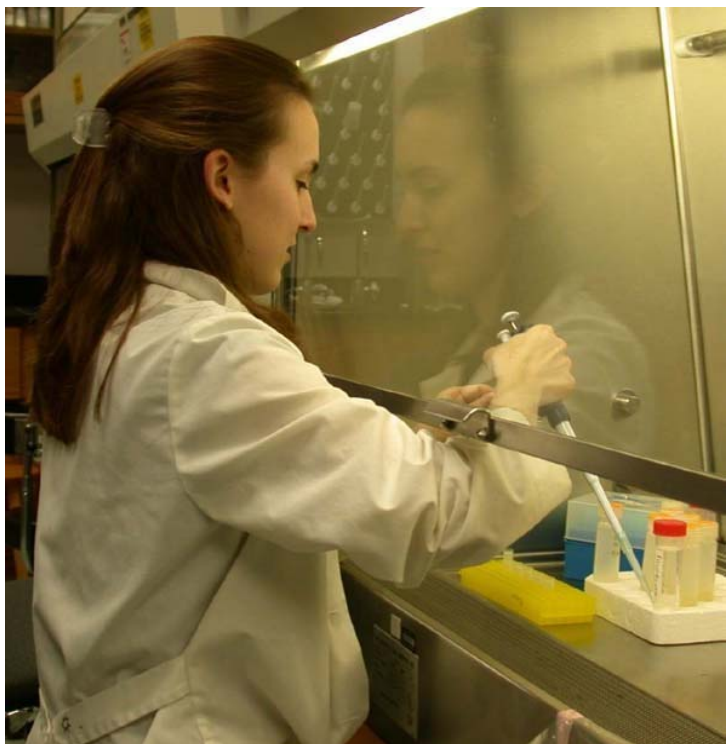


SCHOOL OF SCIENCE AND MATHEMATICS

Undergraduate Research Poster Display

April 14 - 18, 2004

Caputo Hall Lobby



- BIOLOGY
- CHEMISTRY
- COMPUTER SCIENCE
- EARTH SCIENCES
- MATHEMATICS
- PHYSICS

T A B L E o f C O N T E N T S

	<u>Abstract Number</u>
Biology.....	1-12
Chemistry.....	13-21
Computer Science.....	22-24
Earth Science.....	25-29
Mathematics.....	30-31
Physics.....	32-35
List of Undergraduate Research Students.....	i-iii
Index of Authors.....	iv-v



B I O L O G Y

1) **Body Patterns of *Octopus bimaculoides* During Predation**

Prosperi, David and Boal, Jean

Octopuses, as well as other cephalopods, have been known for their ability to change their body patterns at will. Which patterns are expressed at which times has not been studied in much depth. Four octopuses (*Octopus bimaculoides*), two female and two male, were studied to see if they exhibited specific body patterns during the behavior of predation on common fiddler crabs. Ten predation events were recorded for each octopus using a video camera, for a total of forty trials. These videos were then analyzed to see if certain body patterns were favored during predation. The predation event was divided into three stages: attention, attack, and retreat. Transition probabilities were calculated to see if body patterns were exhibited in a particular sequence during the predation event. During the attention and attack stages of the predation event, no specific body pattern was favored. During the retreat stage of the predation event, the disruptive body pattern was most commonly shown. The disruptive body pattern is considered to be cryptic. While the octopus is in the retreat stage of the predation event it is very susceptible to predation; showing a disruptive pattern during retreat could be selectively advantageous.

2) **Conditional Discrimination Learning in Cuttlefish (*Sepia pharaonis*)**

Grudowski, Jessica, Hvorecny, Lauren and Boal, Jean

Cephalopods (excluding *Nautilus*) have a higher degree of cephalization and a more complex nervous system than other invertebrates, and are thought to be capable of complex learning. We designed our study to test conditional discrimination learning in the cuttlefish, *Sepia pharaonis*, using a maze task. In the maze, patterned fabric (spotted/striped) was placed surrounding two open exits. The location of the fabric was randomly located (left/right) for each trial. Each cuttlefish was assigned a maze cue of either algae or a brick, which was placed between the two exits. These cues were used to indicate which exit, spotted or striped, was open. The criterion for learning was 6 out of 7 escapes in a row in less than one minute. Once a cuttlefish reached the criteria with one cue and patterned exit it was trained with the other maze cue and patterned exit. Once the subject reached criterion on the second maze, it was tested with the two maze configurations interspersed randomly. Eight cuttlefish demonstrated learning in problem one and six in problem two. In this last stage of the experiment, five cuttlefish demonstrated conditional discrimination learning by meeting criterion within the minimum possible number of trials. We conclude that cuttlefish are capable of retaining information needed to solve two separate maze tasks based on visual cues and thus show conditional discrimination learning.

3) **Spatial Learning in *Octopus Bimaculoides***

Hvorecny, Lauren, Grudowski, Jessica and Boal, Jean

Field observations indicate that octopuses travel long distances and learn new routes; the cues they use to orient are unknown. The following experiments were designed to test spatial learning in *Octopus bimaculoides*. In our first experiment, octopuses were taught to solve two different maze configurations, first one and then the other. The octopuses were then given trials with the two maze configurations in random order to determine whether octopuses could solve a conditional discrimination problem. Four of six octopuses successfully solved the conditional discrimination problem. Our second experiment was designed to determine what cues the octopuses were using to orient. Octopuses were first trained to find a specific burrow within a maze. After the octopuses learned the location of the burrow, we changed the placement of the visual cues within the maze. Performances improved when all cues were

removed from the maze. Performances were disrupted when the maze was rotated 180 degrees within the room. Eliminating single cues within the maze did not noticeably disrupt performances. We conclude that the octopuses were paying little attention to the visual cues within the maze and were orienting using cues outside the maze. In summary, *Octopus bimaculoides* solved a conditional discrimination problem and appeared to orient using distant rather than local cues.

4) The Effects of Liquid Bleach on Pig Decomposition in Southeastern Pennsylvania
Way, Lauren and Wallace, John R.

Some forensic evidence suggests that the presence of drugs or toxins in decomposing remains affects insect feeding activity and complicates the estimation of a postmortem interval. The purpose of our study was to evaluate the effects of a common household chemical, liquid bleach on pig decomposition in both a sun and shade microhabitat, and determine the degradation rate of bleach overtime. Experimental treatments consisted of 3 control pigs (not treated with bleach) and 3 doused pigs (doused with \approx 4 liters of Ultra Chlorox® liquid bleach) per microhabitat. We observed no differences in the decomposition process or insect colonization on experimental treatments or between microhabitats. Hypochlorite was able to be extracted from pig skin samples, however, the rate of degradation was unable to be determined due to errors in the methodology. Although this experiment requires repeating, it does appear that bleach concentration does decrease over time.

5) Macroinvertebrate Communities on Freshwater Sponges with Special Focus on Spongillafly (Sisyridae: *Climacia* sp.) Population Dynamics
Roach, Laura and Wallace, John R.

The purpose of this study is to provide baseline descriptive information on the invertebrate fauna inhabiting freshwater sponges and document aspects of the population biology of spongillaflies. Our objectives included: describe the aquatic habitat of larval spongillaflies in terms of physical/chemical attributes; compare the diversity and abundance of the invertebrate taxa inhabiting freshwater sponges as a function of depth and sponge microhabitat and; compare larval spongillafly growth rates as a function of depth and microhabitats. Freshwater sponges were collected in a quarry from three depths · Shallow · 23-24 feet ·, Middle · 27-29 feet · deep □ 33-38 feet · and three locations · quarry wall, floor and submerged structure · and examined for spongillaflies and other macroinvertebrates. Spongillafly abundance was significantly greater than any other invertebrate found on the sponges. Other macroinvertebrates inhabiting sponges included chironomids, other diptera, *Ceraclea* caddisflies, anisopteran and zygopteran odonates, amphipods, isopods and snails. Spongillaflies were most abundant on the quarry floor and in the deepest water. *Ceraclea* caddisflies and amphipods were most abundant on sponges at shallow depths. Chironomids were more abundant on sponges located on submerged structures such as boats.

6) Impacts of Stream Restoration on Aquatic Insect and Fish Communities on the Hammer Creek, Lancaster County, PA
Davis, Jennifer and Wallace, John R.

Due to the increasing number of non-point source pollutants from runoff into aquatic systems, stream restoration projects have become increasingly more common throughout the United States. Natural stream designs, i.e., streambank stabilization and/or stream relocation are often used to improve aquatic conditions. Macroinvertebrate and fish abundance and biodiversity were observed to determine the effects of stream restoration on Hammer Creek. Macroinvertebrate and fish communities were sampled and identified at five sites before and after channel restoration was initiated (July, August, December 2002 and April, August 2003) on Hammer Creek in Lancaster County, Pennsylvania. Biodiversity indices were calculated and statistically compared to determine the difference between pre and post-restoration macroinvertebrate and fish communities. Since the stream channel was re-located in this project such a traumatic event may have caused

macroinvertebrate and fish abundance and diversity in the upper and lower impact areas to decrease post-restoration. However, by August 2003, macroinvertebrate and fish abundance and diversity had recovered and exceeded pre-restoration levels at some sites. We recommend continued management and monitoring of these populations before and after stream restoration projects in which stream channels are relocated. These projects may positively influence the instream biotic communities and therefore provide rehabilitative opportunities for streams in declining physical and biological conditions.

7) Enzyme-linked Immunosorbent Assay of Chlorpyrifos and Atrazine in Native and Exotic Crayfish from Lancaster County, PA.

Iera, J. A. Turchi, S. L and Wallace, J. R.

Our objective in this study was to assay for the presence of two pesticides, atrazine and chlorpyrifos, in crayfish collected from creeks and rivers throughout Lancaster County, Pennsylvania. Approximately 100 crayfish from 33 different sites were analyzed. Enzyme-linked immunosorbent assays (ELISA) were used to detect the presence of the pesticides in the tissue of the crayfish. Both pesticides were detected in the entire set of samples. A maximum concentration of chlorpyrifos at 4.6 ppb and a maximum concentration of atrazine at 3.4 ppb occurred in crayfish from the same site in the county, and from the same crayfish species *Orconectes limosus*. The tests conclude that chlorpyrifos and atrazine exist in crayfish throughout Lancaster County, which leads to an environmental concern of the area, as well as a concern of the pesticide levels that may exist in crayfish sold as live bait.

8) Seasonal Dynamics of Cyanobacterial and Yellow-Green Algal Floating Mats in Roddy Pond on the Millersville University campus.

Schoen, Erika, McGrath, Katy, and Ambler, Julie

Floating algal mats have been observed each year in Roddy Pond from late spring to fall. Cyanobacterial mats are indicators of nutrient rich water, shade aquatic plants which create habitat for fish and invertebrates, and may produce neuro- and derma-toxins. We documented the decline of the floating mats from October 3 to November 7, 2003. Water temperature was measured continuously with a HOBO data logger, and primary production of cyanobacterial mats was measured *in situ* with the light dark bottle method on four dates. Spatial coverage of mats was determined by dividing the pond into 9 sections to estimate percent cover. Two types of algal mats were observed: dark green cyanobacterial and yellow-green algal mats. Nematodes, copepods, and ostracods were present in both types of mats. Abundance of algal mats dramatically declined after Oct. 3 and never increased even though temperatures in late October were similar to those earlier in the month when mats were present. Net primary production (NPP, balance between community respiration and total photosynthesis) declined from Sept. 16 to Oct. 23, with negative NPP on Sept. 25 and Oct. 7. Several days of negative NPP and decreasing daylength probably caused the observed population decline of mats.

9) Construction of Yeast Strains Deficient in Pseudouridine Synthase (Pus3p) Activity

Arnold-Croop S. E., Harbaugh D. L. and Hepfer, C.

In the yeast *Saccharomyces cerevisiae* a specific type of genetic exchange known as *HOT1*-associated recombination has been implicated in maintaining homology between repeated ribosomal RNA genes. Deletion of the *DEG1* gene reduces this type of recombination and prevents cell growth at 37°C. The mechanism by which *DEG1* impacts these phenotypes is unknown. Pseudouridine synthase 3 (Pus3p), the product of the *DEG1* gene, modifies the anticodon arm of transfer RNA at positions 38 and 39 by catalyzing the conversion of uridine to pseudouridine. These residues enable transfer RNA molecules to achieve the three-dimensional conformation necessary for their transport to the cytoplasm and efficient participation in protein synthesis. No relationship between the pseudouridylation of transfer

RNAs and genetic recombination has been established. It is possible that *DEG1*'s effect on recombination is simply a consequence of slowed cellular metabolism due to the impaired functioning of unmodified transfer RNAs. If this is the case, deletion of any gene coding for a pseudouridine synthase should have a similar impact on recombination. In order to test this hypothesis, yeast strains deficient in pseudouridine synthase 3 (Pus3p) were created using Polymerase Chain Reaction (PCR) technology. PCR products that include the *kan^r* gene, coding for geneticin resistance, and are flanked by sequences lying immediately 5' upstream and 3' downstream of the *DEG1* gene were used to transform wild-type yeast. Successful replacement of the *DEG1* gene with *kan^r* was verified by PCR analysis. Recombination rates and temperature tolerance will be compared in *pus3* deletion strains and in strains deficient in other pseudouridine synthases (Pus1p, Pus2p and Pus4p). These results will indicate if Pus3p's effect is specific and will further elucidate recombination mechanisms in yeast cells.

10) Rodent Performance in the Morris Water Maze Under Normothermic and Hypothermic Conditions

Krisa, L., Shoemaker, L., and Hoover, J. E.

We examined whether hypothermic conditions affect the performance of mice in the Morris water maze (MWM), a commonly used task to study spatial learning and memory in rodents. The task assesses the ability of animals to remember the location of a spatially fixed platform hidden in a large pool of opaque water. An animal's performance in the task is measured as the length of time required to escape from the water by swimming onto the platform. Equal numbers of adult mice (total $n = 36$) were randomly assigned to undergo training in the MWM at one of three different water temperatures: 20 C, 28 C, and 36 C. Subjects performed three trials per day (intertrial interval = 30 s) for six consecutive days. The location of the platform was kept constant for each animal while the animal's starting position was varied from trial to trial. Measurements of rectal body temperature were recorded before and after training each day. Statistical analysis (ANOVA) of changes in rectal body temperature before and after training revealed significant differences among the three groups of animals ($p = 0.000$). Mice assigned to the 20 C treatment exhibited an average change in body temperature of -6.78 C, while the average changes for mice in the 28 C and 36 C treatments were -2.7 C and 0.0 C, respectively. Interestingly, analyses of variance revealed no statistically significant differences in the escape latencies of animals randomized to the three water temperature treatments ($p = 0.114$). Over the course of training, subjects in each group learned to escape the water by finding and climbing onto the hidden platform. Thus, although mice required to complete the MWM at water temperatures of 20 or 28 C became hypothermic, their performance in this task was no different than that of normothermic mice.

11) Nitrate Dynamics in a Primary Stream with Impoundments

Kasitz, Jonathan P. and Steucek, Guy L.

Eutrophication of the Chesapeake Bay is a major environmental problem generated by nutrient loading due to intensive agricultural operations commonly found in Lancaster County. We studied nitrate concentrations in Silver Mine Run, Pequea Township, Lancaster County, Pennsylvania for more than two years to determine the dynamics of nitrate in a primary stream. This stream is approximately 2500 m in length with four impoundments (ponds). The upper two thirds of the watershed for Silver Mine Run is agricultural and residential, whereas the lower third of the watershed is a natural landscape. We measured nitrate levels above and below ponds to determine the impact of runs and ponds on in-stream nitrate. Highest nitrate levels were observed in the early spring and lowest in late summer. Ponds removed approximately 86 percent of the nitrate over the course of a year, whereas nitrate entered the stream within the runs. There is a strong correlation between the amount of agricultural ground in a watershed compartment and the amount of nitrate that entered Silver Mine Run in that segment. A storm event diluted the stream concentrations several fold in the space of a few hours. Forest buffers appeared to have little effect on the entry of nitrate into the watercourse. Policy decisions to remove in-stream ponds may

elevate the loading of nitrogen as nitrate in the Chesapeake Bay and thereby promote eutrophication of the Bay. Likewise, riparian forest buffers appear to have little effect in abating nitrate entering streams.

12) Water Quality Monitoring of a Conestoga River Tributary for the Outdoor Classroom at Martin Elementary School

Dill, Renee, Riley, Katie, and Ambler, Julie

This study involved monitoring water quality of an unnamed tributary of the Conestoga River that runs behind Martin Elementary School on Wabank Road, Lancaster. This is part of a stream restoration project that the school is starting to undertake in order to use the area as an outdoor classroom. The water quality must first be determined before children can be exposed to the area. In order to do this, fecal coliform colony concentration, nitrate nitrogen, ammonium nitrogen, and temperature were tested over the past few months. Samples were taken once a week from two designated sites along the tributary. Temperature records were kept continuously using a temperature data logger. Times of high sediment levels in the stream due to snow melt and storms were also recorded to determine if these events corresponded to higher levels of bacteria, nitrate nitrogen, and ammonium nitrogen.

C H E M I S T R Y

13) Effect of Ligand Binding on the Electrochemical Response of Hemoglobin

Ciesiensi, Katie L. and Rickard, Lyman

Heme proteins are of great interest because they serve as oxygen carriers, electron carriers, and enzymes. In this study hemoglobin is used as a model for heme proteins that transfer electrons because many of these heme proteins are membrane bound and difficult to isolate. The goal of this research project is to study the effect of ligand binding (CN^- , N_3^- , NO_2^-) on the electrochemical response of hemoglobin. Cyclic voltammetric peak potentials and peak currents at a surfactant-coated electrode were used to measure the electrochemical response of hemoglobin

14) Surfactant Charge Effect on the Electrochemistry of Hemoglobin

D'Antonio, Edward L. and Rickard, Lyman

Hemoglobin functions physiologically as an oxygen receiving and delivering metalloprotein. In this study hemoglobin served as a model for proteins that are electron carriers. Modified surfactant coated glassy carbon electrodes have been shown to embed large proteins within the films and contribute to improvements in the electrochemical response. Cationic, anionic and electrically neutral films were investigated to determine the effect of surfactant charge on protein electrochemical response.

15) Nitration of Di-substituted Aromatic Rings

Veety, Brian C. and Anna, Laura J.

Department of Chemistry, Millersville University, 50 E. Fredrick Street, Millersville, PA 17551

Several di-substituted aromatic compounds were nitrated using electrophilic aromatic substitution conditions to examine the directing effects of different groups. Starting materials were chosen in order to look at various competitions between types of directing groups and their activating properties. Using NMR spectroscopy and GC-MS, a ratio of products was determined from each reaction. Molecular

modeling calculations of the lowest energy intermediate of each reaction were used to predict the major site of nitration. These results could be used to develop a laboratory experiment for an organic chemistry course to examine competitive effects between directing groups in electrophilic aromatic substitution reactions.

16) Quantitative Measurement of Lead in the Paint of Millersville University Owned Buildings

Brun, Clee P. and Hill, Patricia S.

Paint samples from buildings on the Millersville University campus were collected and analyzed for lead content. Techniques used for analysis of the paint samples included atomic absorption spectroscopy (AAS), optical microscopy with microchemical testing, and laser induced breakdown spectroscopy (LIBS). The results from the three techniques as well as the advantages and disadvantages of each method were compared.

17) Analysis and Restoration of a 19th Century Painting Through Analytical Techniques

Boyer, Jennifer L. and Hill, Patricia S.

A 19th century painting (approximately 150 years old) is being analyzed to determine its composition. It is apparent by looking at the painting that the choices of paper and backing were not of the best quality because it is chipping and falling apart. The varnish used to preserve the painting has produced a yellow-brown tint across the entire work, creating a dull, filmy look. The adhesive holding the paper to the backing has also lost its effectiveness. The ultimate goals for this research include determining what varnish was used and the best way to remove it without reducing the intensity of the pigments; identifying the pigments contained in the painting to determine whether these correspond to the approximate age of the work; and cleaning and restoring the painting to the best condition possible without affecting the original image.

18) Evaluating a Potential Connection Between Inositol Hexakisphosphate (IP₆) and Mg²⁺ in *Saccharomyces cerevisiae*

Porter, Jason R and Miller, Aimee L.

Inositol hexakisphosphate (IP₆) is a known mRNA export regulator in the yeast *Saccharomyces cerevisiae*. Genetic studies have established a synthetic lethal relationship between genes encoding proteins related to generating IP₆ (*IPK1*) and regulating intracellular Mg²⁺ levels (*ALR1*). The primary goal of this research was to investigate the possible correlation between IP₆ production and cellular Mg²⁺ levels. Intracellular Mg²⁺ levels were measured by atomic absorption, allowing a comparison between yeast cells where IP₆ is produced (wild type) and those where it is not (*ipk1Δ*).

19) Effect of Mg²⁺ on Growth of a *nup159-1 S. Cerevisiae* Strain Expressing a Mutant Nucleoporin Component of the Nuclear Pore Complex

Crowell, Mary K and Miller, Aimee L.

Nup159 is a nucleoporin located on the cytoplasmic face of the Nuclear Pore Complex (NPC). It plays an essential role in the transport of mRNA across the nuclear envelope. Previous research has shown that the *nup159-1* mutant yeast strain is temperature sensitive and not viable at 37°C. Preliminary results indicate cell growth may be rescued in the presence of 200 mM Mg²⁺. The purpose of this project was to determine whether there is a direct correlation between the concentration of Mg²⁺ in the growth

medium and viability of the *nup159-1* strain at 37°C. Growth curves for the *nup159-1* strain at 25°C, 30°C, and 37°C were compared with those for wildtype cells as well as with *alr1Δ* cells known to have a Mg²⁺-dependence.

20) Proton-coupled Electron Transfer in a Manganese-oxo Cubane Model of PSII

Dennes, Thomas III¹ and Dismukes, Charles G.²

¹Department of Chemistry, Millersville University, Millersville, PA, 17551

²Department of Chemistry, Princeton University, Princeton, NJ, 08544

The Mn₄O₄ cubane core is a promising synthetic model for photosystem II. The kinetics of the H-O dehydrogenation reaction of a series of six para-substituted phenols by [Mn₄O₄(O₂PPh₂)₆], **1**, to form Mn₄O₃(OH)(O₂PPh₂)₆ were studied. The reaction is bimolecular overall and first order with respect to both the phenol and **1**. The rate varies over three orders of magnitude and exhibits a linear correlation with the H-O bond dissociation energy (BDE) between 82.2 and 94.1 kcal/mol. The H/D kinetic isotope effect (kH/kD) was found to be 2.03±0.19 and independent of the BDE. The enthalpy and entropy of activation were measured using p-Me-phenol from the temperature dependence of the rate constant. A large entropy decrease (4.6x10³ kcal/molK) and small enthalpy (2.8 kcal/mol) of activation were found, indicating an appreciable increase in order in the transition state. These data show that the transition state is more complicated than merely direct hydrogen atom transfer reaction and must involve the attainment of a reactive geometry suitable for PCET. However, docking experiments using the XRD crystal structure of **1** revealed no closer access to the corner oxos than *ca.* 7 Å. Molecular dynamics simulations were performed on a solution of **1** and phenol. A potentially reactive geometry could be achieved in which atomic HO-phenol contact with the corner oxos of **1** takes place infrequently. Formation of this encounter complex requires gearing of three interlaced phenyl rings surrounding each corner oxo. These simulations support well the activation studies and point to gearing of the phenyl phosphinate rings as a significant contributor to attaining the reactive transition state in this PCET reaction.

21) Synthesis and Characterization of Novel Tungsten-Diphos Complexes

Rood, Jeff, Rajaseelan, Edward, and Burkholder, Eric¹

¹Department of Chemistry, Syracuse University, Syracuse, NY 13244

Novel Tungsten complexes of the type W(CO)₂Br₂(L-L)₂, (L-L = dpmm, dppe, dppp) have been synthesized and characterized by elemental analysis, infra red spectroscopy, and multinuclear (¹H, ¹³C, ³¹P) NMR spectroscopy. The x-ray crystal structure of W(CO)₂Br₂(dpmm)₂ is determined where one diphenylphosphinomethane(dpmm) ligand is coordinated as a bidentate and the other as a monodentate ligand. The synthesis involving diphenylphosphinobutane(dppb) resulted in the formation of seven coordinate W(CO)₃Br₂(dppb).



22) **A Haptic Surgical Simulator for the Continuous Curvilinear Capsulorhexis Procedure During Cataract Surgery**

Webster, Roger, Sassani, Joseph¹, Shenk, Rodney, Good, Nathan

¹Department of Ophthalmology, Penn State University College of Medicine, Milton S. Hershey Medical Center, Hershey, PA USA 17033

This paper describes a technique for simulating the capsulorhexis procedure during cataract surgery. The continuous curvilinear capsulorhexis technique can be a difficult procedure for beginning ophthalmology surgeons. In the initial phase of tearing the tissue, the tear vector is tangential to the circumference of the tear circle. However, without the proper re-grasping of the flap of torn tissue close to the tear point, the tear vector angle quickly runs downhill possibly causing severe damage to the tissue. Novice surgeons tend to try to complete the capsulorhexis without the time consuming re-grasping of the tissue flap. Other factors such as anterior bowing of the lens diaphragm, patient age, and shallow anterior chambers add to the problematic nature of the procedure. Our capsulorhexis simulator models these various tear problems and anomalies to provide a training environment without the dangers of using live patients.

23) **Constructing a Natural Language Parser**

Blanchard, Daniel and Elzer, Stephanie

Parsing is the process of taking a string of input and splitting it into categorically labeled pieces, such as parts of speech or clauses. The parsing of natural language is important because it allows for a more natural interaction with a computer and allows linguistic analysis programs, such as grammar checking software, to exist. Parsing natural language is usually a slow $O(k^n)$ operation, unless one utilizes the Earley parsing algorithm. This famous algorithm outlines a method to reduce the complexity of the problem to $O(n^k)$ time, which drastically increases the number of utterances that can be parsed within a set period of time. This project involved implementing the Earley algorithm and exploring several pruning techniques as to their potential for improving the parsing process.

24) **A Virtual Reality Trainer for Operative Set-up and Exposure for Laparoscopic Cholecystectomy**

Webster, Roger,² Haluck, Randy S.¹, Good, Nathan, Sampson, Shanna, Reeser, Jon, Boyd, Joshua, Benson, Aaron, and DeSanto, David

¹Department of Surgery, Penn State College of Medicine, Milton S. Hershey Medical Center, Hershey, PA USA 17033

²Verefi Technologies Incorporated, www.verefi.com, Hershey, PA, USA 17033

This paper describes a laparoscopic cholecystectomy surgical training software system we have developed using the Immersion Virtual Laparoscopic Interface™ (VLI) hardware. The trainer is designed to train and test for many laparoscopic skills such as: manipulation of the laparoscope, grasping and stretching the gallbladder to expose the cystic duct, clip application to the cystic duct, cutting the cystic duct, and removing the gallbladder from the abdomen. Simulated patient breathing is accomplished by using a texture motion algorithm. The gallbladder, cystic duct and bile ducts are stretched and compressed using Hooke's law of $F=-kx$ within a mass-springs model. The intent is to provide an effective method to learn the laparoscopic cholecystectomy procedure using a low cost surgical simulator. A port of the software to the Immersion Surgical Workstation™ with haptics is currently underway.

EARTH SCIENCE

25) **Anomalous Distributions of Calanoid Copepod Species During July 2003 in Coastal Waters off Chincoteague Inlet, VA**

Miller, Carrie J., Ambler, Julie W., and Soong, Yin S.

Hydrographic and biological parameters were collected on July 17, 2003, along a transect starting at Chincoteague Inlet, VA, and extending 42.5 km offshore. Vertical profiles of temperature and fluorescence (index of algal biomass) were measured at 14 stations with a Seabird Sealogger 25 CTD, nitrate and phosphate were measured from bottle samples, and vertical tows of zooplankton (small copepod crustaceans) were collected. The dominant feature was a deep chlorophyll maximum (DCM) layer, which extended along the entire transect at depths of 6 to 14 meters and occurred just beneath the seasonal thermocline. The 14-station transect was divided into 3 main regions: the well-mixed inlet, a frontal zone where isotherms approached the surface, and the stratified deeper ocean. Nitrate and phosphate were low at all stations, $< 2 \mu\text{M}$. Nutrients had probably been much higher, since high chlorophyll and zooplankton concentrations ($60 \text{ animals L}^{-1}$) were found in the frontal zone. Zooplankton samples included northern calanoid copepod species, which are not typically seen off Chincoteague Inlet, and probably represented significant onshore water transport prior to our sampling. A transition between dominant copepod species could be seen, with *Acartia tonsa* dominant in nearshore waters and *Temora longicornis* as well as *Pseudocalanus spp.* offshore. Since 2003 was a positive North Atlantic Oscillation (NAO), the Labrador Current may have extended further south and come closer to shore than during a negative NAO year. Southerly winds prior to July 17, 2003 were favorable for coastal upwelling. These conditions may have facilitated the movement of the northern copepod species into the transect area.

26) **Correlating Measured Pollutants in Northeast Philadelphia to Sources Using ArcGIS**

Lowery, Evan, Brewer, Daniel, O'Donnell, Dennis, and Rabatin, Daniel

Pollution today has become both an important social and economic factor in every American's life. It has been linked to both illness and ecological disaster. Yet, little is known about how emissions spreading across the mid-Atlantic and northeastern states, are affected by the weather they encounter. For instance, do areas having normally higher levels of CO₂, SO₂, and NO_x coincide with areas of increased precipitation, health problems, and ecological disasters? In order to discover answers to these and other questions, data from a combination of API analyzers, small balloon soundings, historical regional emissions data, National Weather Service observations and model output, back trajectories, and advanced modeling software (ArcGIS) were integrated to study haze and pollution events in Philadelphia.

HYSPLIT back trajectories were mapped up to 48 hours in advance of the event in hourly intervals, giving the location of air parcels at three specific heights. Combined with (EPA) emission data, GIS was used to display an air parcel on its way to Philadelphia traveling through weak and intense concentrations of CO₂, NO₂, and NO_x. Our research focuses on the path the air parcel travels through these regions of varying trace gas concentrations, and their affect on the local concentrations observed in Philadelphia. Future plans include the incorporation of precipitation totals at each of the emissions plants and population demographics to help us further understand the effect of meteorology on pollution concentrations.

27) Summary of Northeast Oxidant and Particle Study (NE-OPS) 2002

O'Donnell, Dennis M. and Clark, Richard D.

Air pollution is not a problem that is restricted to a certain area. Pollutants produced in regions hundreds of miles away can have a far-reaching effect on the air quality at a particular downstream site. The goal of this research is to identify these regions and also track the trajectories of the pollutants using geospatial analysis (ArcGIS), and estimate the contribution of urban plumes to the concentrations observed near Philadelphia.

During the summer of 2002 there were a variety of interesting air quality events in the Philadelphia area. Ground measurements were taken using a TSI three wavelength total and back scattering nephelometer and multiple trace gas analyzers (CO, O₃, SO₂, NO/NO₂/NO_x). Aloft measurements up to 300m AGL were taken using a tethered atmospheric sounding system, which recorded conventional meteorological variables, ozone concentrations and particle concentrations using laser diode scatterometry. Back trajectories combined with emissions data from the Environmental Protection Agency are used to identify the possible sources of the trace gases observed at the Philadelphia site. ArcGIS is employed to evaluate source-receptor relationships, dispersion of pollutants along trajectories, and elucidate transport mechanisms. A brief analysis of events such as the haze event of July 1-3, the Canadian smoke event on July 5-8, the sea breeze event of July 20, and other high ozone episodes will be included.

28) Using Modis to Investigate a Canadian Wildfire: Smoke Event

MacKenzie, Wayne M. Jr. and Scala, John R.

The Moderate Imaging Spectrometer (MODIS) sensor flying on a NASA operated satellite (Terra) provides unique perspectives of the Earth's atmosphere, ocean and land surfaces. The high spatial and spectral resolution provided by the 36 channel instrument differentiates Earth emission from solar reflectance, vegetated from non-vegetated surfaces, and details atmospheric profiles of temperature and moisture. The Aerosol Product, which monitors aerosol optical thickness, and aerosol size distribution, is applied to a smoke/haze event that occurred over several large metropolitan cities in the mid-Atlantic on July 6-8, 2002. The pollution resulted from rapid transport of wildfire products southward from Northern Québec. These fires were sparked by lightning associated with a mid-latitude cyclone. The high aerosol content of this plume saturated the algorithm over land preventing the instrument from differentiating cloud mass from the fire products. However, characterization of the aerosol plume over water immediately downwind of the coast (e.g., NYC metropolitan area) provided more information on key properties of the plume including corrected aerosol optical thickness, aerosol content, mass concentrations, reflectance and backscattering.

29) Relationships Between Gulf of California Moisture Surges and Precipitation in the Southwestern U.S.

Hain, Christopher, Higgins R.W.¹ and Shi, Wei²

^{1,2} Climate Prediction Center, NCEP, Camp Springs, MD

Relationships between Gulf of California moisture surges and precipitation in the southwestern United States are examined. Standard surface observations are used to identify gulf surge events at Yuma, Arizona for a multi-year (July-August 1977-2001) period, and CPC precipitation analyses and NCEP/NCAR Reanalysis data are used to relate the gulf surge events to the precipitation and atmospheric circulation patterns, respectively. Emphasis is placed on the relative differences in the precipitation and circulation patterns for several categories of surge events, including those that are relatively strong (weak) and those that are associated with relatively wet (dry) conditions in Arizona and New Mexico after onset. The extent to which these patterns are influenced by a phasing of tropical easterly waves and midlatitude westerly waves is also considered. Results indicate that a significant fraction of the events in all

categories are related to the passage of tropical easterly waves across western Mexico, but that the strength and location of upper-tropospheric anticyclonic circulation features in midlatitudes strongly influence whether a given surge will be associated with anomalously wet (dry) conditions in Arizona and New Mexico.

M A T H E M A T I C S

30) **Periodic Orbits in Triangular Air Hockey**

Baxter, Andrew and Umble, Ron

This project examines the existence of periodic orbits on a triangular air hockey table. Periodic orbits are known to exist on all equilateral, acute, right and isosceles triangles, as well as obtuse triangles whose interior angles are rational multiples of π . Whether or not periodic orbits exist on every obtuse triangle is an open question, and is the focus of our current work.

31) **Teaching Styles and the van Hiele Levels: An Analysis of the Effects of Two Teaching Styles on Student Learning in Geometry.**

Boyle, Shannon and White, Janet

The importance for students to have a solid understanding of geometry is increasing in high schools throughout the United States. For this reason, educators must be aware of how students learn geometry and what styles of teaching are the most effective in geometry courses. Pierre van Hiele and Dina van Hiele-Geldof developed a theory that describes a set of levels that students follow when they learn geometry. Their theory has been the focal point of a great deal of research which details the learning processes of students taking geometry. However, the amount of research completed on which teaching styles will create the most beneficial environment for student learning is limited. In this study, the researcher analyzed the effects of two different teaching styles, constructivist and traditional, on student learning by observing two teachers and testing their students using a pre and post assessment developed by Zalman Usiskin.

P H Y S I C S

32) **Incoherent Radar Backscatter From the Ionosphere**

Clark, Linde and Price, C. W.

Incoherent scatter radar (ISR) can be used to derive ionospheric parameters such as electron densities, ion and electron temperatures, and ion and electron drift velocities. In order to perform this analysis it is necessary to represent density fluctuations, vis-à-vis refractive index inhomogeneities, caused by pressure perturbations and thermal fluctuations within the ionospheric medium as a spectrum of waves, which can be studied using Fourier analysis. The two dominant types of density fluctuations are considered, Langmuir waves and ion-acoustic waves. By using Fourier analysis and considering the backscatter of the signal from these refractive index inhomogeneities, two distinct Bragg scattered lines in the ISR spectrum can be predicted.

33) **Visualizing the Resonance Phenomenon**

Kurman, Matt and Dooley, J. W

The amplitude and phase of a driven damped harmonic oscillator may be visualized using "Barton's Pendulums Experiment," as described in *Vibrations and Waves*, French A. P. (Chapman & Hall 1971). We present a realization of this demonstration, using 10 light pendulums with lengths distributed around 1 meter, driven by a 4kg 1 meter pendulum. The pendulums are coupled together on a 1" shaft, mounted on pillow blocks to an A-frame stand. The stand was designed to collapse for transportation and storage.

34) **Heat Conduction in a Metal Cylinder**

Ryan, Jason T. and Price, C. W.

Conduction, convection and radiation are the three types of heat transfer. I will be concentrating on conduction in my research. Through the use of partial differential equations (PDE) and the appropriate boundary values I can mathematically model the flow of heat through a metal rod. The purpose of my first experimental set up was to test experimental techniques for use in later experiments. I chose to use simple time independent boundary conditions in a one dimensional heat equation, and built an experimental set up to reflect this choice of conditions. I can then compare the experimental data with the solution to the PDE. I plan to build experiments for time varying boundary values, two dimensional heat flow, and internal heat sources. All of these can be modeled with more complicated versions of the heat equation. I want to apply my findings to real world situations involving heat flow, mainly the heat generated in impact type drills used in construction applications.

35) **The Anisotropic Electrical Properties of Chiral Sculptured Thin Films**

Snyder, Matt and Gilani, T. H

Chiral Sculptured Thin Films exhibit a property of unidirectional nonhomogeneity which is responsible for a subsequent electrical anisotropy in the films. The Montgomery method is used to measure the anisotropic resistivity in the films which in turn is used to map the dimensions of the anisotropic sample to those of an equivalent isotropic sample with a uniform resistivity. Four films were studied, each deposited onto a silicon substrate with thicknesses ranging from 200-3000 nm.



I N D E X

<u>Name</u>	<u>Abstract Number</u>
Ambler, Julie W.....	8, 12, 25
Anna, Laura J.....	15
Arnold-Croop, S. E.....	9
Baxter, Andrew.....	30
Benson, Aaron.....	24
Blanchard, Daniel.....	23
Boal, Jean.....	1, 2, 3
Boyd, Joshua.....	24
Boyer, Jennifer L.....	17
Boyle, Shannon.....	31
Brewer, Daniel.....	26
Brun, Clee P.....	16
Burkholder, Eric.....	21
Ciesienski, Katie L.....	13
Clark, Linde.....	32
Clark, Richard D.....	27
Crowell, Mary K.....	19
D'Antonio, Edward L.....	14
Davis, Jennifer.....	6
Dennes, Thomas III.....	20
DeSanto, David.....	24
Dill, Renee.....	12
Dismukes, Charles G.....	20
Dooley, J.W.....	33
Elzer, Stephanie.....	23
Gilani, T. H.....	35
Good, Nathan.....	22, 24
Grudowski, Jessica.....	2, 3
Hain, Christopher.....	29
Haluck, Randy S.....	24
Harbaugh, D. L.....	9
Hepfer, C.....	9
Higgins, R. W.....	29
Hill, Patricia S.....	16, 17
Hoover, J. E.....	10

Hvorecny, Lauren.....	2, 3
Iera, J. A.....	7
Kasitz, Jonathan.....	11
Krisa, L.....	10
Kurman, Matt.....	33
Lowery, Evan.....	26
MacKenzie, Wayne M.....	28
McGrath, Katy.....	8
Miller, Aimee L.....	18, 19
Miller, Carrie J.....	25
O'Donnell, Dennis.....	26, 27
Porter, Jason R.....	18
Price, C. W.....	32, 34
Prosperi, David.....	1
Rabatin, Daniel.....	26
Rajaseelan, Edward.....	21
Reeser, Jon.....	24
Rickard, Lyman.....	13, 14
Riley, Katie.....	12
Roach, Laura.....	5
Rood, Jeff.....	21
Ryan, Jason T.....	34
Sampson, Shanna.....	24
Sassani,, Joseph.....	22
Scala, John.....	28
Schoen, Erika.....	8
Shenk, Rodney.....	22
Shi, Wei.....	29
Shoemaker, L.....	10
Snyder, Matt.....	35
Soong, Yin S.....	25
Steucek, Guy L.....	11
Turchi, S. L.....	7
Umble, Ron.....	30
Veety, Brian.....	15
Wallace, John R.....	4, 5, 6, 7
Way, Laruen.....	4
Webster, Roger.....	22, 24
White, Janet.....	31