OF AJAX ANTIBACTERIAL DISH SOAP ON SEA URCHIN FERTILIZATION

R. R. Stultz, L. G. Hollingsworth and W. P. Van Duzee (teacher). Saugus High School, 21900 Centurion Way, Saugus, CA 91350.

This study examined the question of possible AJAX Antibacterial Dish Soap involvement in sperm-egg interaction in the sea urchin *S. purpuratus.* The control, eggs and sperm incubated in artificial sea water, resulted in 98% ± 2% of the eggs being fertilized. Then eggs were introduced to a 10% solution of AJAX Antibacterial Dish Soap. The sperm were added to the mixture and the percent of fertilization was recorded. The solution of AJAX Antibacterial Dish Soap at 10% killed the sperm immediately and caused the eggs to produce fertilization halos without actually being fertilized. In addition to the production of halos, membranes of 56% of the eggs tested had ruptured membranes. New eggs and sperm were invaded by .001% solution of AJAX Antibacterial Dish Soap. This decreased fertilization to 54% ± 7%. Each experiment was repeated several times. The results suggest that AJAX Antibacterial Dish Soap affects sperm-egg interaction of sea urchin.

2818

PCR AMPLIFICATION AND SEQUENCING OF THE HUMAN VNTR pMCT118

R. E. Appleton, C. Atashian, S. Bahl, V. Defterderian, J. J. Dellomes, R. J. Jackson, M. C. Miller, C. W. Packer, J. A. Rhodes, M. H. Rod, K. Tsao, and J. McLaughlin (teacher). Granada Hills High School, 10535 Zelzah Avenue, Granada Hills, CA 91344.

The purpose of this investigation was to determine the genotype and base sequence of the eleven individuals in our honors biology class with respect to the VNTR known as pMCT118 found on chromosome 1. In this experiment the VNTR designated pMCT118 was amplified and then sequenced using a DNA sequencer. A VNTR (variable number of tandem repeats) is a special type of polymorphism that is composed or repeated copies of a DNA sequence that lie next to one another on the chromosome. The VNTR pMCT118 is a non-coding region of chromosome 1 composed of repeated copies of a DNA sequence of 16 base pairs. First cheek cells were isolated using a 0.9% saline solution, collected by centrifugation, resuspended in Chelex, and then boiled to liberate the chromosomal DNA. A sample of the chromosomal DNA was then combined with other products needed for PCR amplification. The PCR mixture was amplified for 35 cycles using the following step file: 95°C for 30 seconds, 65°C for 30 seconds, and 72°C for 30 seconds. The PCR products were then electrophoreised using a 1.5% agarose gel. The DNA was stained with Ethidium Bromide, and the gel was photographed using a transilluminator under UV light. Following this, the alletic bands of DNA were excised from the gel and placed in a 0.3 M NaOAC solution. Overnight, the DNA diffused from the gel, and the DNA in the supernatant was ethanol precipitated. Then the concentration of the allelic DNA was determined using a spectrophotometer. The DNA was combined with products needed for cycle sequencing including a cocktail sequencing solution containing both dNTP's and ddNTP's. The cycle sequencing reaction was amplified using a thermal cycler for 25 cycles using the following step file: 96°C for 10 seconds, 50°C for 10 seconds, and 60°C for 4 minutes. The sequencing product was again ethanol precipitated, and then sequenced using the ABI PRISM 377 DNA Sequencer at C.S.U.N. Gel analysis of the pMCT118 resulted in definitive bands for each member of our team. The estimated number of repeats for each individual ranged from 16 to 35 repeats. The sequence reaction was unsuccessful in producing fragments which could be analyzed, and as a result verification of the exact number of repeats was not possible. However, the electropherogram (which summarizes the results of the DNA sequencing) of the downstream strand did confirm the base sequence of the 16 bp repeat. We also had partial confirmation of the base sequence from the upstream strand.

2819

STUDENTS WITH ASTHMA AND LOCATION OF HOME

M. Andrade, B. Arellano, H. Carzares, E. Contreras, D. Culebro, B. Hwe, Y. K. Kim, S. Lagunas, W. Lee, H. A. Liu, W. Lo, J. Lopez, H. Lu, T. Ly, A. Mac, S. Macias, J. Medina, R. Mmontemayor, L. Morales, M. Moran, L. Nguyen, C. Placencia, D. Rodriguez, I. Rubio, L. Santox, K. Situ, R. Soto, M. Tapia, K. Ton, G. Valdovinos, H. C. Wong and G. Jones (teacher). Florence Nightingale Middle School, 331 N. Figueroa St., Los Angeles, CA 90065.

It was hypothesized that students who live near a freeway are more likely to suffer from illness related to asthma than students who live farther away from freeways. Data was provided by the school nurse about students who go to the health office for asthma treatments. Of the 1950 students at Nightingale Middle School, 26 or 1.33% go to the nurse on a regular basis, with a combined total of 110 days absent from school to date due to illness, or an average of 4.23 days. A survey was developed and given to four classes. A total of 114 students missed a total 183 days due to illness, or an average of 1.605 days. Students with asthma missed 2.625, or 60% more days due to illness. On plotting the residences of the students with asthma on a map, it was noted that they lived relatively near major freeways whereas the general populace is spread out over a considerably larger area. After comparing the days missed due to illness and the location of residences on the map, it was concluded that close proximity to freeways is a factor influencing asthma-induced illnesses.

2820

HOW LIGHT IMPACTS BETTA FISH

Joseph Schwab, T. Miller (teacher). Francis Parkman Middle School, 20800 Burbank Boulevard, Woodland Hills, CA 91367.

The purpose of this experiment was to determine how light impacts the life of a Betta Fish. It was my hypothesis that light is crucial to the Betta's orientation to direction because Betta Fish have monocular vision and cannot without difficulty focus on a single object. In the experiment five fish were placed in separate habitats and subject to (1) constant natural sunlight; (2) constant inside artificial seventy-five watt light bulb; (3) inside sporadic intense light; (4) inside complete darkness and (5) periodic outside sunlight. I observed Betta Fish and used light to determine direction and how they reacted toward the light. During a month long period I tested and observed the five Bettas within their habitats. The Bettas in natural sunlight and those in artificial light used the light to determine directions of "up" and "down." In contrast the Betta in darkness had difficulty determining any direction. The Betta exposed to sudden bursts of light reacted with shock and temporary total disorientation. However, once adapted to the light the Bettas calmed down and followed the light. Whenever, any of the Bettas were subject to bursts of brightness, they all responded similarly with frenzy and rapid swimming. All of the tests and findings were recorded on a daily log in order to compare like or different behaviors. After completing the experiment I determined that the physiological make-up of the Betta Fish (due to their limited monocular vision) was directly linked to the frenzy caused by the burst of light. The experiment proved that my hypothesis was correct that light impacts the life of a Betta Fish.

2821

ENVIRONMENTAL PARAMETERS OF THE GUPPY, POECILIA RETICULATA

Christine Estrada, Jacqueline Hernandez, Kimberly Hurtado, Amanda Ingram, Nancy Martinez, Cecilia Navarette, Giselle Navarro, Dominique Paisano, Karen Pineda, Reyna Ruvalcaba, Marisol Solano, Rene Tellez, Carlos Torres, Eddi Zepeda, Monica Sharma, Ximena Alsina, Elizabeth Arias, Adriana Arizon, Erin Bivins, Danny Carranza, Janet Hurtado, Hugo Mariscal, Jose Martinez, Lizette Martinez, Josephine Maya, Mariana Mendez, Richard Pickwoad, Erick Pulido, Jaime Rodriguez, Joana Samson, Naly Stucki, Jessica Suarez, Cynthia Torres, Marlene Velez-Santos, Melanye Wawrik, Jafet Sauceda, Wendy Mayea (teacher). Olive Vista Middle School, 14600 Tyler St., Sylmar, CA 91342.

Guppies, *Poecilia reticulata*, are a live-bearing omnivore fish that are native to the fresh waters of Trinidad and Venezuela. Guppies are common household pets, and frequently used for studies of sexual selection and evolutionary modeling. While guppies have evolved in tropical rivers and streams with fairly constant environmental parameters, we hypothesized that guppies are resilient to a wide range of environmental conditions in laboratory aquaria. To test this hypothesis, we measured guppy activity with varying intensities of light, plant density, and temperature. In addition, we measured food preference for four different types of food. To measure guppy activity with varying light intensity, guppy behavior was measured in two ten-gallon tanks: one which received eight hours of light per day and another, in which a box with a small door for observation, was placed over the tank. In the lighted treatments, 88% of the guppies remained actively swimming while the other 12% hovered near the gravel. In the dark treatment, 100% of the guppies hovered over the gravel during observations, indicating guppies are more active in daylight. In order to measure the effect of plant density on guppy activity, no-plants, low and high levels of synthetic plants were placed in six two-gallon aquaria. In the tank with no plants, a medium amount of activity was observed compared with no activity in the high-density treatments. Guppies preferred a medium plant density where they exhibited the highest levels of activity, including courtship displays. Guppies were housed in ten-gallon aquaria at 72°F and 84°F to test the effect of temperature on guppy behavior. All guppies survived both temperature ranges. However, they exhibited higher activity levels at 84°F indicating a preference for warmer water. When given the choice between a quantified amount of flake food, floating algae wafers, or sinking algae wafers, guppies first choose to eat flake food 100% of the time. In addition, preference for two brands of flake food was measured. Guppies consumed all of the Aquarian flake food in an average of 332 seconds versus 371 seconds for Tetramin, indicating a preference for Aquarian flake food. Results support our hypothesis that guppies will survive in a wide range of environmental conditions such as light, plant density, temperature, and feeding. While guppies do show environmental preferences, indicated by activity levels, they also exhibit genotypic plasticity and are able to survive various environmental differences in light intensity, plant density, temperature, and food.

2822

WILL MEALWORMS SHOW A PREFERENCE TO BREAKFAST CEREALS?

Melvina Cole, Andrew DeLuca, Gustavo Estrada, Jose Garcia, Lontoya Hams, Jessie Hernandez, Yuridia Torres, Gabrielle Velasquez, C. F. Hajdu (teacher). Marlton Charter School, 4000 Santo Tomas Drive, Los Angeles, CA 90008.

The purpose of this experiment was to determine if mealworms (*Tenibrio molitor*) would show a preference to commercial breakfast cereals. The four commercial breakfast cereals tested were Oreo O's®, Wheaties Energy Crunch®, Cinnamon Toast Crunch®, and Life®. Prior to conducting our experiment we gathered information to form our hypotheses by graphing the nutrient information gotten from the labels on each cereal box. The information from each cereal that we compared were amount of calories, sodium, and percent U.S.R.D.A. (recommended daily allowance) of protein, vitamin A, vitamin C, thiamine, riboflavin, niacin, calcium, and iron. We used the nutrient information graphed to form our hypotheses. One person hypothesized that the mealworms would prefer Oreo O's®, four people hypothesized that the mealworms would prefer Wheaties Energy Crunch®, one person hypothesized that the mealworms would prefer Cinnamon Toast Crunch®, and one person hypothesized that the mealworms would prefer Life®. To perform our experiment we used 12 *Tenibrio molitor* mealworms, 12 plastic mini-petri dishes (35 mm x 10 mm), and 4 stopwatches to provide for the 3 trials for each cereal tested. In each trial one morsel of cereal was placed into a petri dish along with one mealworm. Cereal presence was measured by monitoring the feeding time per trial during a 2-minute duration. Feeding time was measured with a stopwatch whenever the mealworm's mandibles came into contact with the test cereal. The 3 feeding time trials for each cereal were then averaged so a comparison of feeding times for the 4 cereal brands could be made. We found the following average feeding times: Oreo O's®: 18.7 seconds, Wheaties Energy Crunch®: 10.7 seconds, Cinnamon Toast Crunch®: 47.7 seconds, and Life®: 12.7 seconds. Our experimental results showed the mealworms to have a feeding preference to Cinnamon Toast Crunch® cereal. The experimental results supported one of our hypotheses.

2823

"LEARNING" THE MICROBIAL LAVA LAMP PROTOCOL

N. Hariri, K. Kashanchi, A. Zonnis and D. Gaughen (teacher). Taft High School, 5461 Winnetka Avenue, Woodland Hills, CA 91346.

Our chemistry class of 37 students conducted the standard Microbial Lava Lamp Protocol. Our class was divided into twelve, three -person teams with one student serving as the control. The experimental setup required two teams of three students; we duplicated the protocol for each of six lamps at varied percents of sugar solutions. The solutions started at 5% sugar and incrementally increased by 5% until we had a 30% sugar solution. Each sugar solution color-coded the glass/alginate/yeast beads. Bubbles and "successful" beads were counted for three successive days. Successful beads were those which rose carrying CO2 to the top of the sugar solution, fell

to the bottom after releasing the CO2, and rose again to repeat the cycle. We were concerned with the low (5% to 16%) success rate. After analyzing the bead weight and size, we decided to repeat the entire class-wide experiment again. We found that the replication proved no more successful than the first experiment. Teams that did well the first time were about as successful as the replication. We observed that little "learning" by teams was achieved by repeating the experiment.

2824

EFFECTS OF HOUSEHOLD PRODUCTS ON PLANT LIFE

A. M. Sloan, S. E. Hong, W. Van Duzee (teacher). Saugus High School, 21900 Centurion Way, Saugus, CA 91350.

This experiment tested the effects of household products on the life of the *Tanacetum Vulgare* herb. Each of five plants were treated with ten milliliters of either full strength bleach, Sunkist orange soda, Windex glass cleaner, 15% salt water, or 25% sugar water solution. As a control, five plants were treated with ten milliliters of Arrowhead bottled water. The plants sat inside in a constant environment overnight. They were examined eight hours after treatment. The experiment was repeated five times. In comparison to the control using the Arrowhead bottled water, the remaining five plants were inspected for changes in appearance. Arrowhead water caused the plants no damage, for they were green, sprouting, and appeared undamaged. Bleach produced plants with all the leaves turning brown, 50% of the stem turning brown, all the plants wilted, and the soil turning lighter in color. Sunkist orange soda caused the plants to both wilt and turned 30% of the total leaves brown. Therefore, the bleach and Sunkist orange soda had a negative effect on the life of the plants. The plants treated with the full strength Windex, 15% salt water, and 25% sugar water remained green and vibrant, and they appeared to be the same as the control, so these substances seemed to have no effect on the life of the plants. The results suggest that when some household items are put into the sewage system they can have a negative effect on natural plant life in the environment.

2825

EFFECT OF pH ON SEA URCHIN FERTILIZATION

Sandra Madrid, Danny Garay, Chanthan Pom, Raymond Gamolo, Mayra Lugo, Stacy Lambert, Maricris Jocson, Edwin Linares, Ricardo Langoria, Eder Parales, Ingrid Valencia, Jessica Salgado, Patricia Cruz, Jeffrey Blanco, Silvana Davila, Alfonso Padilla, Noel Parra, Araceli Prudencio, Richard Leos, Daniel Martinez, Jose Bermudez, Victoria Boutros, Yennis Orellana, Carol Sida, Marianne Decastro, Cristina Cervantes, Sadie Torres and Nandita Pal (teacher). Robert Fulton Middle School, 7477 Kester Avenue, Van Nuys, CA 91405.

Acid rain and other pollutants may alter the pH of the ocean and adversely affect marine life. We were interested to find out how pH change may effect the fertilization of sea urchins. In this study we used male and female *Strongylocentrotus purpuratus* sea urchins. The sea urchins were injected 3 times with about 0.5ml of 0.55M KCL in three points of a triangle around the mouth into

2829

LIVING ON OR NEAR AN OIL FIELD OR CONTAMINATED SITE INCREASES THE NUMBER OF DAYS MISSED DUE TO ILLNESS

V. Alcala, Y. Arriaga, I. Barbolla, T. H. Chung, E. Contreras, A. Corea, K. Y. Fu, P. Garcia, Z. He, Z. Huang, L. Leon, A. Martinez, M. Medina, R. Medina, F. Navarro, A. Pena, R. Pinedo, Y. Rodriguez, and G. Jones (teacher). Florence Nightingale Middle School, 3311 N. Figueroa St., Los Angeles, CA 90065.

It was hypothesized that students who live on or near declared contaminated sites, such as over an oilfield, will be absent from school more days due to illness than students who live elsewhere. The Nightingale Middle School attendance office provided us with a list of 295 students who live on or near possible contaminated sites. These students missed a total of 785 days of school, an average of 2.66 days. Students who lived on Cardinal St. and surrounding streets, where soil was removed last year due to contaminates, reported significantly more absences, 4.26 days as compared to 2.66 days. Four classes with 114 students were surveyed; 6 thought they might live on a contaminated site, reporting 183 days absence due to illness, or an average of 1.605 days. The class noted that although the students who live in areas that might be contaminated are absent more, it is not known how many are result of illness, as the information provided by the attendance office reported total absences, whereas those completing the survey only recorded days absent due to illness. Further investigation is needed to see if the differences noted between the groups are due to illness or other reasons.

2830

HIGH ENERGY ASTROPHYSICS RESEARCH AT VAN NUYS HIGH SCHOOL

John Byun, Eugene Chang, Ravi Gupta, Brandon Jue, Victor Meyerson, Soo-Jin Oh, Jason Srisathapat, Arthur Altshiller (teacher). Van Nuys High School, 6535 Cedros Ave, Van Nuys, CA 91411.

The California High School Cosmic Ray Observatory (CHICOS) is a collaborative project involving Caltech, Cal State Northridge, UC Irvine, and local high schools to site a large array of particle detectors in Los Angeles. Van Nuys High School was one of the first schools to become involved with CHICOS. The above students participated in an experimental course, Project Physics, taught by A. Altshiller, in which they studied Cosmic Rays, GPS, plotted the coordinates of a Cosmic Detector Array for participating San Fernando Valley High Schools, and established a web page to coordinate their efforts: *http://projectphysics.cjb.net/*

This established a starting point for them to become part of the CHICOS concept that capitalizes on the infrastructure of the schools to achieve dense detector coverage over a vast area. The course was taught in Summer 2000. The array that they originally helped to plot will be capable of detecting and characterizing a sample of the highest energy cosmic rays. The project offers students and teachers in local high schools a unique opportunity to collaborate with university researchers and address fundamental issues at the forefront of present-day astrophysics and

particle physics. As soon as the Van Nuys HS detector network goes onto a fast data line, some of these students will become involved in analysis of the data collected on the roof top of their own school. The array is currently under development and extended air showers have already been observed. Van Nuys High School of the Los Angeles Unified School District and its two physics teachers and students are part of the CHICOS collaboration.

2831

CREATING A PROTEIN WHICH WILL PREVENT ENTRY OF HIV-1 AND HIV-2 INTO CELLS

Marcos Canales, Marevna Garcia, Ms. Oryla Wiedoeft (teacher). Dr. Stan Metzenberg, Ph.D.(CSUN research advisor). San Fernando High School, 11133 O'Melveny Avenue, San Fernando, CA, 91340.

The long term goal of the research is to discover specific proteins which prevent human immunodeficiency viruses (HIV-1 and HIV-2) from binding to receptors on the cell surface, thereby preventing viral entry and infection of cells. To achieve this goal we are using phage display technology to create a library of proteins which we will test in hopes of finding a protein which can effectively block the site of HIV binding and entry into cells. Potential effective proteins will be characterized using binding assays, DNA sequencing, and site-directed mutagenesis studies.

Progression of HIV-1 disease in humans, is associated with the destruction of $CD4^+$ T-cell populations, leading to acquired immune-deficiency syndrome (AIDS). CD4 is a cell surface glycoprotein found on mature helper T-cells, immature thymocytes, monocytes and macrophages. While the mechanism for T-cell destruction is not fully understood, research has found that the entry of HIV-1 into cells depends on a CD4 receptor on the cell surface and a co-receptor that is a member of the family of chemokine receptors. Certain chemokine receptors have been shown to be essential fusion factors for HIV infection. By creating proteins which can block binding of HIV to chemokine and CD4 receptors we propose that HIV entry into cells will be blocked.

2832

THE RELATIONSHIP BETWEEN VISION AND EYE COLOR

Monica Sharma and Wendy Mayea (teacher). Olive Vista Middle School, 14600 Tyler St. , Sylmar, CA 93063.

Today, many children and adults wear glasses or contact lenses to correct their vision disorder. These disorders are classified into two groups: myopia and hyperopia. Myoptic vision occurs when the cornea incorrectly focuses light, hindering vision of distant objects. In contrast, hyperopia is where the eye focuses better on distant objects. This research investigates the relationship between sightedness and eye color pigmentation. In order to conduct this research, I surveyed twenty-five people who wore glasses and had brown, hazel, green, or blue eyes. One hundred percent of the hazel and blue-eyed lens wearers were nearsighted. In contrast, of the brown or green-eyed lens

wearers, 40% were myopic, and 60% were hyperopic. These results support the hypothesis that there is a relationship between eye color and sightedness, where hazel and blue eyes are more likely to be myopic than brown or green eyes. Consequently, students with hazel and blue eyes may be more likely to have difficulty with seeing distant objects, such as a chalkboard, in school.

2833

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

G. Alibeigi, S. Alkhas, J. Baum, N. Behzadi, A. Block, M. Boylan, J. Buchanan, B. Cho, N. De Grakovac, B. Donath, A. Dong, A. Garnez, P. Ghasemi, J. Gordon, A. Guillen, K. Hamzelou, D. Hanna, R. Hunt, K. John-Charles, B. Karavani, T. Kennedy, K. Lew, S. Montalvo, B. Nevarrez, R. Nichols, M. Noorzay, L. Rubalcava, A. Sacks, C. Shahmirzadi, S. Shayan, L. Sherrod, J. Stone, J. Strelioff, M. Watenmaker, N. Weisberg, M. Weitzman, S. Wilson, C. Zamarripa, T. Miller (teacher). Parkman Middle School, 20800 Burbank Blvd., Woodland Hills, CA 91367.

This study examined where families of collembola prefer living, in the soil or the leaf litter. Our hypothesis was that different families of collembola would be found in the soil samples rather than in the leaf litter samples. Collembola are microscopic arthropods that have a head, thorax, abdomen and six legs. Some collembola have a jumping organ called a furcula that can quickly propel them away from predators, thus, their common name "springtails." We collected leaf litter samples and soil samples from nine different sites from the Parkman Middle School Garden. Tullgren Funnels were used to capture collembola in water. Soil samples were placed in water so a floating method would cause the animals to come to the surface. All collembola were identified and the live animals were collected using a small wire loop. The collembola were placed in prepared and labeled culture jars. Four families of collembola were collected and identified. Our data clearly showed that the Entomobryidae preferred living in the leaf litter. The Onychiuridae preferred living in the soil. The Isotomidae family were found in both habitats, although they generally preferred the leaf litter. Two Sminthuridae were collected so clear results were not obtained for that family. Our results proved our hypothesis correct.

2834

DO HIGH-PHOSPHATE DISHWASHING DETERGENTS HAVE A DAMAGING EFFECT ON FRESHWATER PLANT LIFE?

Alexandra Fischl, T. Miller (teacher). Parkman Middle School, 20800 Burbank Blvd., Woodland Hills, CA 91364.

The objective of my experiment was to see if high-phosphate dishwashing detergents would have a damaging effect on freshwater plant life. I hypothesized that the high-phosphate dishwashing detergent would have a damaging effect on freshwater plant life. I filled three jars with aquarium water, and then placed an elodea into each of them. I then placed them on an outside

table that received direct sunlight. Nothing was added to jar #l whereas 12.5 ml of high-phosphate dishwashing detergent was added to jar #2, and 25 ml of high-phosphate dishwashing detergent was added to jar #3. I then recorded the results for one week. Lastly, I repeated the experiment five more times. I observed many changes in the elodea plants throughout the week they were tested; jar #2 became cloudy and the elodea eventually suffocated, in jar #3 the elodea suffocated more quickly. I was able to tell that the elodea suffocated, because they became transparent, meaning that they were not able to receive oxygen. The results did support the hypothesis, each time the experiment was conducted, that the high-phosphate dishwashing detergent would have a damaging effect on freshwater plant life.

2835

DO CAT'S EYES GLOW IN THE DARK?

Sandra Madrid, Mayra Lugo, Chanthan Pom and Nandita Pal (teacher). Robert Fulton Middle School, 7477 Kester Avenue, Van Nuys, CA 91405.

The purpose of this experiment was to find out whether cat's eyes glow in the dark. In order to do this experiment we made a model, which would simulate a cat's eye. We used a coffee can and covered the top end with a circular construction paper. At the center of the paper circle we cut a long oval opening to represent the pupil of a cat's eye. We took this model in a darkened room, held it at arm's length and at eye level so that the paper faced us. We looked towards the opening in the paper and recorded our results. Next we used a flashlight to shine a light towards the opening in the paper and recorded our observations. We repeated this procedure with varying slit sizes to represent the varying pupil size. We found there was a direct relationship between the pupil size and the intensity of the glow. The larger the pupil the greater was the glow. We also concluded that the cat's eyes do not "glow" in the dark. The inside of the can is what glows. The glow from the animal's eyes is due to the reflection of external light. The back of each cat's eyes has mirror like cells that can reflect the light. These cells are filled with a chemical called guanine that reflects even the smallest amounts of light and plus floods the eyeball with light, causing it to appear to glow. The eyes do not appear to glow during the day because the dark, oval-shaped slit in the animal's eyes (called the **pupil**) is only slightly open. Any light reflected during the day is not noticed because of the brightness of the sun's light.

2836

EFFECTS OF FOOD ON HAMSTERS

Joanna Avila, Kim Hurtado, Wendy Mayea (teacher). Olive Vista Middle School, 14600 Tyler St., Sylmar, CA 93063.

The purpose of this experiment was to determine if different food rewards would affect the length of time it takes for pet hamsters to navigate their way through a maze. Our hypothesis is that the type of food placed at the end of the maze would not effect the time required to complete

2840

EFFECTS OF AMYLASE ON SEA URCHIN FERTILIZATION

Karl Janich, Keivan Javadi, W. P. Van Duzee (teacher). Saugus High School, 21900 Centurion Way, Saugus, CA 91350.

The purpose of this experiment was to test the effects of amylase on the fertilization of the sea urchin, *S. purpuratus*. First, there were three different solutions made, each with varying concentrations of amylase in distilled water. The three concentrations of amylase were 10%, 1%, and 0.1%. Also, a control was used without the addition of amylase. Each of these solutions was added to the artificial sea water solution containing eggs. Next, the sperm was added in and the fertilization process was observed. Under a microscope, the percent of fertilization was recorded for each sample. Each experiment was repeated three times. The fertilization rate of the control value without amylase was 98% ± 2%. With a 10% concentration of amylase, there was no fertilization observed at all. With a 1% concentration of amylase, there was a fertilization rate of 45% ± 5%. With a 0.1% concentration of amylase, there was a fertilization rate of 93% ± 2%. These experimental results indicate that as the concentration of amylase increases, the fertilization rate of sea urchins decreases.

2841

DO DIFFERENT COLORED LIGHTS AFFECT PHOTOSYNTHESIS?

Ricardo Longoria and Nandita Pal (teacher). Robert Fulton Middle School, 7477 Kester Avenue, Van Nuys, CA 91405.

It is known that plants need sunlight to live and grow. We wanted to find out how different colored lights may influence photosynthesis and the growth of a plant. We used three green houseplants. Plant A was kept in the sunlight, Plant B was kept under an artificial orange light and Plant C was kept in a dark closet with artificial blue light. All the plants received the same amount of water. We recorded the height of each plant for 3 weeks. We found that in three weeks Plant A grew 23.9 cm, whereas Plant B grew 15.7 cm, and Plant C grew only 2.6 cm. Although Plant B grew less than Plant A, it looked green and healthy. Plant C on the other hand looked yellowish brown. Our results suggest that a plant can grow and carry out photosynthesis in artificial orange light but not in the dark with an artificial blue light. Although research scientists have shown that chlorophyll can absorb both red and blue light, it is the combination of pigments in a plant, which determines which wavelengths of light, can be utilized in photosynthesis. In our experimental set up the artificial blue light in the dark closet was not adequate to support photosynthesis. No plant absorbs light with equal effectiveness across the visible spectrum. This is why different colors of light may affect photosynthesis and the subsequent growth of plants.

2842

THE ACTIVITY ADVENTURES OF TEMPERATURE STRESSED CORN SEEDLINGS

Gonzales, Daisy; Iraheta, Xiomara; Barker, Patricia (teacher). Hollywood High School, 1521 N. Highland, Hollywood, CA 90028.

Plant Beta-Glucosidases have numerous functions in metabolism. Extracts of corn seedlings contain many enzymes including Beta-Glucosidase. The activity of this enzyme is related to plant growth. Beta-Glucosidase was extracted from corn seedlings that were imbibed overnight at 0° C using 50 mM NaAc, pH 5.0. All procedures were carried out at 0°C unless otherwise noted. The enzyme was centrifuged to remove unnecessary proteins and the supernatant was saved. The enzyme was diluted at the ratio of 1:100 with 10 mM citrate – 20 mM phosphate, pH 5.5. Then the diluted enzyme samples were simultaneously incubated at 0°C, 25°C, 50°C, and 75°C for 5 minutes. The absorbance was measured spectrophotometrically at 410 nm. The results showed that the greatest absorbance occurred at 50°C. It can be concluded that at 50°C Beta-Glucosidase is most active. Future studies could include other grinding techniques to better pulverize corn kernels to produce a more concentrated extract.

2843

ION ACOUSTIC WAVES

Clare Moynihan (student), Louisville High School, Woodland Hills, CA; Elise Wetzel (student), Louisville High School, Woodland Hills, CA; Chris Wetzel (student), Loyola High School, Los Angeles, CA; Richard Buck (teacher). Louisville High School, Woodland Hills, CA.

Over the last several years the Los Angeles Physics Teachers Alliance Group (LAPTAG) has built a plasma device and designed experiments for high school students to learn about the properties and behavior of plasma. The experiment took place at the lab of Dr. Walter Gekelman of UCLA, the Principle Investigator for this experiment. One of the first experiments we performed was to create pulsed ion acoustic waves in Argon plasma. We measured the wavelength and frequency of the wave pulses and thereby calculated the velocity of the wave. An antenna immersed in the plasma, which is pulsed by a function generator, creates the waves. Measurements are made using a Langmuir probe and read out on an oscilloscope. From this information we calculated values such as the temperature of the plasma, the plasma density and percent ionization of the plasma. In order to do these experiments we had to understand what plasma is, how plasma can be created using a helicon source, how to use an oscilloscope and how to use a wave analysis program called PV Wave.

2848

THE EFFECTS OF D-MANNOSE ON THE DEVELOPMENT OF THE SEA URCHIN GASTRUIA

Monica J. Tully (teacher). Mulholland Middle School, 17120 Vanowen St., Van Nuys, CA 91406.

The objective of this project is to allow eighth grade students to conduct developmental research within the classroom using the sea urchin as a model. This project is a continuation of experiments that showed D-mannose binding lectin (Lens culinaris agglutinin) caused exogastrulation to occur in embryos treated 24 hours after fertilization. Now we will discover if D-mannose causes the same result to occur. This project may help us to understand the molecular basis of the secondary mesenchyme cell-blastocoel wall interactions. It will also help us to discover if these interactions are controlled by lectins and sugars that may be on the surfaces of these cells.

The students will be able to incorporate the concepts and skills they learn (scientific thinking, communication, investigation, scientific tools, and real world applications) into their own research/science fair projects. The students will be guided by the instructor and will later work independently in groups of three to four students.

Making research projects easy

Our approach to the research component of this research/discovery experience is, primarily, to list a wide variety of projects the students could perform, and to provide readings for background information (see references). Once your students have been introduced to the basic sea urchin fertilization and development methodology (see next page), they will find research projects easy—most can be simple offshoots of the basic classroom experiment. The experience culminates in a presentation to the class and a write-up using standard scientific journal format.

All experiments use little other the sea urchin gametes and artificial sea water, and are generally so-called fail-safe projects that provide meaningful results regardless of the results. This is key to the successful completion of a project by all your students rather than just the typical select few. A representative group of experiments follows:

Effects of one of the following on fertilization membrane formation or on early development:

- total salt concentration (by boiling to concentrate or diluting sea water with distilled water—try a range of concentrations from 0.1 that of normal seawater to 10 times the normal amount)
- concentrations of specific ions such as sodium, potassium, calcium, magnesium, heavy metals, and so on (for example, use the chlorides of these metals)
- pH (try values from pH 3 to pH 12) n.b. normal pH for sea urchins is pH 8
- temperature (0°C to 30°C) n.b. 15°C is normal temperature for the sea urchins
- specific drugs or chemicals that may interest students (you could experiment with caffeine or aspirin, or any other over-the-counter, safe chemical).

Recent studies have shown that cyclin is the key component in the cell cycle. Conclusive evidence from studies involving none other than sea urchin eggs link this protein to the cycle that affects all aspects of life—everything from embryonic development to the generation of new tissue in a healing wound.

Scientist now hope to use this new knowledge to combat growth and development disorders, or diseases of excess growth such a cancer. And to think, it all started with sea urchin embryo research.

Seconds After Sperm Binds to Egg	Event
2	minor influx of socium ions and membrane potential change
8	liberation of calcium ions from intracellular stores
20	cortical reaction, release of acid and major influx of sodium ions begin
30	NAD is converted to NADP
38	oxygen consumption rises
60	fertilization membrane formation is completed
100-200	intracellular pH increases (acidity decreases)
350	protein synthesis increases
400	transport systems are activiated
1300	egg and sperm nuclei fuse
1600	DNA synthesis begins
5500	first cell division occurs

Figure 1 What is happening during fertilization in the sea urchin egg? These events that occur during so-called "egg activation" are discussed in detail in Oppenheimer and Lefebre, Jr., 1989 given in the reading list.

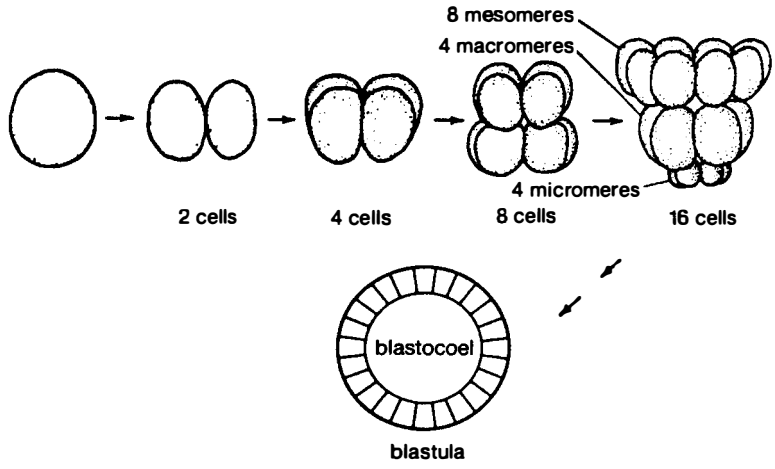

Figure 2 Cleavage in the sea urchin.
Based on Oppenheimer and Lefevre, 1989, pages 119 and 132.

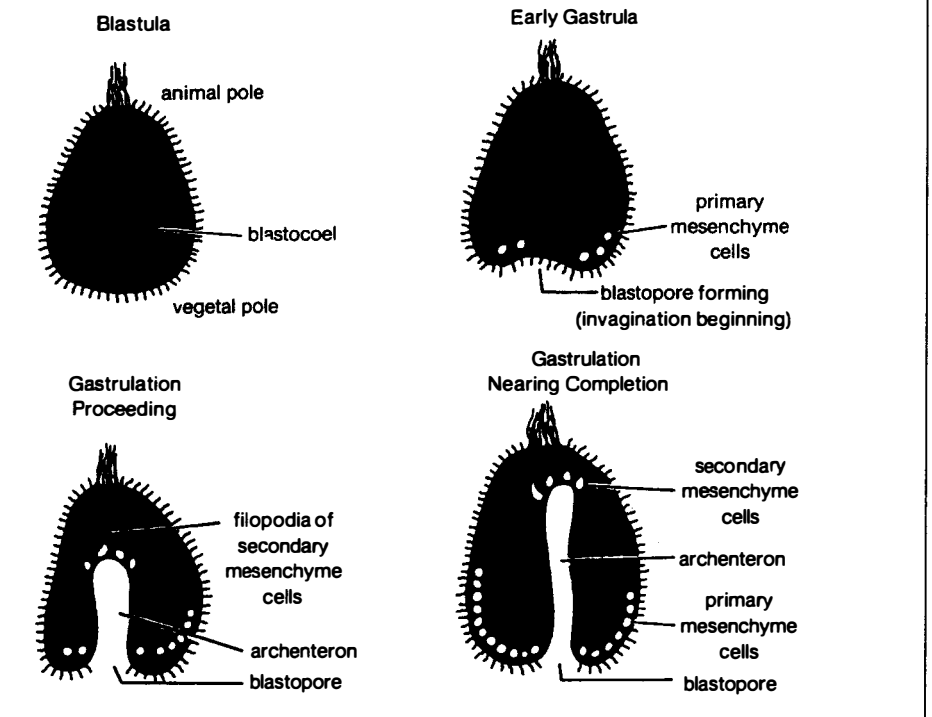

Figure 3 Gastrulation in the sea urchin.
Based on Oppenheimer and Lefebre, Jr., 1989, page 141.

Separate experiments using treatments like these could be performed on sperm only, eggs only, followed by return to standard conditions, or sperm and eggs together.

More complex experiments could involve disaggregation and reaggregation of blastula-stage embryos (see Figures 2 and 3) and the effects of different substances on the reaggregation process. The fact that blastula stage embryos can be easily disaggregated into viable single cells and reaggregated back into swimming embryoids, simply by removal and return respectively of calcium and magnesium to sea water, forms the basis for exciting studies on the forces that shape the embryo.

If you don't live near the ocean, it easy to obtain sea urchins from a variety of companies that ship them worldwide; for decades I have purchased them from Pacific Biomarine, PO Box 1348, Venice, CA 90294-1348 (213-677-1056). One classroom kit, which includes everything needed for up to 20 classes or 600 students, costs about $110 (which includes one-day air shipment costs). Complete instructions for introductory experiments come with the kit (see box). Potassium chloride, included in the kit, causes the urchins to eject their sperm or eggs; sperm are collected without dilution, kept on ice until just prior to use, and the eggs are collected in sea water. Fertilization, beautifully shown by the uplifting of a fertilization membrane, takes about one minute, and the freshly fertilized eggs are placed in Petri dishes that contain sea water for study with a low-power microscope. Students (almost) effortlessly carry out the fertilization process and are fascinated by the developmental events that occur before their eyes (see Figures 1, 2, and 3).

Many of our students who have been introduced to the sea urchin embryo in the classroom have become research scientists; scores of them have co-authored our research publications and have presented their results at professional meetings. Some of them are presently doing a variety of interesting research projects. For example, a particular group of students, funded by NASA, are performing a computer analysis of a variety of parameters that govern sea urchin fertilization and early development, as background for study of this embryo in the space shuttle. Other groups of students are investigating the mechanisms of reaggregation of sea urchin embryo cells, and the nature of specific molecular cell surface components that appear during development.

The sea urchin system is ideally suited for brief experiments that yield reproducible results. It excites the curiosity of students, thereby stimulating research creativity. It is not difficult to whet your students' appetite for knowledge.

For Further Reading

Davidson, E. H. (1987) "Understanding Embryonic Development: A Contemporary View." *American Zoologist*, 27:581–591.

Davidson, E. H., B. R. Hough-Evans, and R. J. Britten (1982) "Molecular Biology of the Sea Urchin Embryo." *Science*, 217: 17–26.

Giudice, G. (1986) *The Sea Urchin Embryo*. Boston: Springer Verlag.

Johnson, D., and R. Johnson. (1975) *Learning Together and Alone: Cooperation, Competition, and Individualization*. Englewood Cliffs, N.J.: Prentice-Hall.

Lapp, D., J. Flood, and L. Thorpe. (1989) "Cooperative Problem Solving: Enhancing Learning in the Secondary Science Classroom." *The Science Teacher*, 51(6): 112–115.

Oppenheimer, S. B., and G. Lefevre, Jr. (1989) *Introduction to Embryonic Development*. Boston: Allyn and Bacon.

Note

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For full-page-sized copies of the figures, free of charge, contact the author.

THE INTRODUCTORY SEA URCHIN EXPERIMENT

STORAGE

Kit arrives by air express.

If not used immediately, sea urchins can be stored as they were packed in the kit—for up to 3 days—in a refrigerator. If packed in wet newspaper, simply keep wet with cold (artificial or natural) seawater. If packed in plastic bags, place intact bags in refrigerator.

Once gametes are extracted from sea urchins, both the eggs diluted in seawater and the undiluted sperm can also be kept viable for up to 3 days in a refrigerator or on ice.

N.b. Sea urchins can be kept alive in a refrigerated marine aquarium at about 9°–12°C.

MATERIALS

- ripe sea urchins
- plastic petri dishes
- beakers
- microscope slides
- pipettes
- compound microscope
- syringe filled with 0.5M KCl
- filtered natural or artificial sea water.

For artificial sea water in grams per liter of solution: NaCl 24.72; KCl 0.67; $CaCl_2 \cdot 2H_2O$ 1.36; $MgCl_2 \cdot 6H_2O$ 4.66; $MgSO_4 \cdot 7H_2O$ 6.29; $NaHCO_3$, 0.180; pH should be about 8.0 and can be adjusted with Tris buffer or NaOH and HCl)

EXPERIMENTAL METHODS

Inject 1–2 mL of 0.5M KCl into each sea urchin around mouth area. White sperm or yellow eggs will be extruded on opposite side of animal. Collect sperm without dilution in a Petri dish kept on ice. Collect eggs by placing sea urchin on a beaker filled with sea water, so eggs fall through sea water. When eggs are settled, pour off sea water and refill with fresh sea water. Eggs in this condition can be stored on ice or in a refrigerator.

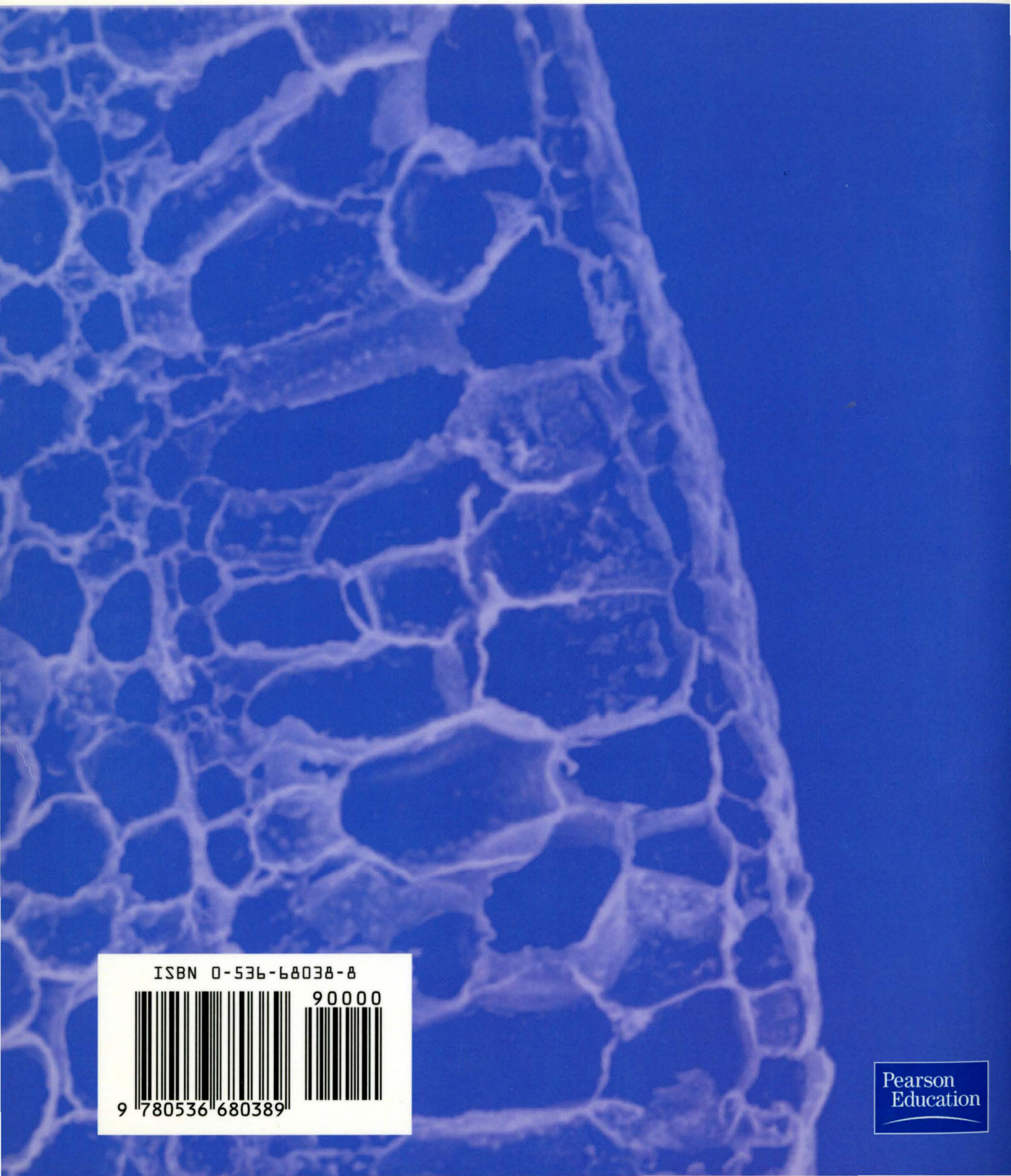
Each student places 1 drop of diluted eggs on microscope slide and quickly sketches the unfertilized eggs.

Within a minute or so, add one drop of *freshly* diluted sperm to the eggs on the slide (sperm are viable only if used immediately after dilution of 2 drops of sperm to 10 mL of sea water). Students observe the lifting of the fertilization membrane, which takes about 1 minute to complete. This can be sketched.

For research experiments, students repeat the basic experiment using different conditions or solutions. Results are easily obtained by counting the numbers of fertilized versus unfertilized eggs in several microscopic fields.

For studying early development, fertilize diluted eggs in a beaker, check for fertilization membranes, and allow fertilized eggs to settle out. Pour off sea water and refill with fresh sea water. Pour very dilute eggs into Petri dishes (half full) and keep dishes in a cool room. Plates may be studied over hours or days to observe early development with crystal clarity.

For research experiments, conditions may be altered at specific times.



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