SCHOOL OF SCIENCE AND MATHEMATICS

Undergraduate Research Poster Display

October 26-29, 2005

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

Note: The names of Millersville University faculty advisors are designated by an asterisk (*) in the abstracts.

1. DEG1, SCH9 and TPK1 May Impact HOT1-Stimulated Recombination Via A Common Pathway in Saccharomyces cerevisiae.

Arnold-Croop, S.E. and Hepfer, C. Ely*
Department of Biology, Millersville University, Millersville, PA 17551

In the yeast Saccharomyces cerevisiae, a specific type of genetic exchange known as *HOT1*-stimulated recombination has been implicated in maintaining homology between repeated ribosomal RNA genes. Five trans-acting <u>HOT1</u> <u>r</u>ecombination <u>m</u>utants (*hrm* 1-5) that reduce this type of recombination have been identified. Mutations in the gene designated *HRM3*, which is identical to *DEG1*, also slows cell growth, especially at 37°C. 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 efficient participation in protein synthesis. Altered synthesis of certain proteins may explain *DEG1*'s impact on growth and recombination, but specific mechanisms of *DEG1* action remain unknown. A second gene, *HRM2,* causing reduced recombination and slowed growth, is identical to *SCH9*. *SCH9* encodes a protein kinase involved in cell growth that may function in parallel to cAMP-dependent <u>p</u>rotein <u>k</u>inase <u>A</u> (PKA). *TPK1*, which encodes a catalytic subunit of PKA, has been shown to repress the recombination defects in *sch9* mutants when over expressed, supporting a relationship between *SCH9* and PKA. It is possible that *DEG1* impacts *HOT1*-stimulated recombination by modulating *SCH9* or *TPK1* activity. In this investigation, *deg1* mutant strains have been transformed with expression plasmids containing *TPK1* or *SCH9*. Recombination rates and temperature tolerance of these transformants were compared to *DEG1* and *deg1* mutant strains. If *DEG1* impacts *HOT1*-stimulated recombination by modulating the activity of *TPK1* or *SCH9* gene products, over expression of these genes could suppress the hyporecombination defect of *deg1* mutants. The results of this investigation should further elucidate pathways involved in genetic recombination in yeast.

2. Antibody Attachment to Nanowire Arrays

Dower, Nicholas J.; Pelliccia, Jose L.; Rickard, Lyman* and Cosentino, M. James *
Departments of Biology and Chemistry, Millersville University and Illuminex Corp., Millersville, PA 17551

A new approach in the development of sensors that will detect extremely small concentrations of analytes such as hormones or cancer indicators in blood and other fluids very rapidly is one that utilizes nanotechnology. In this approach, very small structures such as nanowire arrays need to be coated with active antibodies directed against the analytes to be detected. It is the purpose of these experiments to measure the degree of antibody attachment and the percent of those antibodies that are actually functional. That is, to note the fraction of antibodies that really bind the antigen when they are attached to the nanowires. We have attached antibodies made against an indicator for ovarian cancer (CA 125) to nanowire arrays provided by Illuminex Corporation. These arrays are groups of parallel wires measuring approximately 80 nanometers by 120 nanometers attached to a glass substrate. Through a series of chemical reactions using specific long chain compounds as spacer molecules, the antibodies were incubated with the nanowires and thus covalently attached. We then incubated these functionalized arrays with a fluorescent second antibody made against the attached antibody. The degree of fluorescence detected is proportional to the amount of antibody attached to the nanowires. In order to assess the percentage of the attached antibodies that will actually bind the cancer indicator, we incubated this antigen with the antibodies linked to the nanowires. Then, a third fluorescent antibody directed against

the cancer marker (CA 125) was subsequently incubated with this mixture so as to attach to the CA 125 antigen that had been attached to the first antibody. High levels of fluorescence in this preparation indicated that a significant percentage of antibody that was attached in the initial reactions was indeed active and would bind the cancer marker readily.

3. Distribution and Abundance of Appendicularians in Coastal Virginia Waters

Kopala, Stephanie and Ambler, Julie*
Department of Biology, Millersville University, Millersville, PA 17551

The area between the mouths of the Delaware and Chesapeake estuaries in the Mid Atlantic Bight (MAB) region has a higher salinity than the surrounding areas, making this a unique place to study organisms affected by stratification and density-driven currents. We sampled a 40 mile long transect off the coast of Chincoteague, VA at eight stations during the summer months of July and August. A vertical plankton tow with an 80μm mesh net was used to collect zooplankton samples and a CTD was used to obtain temperature and salinity profiles. Appendicularians were found at near shore stations (1-5) in abundance, with few found at stations 6-8. We found the water column to be stratified with a strong thermocline typical of summer conditions. One appendicularian genus, *Oikopleura*, has been identified from the samples collected. The presence of appendicularians in coastal waters has an important impact on marine food webs. These Urochordates create a gelatinous house around their body through which they filter small (nano- and pico-) phytoplankton. The house can be discarded up to ten times per day as it gets clogged with larger phytoplankton. The discarded houses are an important food source for many animals in the water column, as are the appendicularians themselves

4. Changes in Avian Communities Associated with Streamside Restoration

Lituma, Christopher (MU 2005) and Zegers, David A.*
Department of Biology, Millersville University, Millersville, PA 17551

In July of 2004 LandStudies, Inc. conducted a stream/floodplain restoration project (Fox-Zimmerman) on the Hammer Creek in Lancaster County, PA. The project entailed altering the flow regime of the creek channel as well as providing it with an effective floodplain. In 2002 a similar alteration was performed on another portion of the same creek (Snavely Mill). In May 2004 we started a study designed to assess changes in avian species diversity at theses two locations. Our objective was to document avian community changes during the restoration at Fox-Zimmerman and to compare that to the previously restored Snavely Mill location. At each location a point count census was conducted at 10-20 day intervals from May, 2004 through February, 2005. Four sampling points were established between 10 and 20 meters apart. All birds seen and heard within a 10 meter radius during 10 minutes were recorded. The two sites results showed a significant difference in species richness, but no significant difference in species evenness. Seasonal changes in bird activity, migration and habitat changes associated with restoration probably contributed to the differences seen in the composition of avian communities during the study.

5. The Use of Scanning Electron Microscopy in the Assembly of Nano-Structures

McKinsey, Nichole; Habib, Youssef and Cosentino, M. James*
Department of Biology, Millersville University and Illuminex Corp., Millersville, PA 17551

Nanotechnology involves technological development of devices that operate on the nanometer scale. The goal of this novel technology is to exploit the inherent molecular size of nano-structures since they have unique optical and electronic properties. Thus, nanotechnology has the potential to improve innumerable aspects of our everyday lives. In the manufacture of nano-structures (less than $1x \ 10^{-7}$ m) it is essential to visualize the results of the process so that configuration, spacing, and cleanliness of the preparation can be observed and modified as needed. We have been using a scanning electron microscope (SEM) for this purpose to the advantage of producing consistent arrays of nanowires on a glass substrate. The nanowires we produce are made of silver (Ag) and gold (Au) which lend themselves well to SEM analysis. These arrays are used in the development of devices such as highly accurate sensors for medical diagnostics, chemical detection, photovoltaic structures for high performance portable generation of electricity, as well as thermal management systems. We demonstrate here, the usefulness of SEM to image and measure nanowire arrays under different fabrication processes. By noting the morphometric results of different manufacturing conditions, we can control the width, length and spacing of these arrays so as to optimize their configuration for use in various applications. The images displayed here demonstrate the usefulness in monitoring nanostructure assembly using the scanning electron microscope.

6. Impact of Stream and Floodplain Rehabilitation on Macroinvertebrate Community Structure and Diversity on the Hammer Creek in Lancaster County, PA.

Reppert, Jason C.; Kondikof , Bryan, and Wallace , John R.*
Department of Biology, Millersville University, Millersville, PA 17551

Naturally occurring floodplains act as a barrier to adverse effects from anthropogenic sources, while retaining aquatic organism diversity and potentially increasing stream productivity. The purpose of the study is to examine macroinvertebrate communities in response to stream and floodplain rehabilitation. This is an on-going study initiated with pre-restoration sampling conducted in July/August 2001. Post-rehabilitation sampling began in December 2001 and is continuing until the present. Long-term monitoring is being conducted among five sampling sites: above the restored area (control site), two sites within the restored section of the stream, and two sites 100 and 2500 meters below the impacted reach. Macroinvertebrates were sampled from the sites using a modified Hess sampler (n=6 replicates samples/ site). Macroinvertebrates were identified to generic level and analyzed using several metrics such as, Shannon and Simpson biodiversity indices, percent EPT, Functional feeding group analyses, ratio of scrapers to collector-filterers, and ratio of EPT abundance to Chironomidae. We found that stream restoration "traumatized" the macroinvertebrate community and diversity exhibited a lag-time in recovery. Because of an increase in riffle habitat, a modification of flow regime, and potential for preservation of habitat heterogeneity within these riffle zones, macroinvertebrate diversity may respond according to this improvement in habitat.

7. **Determining a Postmortem Submersion Interval (PMSI) based on Algal/Diatom Diversity on Decomposing Mammalian Carcasses in Brackish Ponds in Delaware.**

Zimmerman, Kathryn and Wallace John R.*
Department of Biology, Millersville University, Millersville, PA 17551

Algae and diatoms have been employed to estimate the location of drowning victims as well as link criminal suspects to specific aquatic crime scenes. However, little or no evidence exists on documenting algal colonization and succession on mammalian carcasses in brackish or marine environments. The purpose of this presentation is to document how saline environments influence not only the rate that pig carcasses decompose, but also characterize the algal/diatom community at each stage of decomposition in order to use species diversity and composition indices to estimate a PMSI. The objectives of this study include: 1) characterize the physical changes and rate of pig decomposition in saline aquatic systems; 2) compare algal diversity on pigs to a natural substrate such as ceramic tiles and; 3) determine if species richness or diversity differs among stages of decomposition. Salinity measurements were determined using a refractometer. To examine algal diversity on pig carcasses vs. a natural substrate, samples were collected every 3 days (trial one) and every 2 days (trial two) for approximately 20 days. Algal samples were preserved in Lugoli solution and glacial acetic acid and stored in dark conditions until analysis. Algae and diatom species were identified using a light microscope and photographed with a Nikon Digital Camera. Species diversity and evenness among stages of decomposition were determined using Shannon and Simpson's diversity indices. The mean diversity indices for pig carcasses and ceramic tiles were compared using a t-test. Previous studies have revised or suggested that five not six stages of decomposition have been identified for mammalian carcasses in freshwater aquatic systems. We describe five stages in this study: Submerged Fresh, Early Floating, Advanced Floating Decay, Floating Remains, Sunken Remains. Ponds in this study maintained a salinity value of 2-4 ppt. Accumulated degree days for trial one of this study was 893 degree days. Algal diversity was significantly greater on pig carcasses than ceramic tiles. Diversity increased significantly as decomposition progressed until pig carcasses had reached the advanced floating decay stage. We found that mammalian carcasses will support algal/diatom communities and that these communities experience plant succession similar to terrestrial habitats. However, in terrestrial systems, plant succession/diversity increases over time, in aquatic systems, plant succession/diversity will increase and eventually decrease as the substrate (mammalian carcass) decomposes. This study shows how algal/diatom diversity and taxonomy can be used to determine the duration a submerged victim has been under water.

C H E M I S T R Y

8. **Rapid Extraction of Pollutants from Fish Tissue for Analysis Using Micoremulsion Media**

Hanson, Alynne L. and Mbindyo, Jeremiah K.N. *
Department of Chemistry, Millersville University, Millersville, PA 17551

A new technique for the rapid extraction of persistent organic pollutants from fish tissue for analysis was developed. The method is based on use of microemulsion media instead of organic solvents such as methylene chloride and hexane. Microemulsions are clear homogeneous fluids with nanoscale structure that consists of droplets or cylindrical conduits of oil in water, or water in oil surrounded by surfactants molecules. They are environmentally friendly replacements to toxic organic solvents. The process developed is much faster than traditional soxhlet extraction. Results using gas chromatography-electron

capture detector (GC-ECD) analysis show quantitative recovery of 4, 4-dichlorobiphenyl from spiked fish tissue.

9. Self Assembled Multilayers of DNA and Polyekectrikytes on Au Nanoparticles

Yourey, William M. and Mbindyo, Jeremiah K.N. *

Department of Chemistry, Millersville University, Millersville PA 17551

Polyelectrolytes are polymers with multiple positively or negatively charged groups. They can be synthetic or naturally occurring. DNA is an example of a naturally occurring polyelectrolyte. In this work, calf thymus DNA and two synthetic polyelectrolytes were assembled on Au coated glass, quartz glass slides and Au nanowires using layer by layer self assembly. The films were characterized using UV-Visible spectroscopy, transmission electron microscopy (TEM) and scanning electron microscopy (SEM). Results show that the film thickness increased with increasing number of polyelectrolytes bilayers. Such films are of interest in fabrication of nanoscale chemical and biosensors, nano reactors and for controlled drug delivery.

COMPUTER SCIENCE

10. Simulating the Curvilinear Capsulorhexis Cataract Procedure on the EYESI™ System

Harris, Matt, [1]; Gerber, Jesse [1]; Billman, Chad [1]; Webster, Roger* Ph.D.[1]; Sassani, Joseph M.D.[2]
[1]Department of Computer Science, Millersville University, Millersville, PA 17551
[2] Department of Ophthalmology, Penn State University College of Medicine, Milton S. Hershey Medical Center, Hershey, PA 17033

 This paper describes a technique for simulating the capsulorhexis procedure during cataract surgery on the EYESI™ system. Eye surgery necessitates sub-millimeter precision and demanding hand-eye coordination in a very small workspace, thus making it difficult to simulate. Some researchers have developed eye surgical simulators, but none have attempted to model 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 downhillpossibly 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. The tissue area is modeled as a curvilinear mesh of nodes and springs. Deformation is accomplished via a physically based particle model utilizing a heuristic algorithm to constrain the deformation calculations to the locality of the tear area to speed up computations. The software alerts the user of any potential tear problems before they occur thus instructing the novice surgeon. For example, as the user approaches the 12 o'clock position the tear vector unintuitively begins to run peripherally. If the surgeon attempts to redirect it by traction directed in a radial fashion toward the center of the lens, the tear only propagates further peripherally (runs downhill). Continuing to try to redirect the tear can cause severe damage to the tissue in an actual patient. The EYESI™ hardware system (from VRMagic GmbH) provides the user with stereoscopic images thus providing 3D viewing. Our capsulorhexis simulator software

models various tear problems and anomalies to provide a useful training environment without the dangers of using live patients.

11. Using an Approximation to the Euclidean Skeleton for Efficient Collision Detection and Tissue Deformations in Surgical Simulators

Harris, Matt [1]; Gerber, Jesse [1]; Webster, Roger* Ph.D.[1]; Billman, Chad; Haluck, Randy, M.D.[2]
[1]Department of Computer Science, Millersville University, Millersville, PA. 17551
[2] Department of Surgery, Penn State College of Medicine, Milton Hershey Medical Center, Hershey, PA 17033

This paper describes a technique for efficient collision detection and deformation of abdominal organs in surgical simulation using an approximation of the Euclidean skeleton. Many researchers have developed surgical simulators, but one of the most difficult underlying problems is that of organ-instrument collision detection followed by the deformation of the tissue caused by the instrument. Much of the difficulty is due to the vast number of polygons in high resolution complex organ models. A high resolution gall bladder model for instance can number in the tens of thousands of polygons. Our methodology utilizes the reduction power of the skeleton to reduce computations. First, we recursively compute approximations to the Euclidean skeleton to generate a set of skeletal points for the organ. Then we pre-compute for each vertex in each polygon the associated skeleton point (minimal distance discs). A spring is then connected from each vertex to its associated skeleton point to be used in the deformation algorithm. The data structure for the organ thus stores for each skeletal point its maximum and minimum distances and the list of associated vertices. A heuristic algorithm using the skeleton structure of the instrument and the skeleton of the organ is used to determine instrument collisions with the organ

12.   High Performance Computing and Computer Aided Engineering

Payeur, Robert M. and Zoppetti, Gary M.*
Department of Computer Science, Millersville University, Millersville, PA 17551

Advances in 64-bit processors, computer systems, and software platforms are bringing more computing power within the reach of Computer Aided Engineering (CAE) users. In June 2004, Intel released the Xeon Extended Memory 64-bit Technology (EM64T) processor, continuing the decades-long trend of dramatic improvements in processor cost/performance. EM64T is a set of extensions to the Intel IA-32 architecture. Features include full 64-bit wide registers, eight additional general purpose registers, eight additional SSE registers, and native 32-bit capability. With parallel advances in interconnects such as PCI Express and Infiniband, and cluster operating systems and management tools, high performance computing (HPC) has become affordable for many companies. IBM engineers have taken these advances and turned them into low-cost, reliable, cluster systems capable of scaling to teraflop performance. In fields such as CAE, these clusters are leveraged to reduce product development time, decrease time to market, and improve product quality. Detailed models are used throughout the engineering process to simulate the performance of proposed and existing designs. In this research we investigate how the confluence of HPC technologies has allowed manufacturing companies to deploy new applications that require increasingly complex models.

13. Mechanisms for Almandine Garnet Weathering in Lancaster County, Pennsylvania

Anderson, Diane and Price, Jason R.*
Department of Earth Sciences, Millersville University, Millersville, PA 17551

Almandine garnet (($Ca,Mg,Mn^{II},Fe^{II})_3Al_2Si_3O_{12}$) weathering is a natural mechanism that removes CO_2 from the atmosphere on geologic timescales ($>10^5$ years).   Previous workers found the weathering of almandine garnet to be determined by the mineral's chemical composition. These findings show that when a protective surface coating forms on almandine garnet the weathering process is transport-limited. In environments were weathering is interface-controlled a protective-surface coating is absent and almandine garnet weathers rapidly.
Petrographic observations of incipiently weathered Lancaster County almandine garnet show a two-stage process. The formation of a likely goethite (FeOOH) and gibbsite ($Al(OH)_3$) surface coatings on some grain edges and fractures reflects the fracture patterns rather than the shape of the grain. This can be explained if almandine garnet weathering is controlled by the evolution of porosity rather than by its chemical composition. The incipient stage of weathering is characterized by limited porosity, allowing for saturation of the surrounding fluid by iron and aluminum cations. The iron and aluminum then precipitates in the fractures of the almandine garnet. As weathering progresses, permeability increases and iron and aluminum are dissolved. The removal of these cations allows the almandine garnet to dissolve completely.

14.   Correlation between Atlantic Ocean Storms and Microseisms Recorded at the Millersville University Seismic Station

Stepp, Matthew; May, Andrea; DeCaria, Alex*
Department of Earth Science, Millersville University, Millersville, PA 17551

Microseisms are small-amplitude, non-local, non-tectonic signals that are ubiquitous on seismic records. One well-known source of microseisms is ocean waves breaking along coastlines, which gives rise to a low frequency peak (around 0.07 Hz), called the primary peak, in the energy spectrum of the seismic data. Another well-known source is non-linear ocean wave interactions occurring near the center of cyclonic storms at sea, which give rise to a higher frequency peak (around 0.14 Hz), called the secondary peak. In this study we performed spectral analysis of the seismic records from the Millersville University (MU) Seismic Station to explore the effects of the intensity of ocean storms, and their distance from the seismic station, on the amplitudes and frequencies of the primary and secondary peaks in the microseism spectrum. Statistically significant correlations were found between certain parameters.

15. Lead Education Initiative

Williams, Michael[1]; Yorks, John[1]; Warren, Christopher[1]; Yalda, Sepideh *[1]; Clark, Richard *[1]; Jenkins, Gregory[2]; Everette, Joseph, [2]; Ramachandran, Rahul[3]

[1] Department of Earth Science, Millersville University of Pennsylvania, Millersville, PA 17551
[2] Howard University, Washington, DC
[3] University of Alabama-Huntsville, Huntsville, AL

As a collaborative partner in Linked Environments for Atmospheric Discovery (LEAD), Millersville University is responsible for the evaluation and assessment of LEAD prototypes, and the development and dissemination of educational materials and services to the wider education community. Toward this effort, Millersville University is collaborating with other LEAD partner institutions, as well as with local high schools in extending several existing tools such as Unidata's Integrated Data Viewer (IDV) and NASA JPL's SWEET ontology for LEAD educational initiatives. Undergraduate students at Millersville have been involved in developing interactive modules and other learning materials around the IDV. Undergraduate students have developed an IDV beginner's tutorial that is specifically designed for pre-college teacher and student users. In addition, they have created IDV bundles that serve as a basis for the visualizations within the LEAD-To-Learn education modules. These modules allow students to interact with and visualize output from the NAM and WRF numerical models, and other data types, while learning through discovery related meteorological concepts. Undergraduate students have also been involved in a significant extension of the Semantic Web for Earth and Environmental Terminology (SWEET) ontology developed at NASA JPL to include quantities of relevance to mesoscale meteorology. Over 560 new quantities have been added, tripling the ontology vocabulary, and this number is likely to reach 1000. Another key enhancement of the Millersville effort is the addition of a glossary for the LEAD ontology. The SWEET-LEAD ontology will be wrapped as a Web Service at the University of Alabama-Huntsville, and will be accessible via the LEAD portal for query, info-mining, and resource cataloging, and is an essential component in the development of a dynamically adaptive learning environment for students and teachers. Finally, Millersville undergraduates worked extensively with Howard University to develop educational supplemental materials for Howard's Weather Camp that took place in July 10-29, 2005. Undergraduate students at Millersville have developed specific IDV bundles that are utilized to enhance the instructional material, but were also used by Weather Camp 2005 students for research projects and further discovery. The tri-poster highlights each of these major educational undertakings.

MATHEMATICS

16. Atmospheric/Soil CO_2 Consumption at Coweeta Hydrologic Laboratory, Western North Carolina, USA

Baxter, Andrew M. (MU 2005) and Price, Jason R.*
Department of Mathematics and Earth Sciences, Millersville University, Millersville, PA 17551

Atmospheric/soil CO_2 consumption has been calculated using watershed flux-based mass balance methods for Coweeta Hydrologic Laboratory in western North Carolina. The study area watersheds

are located in a humid temperate climate and are developed on granitic bedrock. The methods of this study differ significantly from previous studies of CO_2 consumption because accurate watershed solute flux-based mass balance calculations permit CO_2 consumption to be attributed exclusively to the silicate minerals that are weathering. The weathering of silicate minerals is a natural mechanism by which atmospheric CO_2 is consumed on geologic timescales ($>10^5$ years).

 At Coweeta, no carbonate minerals are present in the bedrock, and chemical weathering is attributed to plagioclase feldspar, almandine garnet, biotite, and allanite. If it is assumed that carbonic acid is solely consumed by the weathering of these minerals, then CO_2 consumption values range from 890 to 1300 moles/hectare/year for the three watersheds investigated. These CO_2 consumption rates are lower than those reported in the literature for other localities, often by as much as an order of magnitude.

  For Watershed 2 (W2) at Coweeta, bicarbonate data are available. CO_2 consumption in W2 based on the stream bicarbonate flux is 640 moles/hectare/year, approximately a factor of two lower than the CO_2 consumption calculated from the mineral weathering rates (1300 moles/hectare/year). This difference likely reflects that mineral weathering at Coweeta is consuming acids other than carbonic. Other acids may originate from atmospheric deposition, or from sulfuric acid produced by the weathering of pyrite.

Relatively low CO_2 consumption by silicate weathering at Coweeta may reflect the temperate climate of the region, and/or being underlain by granitic bedrock. However, it is also possible that other methods which calculate CO_2 consumption by separating carbonate-derived bicarbonate from silicated-derived carbonate may overestimate CO_2 consumption.

17.   The General Brachistochrone Problem

Gremmer, John ; Umble, Ron* and Nolan, Michael*
Departments of Mathematics and Physics, Millersville University, Millersville, PA 17551

The original brachistochrone problem posed in the 17th century was as follows, "Given two points A and B in a vertical plane, what is the curve traced out by a particle acted on only by gravity, which starts at A and reaches B in the shortest time." A general theorem is developed using conservation of mechanical energy and the Euler-Lagrange equation to solve the brachistochrone problem for a particle confined to other simple surfaces beyond a vertical plane. Also, the original statement of the problem assumes that the gravitational force is the uniform gravitational force close to the surface of the earth. A solution is developed to solve the brachistochrone problem for the more general gravitational force that is inversely proportional to the square of the distance between the falling particle and a stationary object.

18.   A Habitat Suitability Model for Selected Crayfish Species in Lancaster County, Pennsylvania, Streams.

Laverty, Sean [1]; Buchanan, Robert* [1]; Wagner, Jason [2]; Wallace, John R.* [2]; and Perry, Bill [3].

[1] Department of Mathematics, Millersville University, [2]Department of Biology, Millersville University, Millersville, PA 17551 [3] Department of Biology, Illinois State University.

The introduction of invasive exotic species to previously inaccessible areas provides the opportunity to study the impacts of invasive species on closely related native species. Habitat suitability index [HSI] models offer a coarse estimate of the habitat quality relative to hypothesized

physiological tolerances of a species. The distribution and abundance of two native *Orconectes obscurus* and *Cambarus bartonii* and one invasive *Orconectes rusticus* crayfish along a twenty-three mile length of a Lancaster County, PA, stream and various physical factors at the sample sites were provided by a recent survey (Wagner et.al. unpublished). Of the factors provided, stream width, velocity, pH, and temperature were considered as the factors defining the geographic range of each species. An HSI model was constructed based on these factors to identify regions offering suitable habitat for a species and areas of a stream which are at risk for invasion of *O. rusticus*. Current work involves the development of subindices describing the availability of food and shelter within the stream, using stream order, link magnitude, and substrate measurements. The HSI model will be coupled to a model describing the interactions between size-structured populations of native and invasive species under the influence of a predator.

PHYSICS

19. Measuring the Index of Refraction of Air

Parks, David and Dooley, John*
Department of Physics, Millersville University, Millersville, PA 17551

An optical cell is placed in one leg of a Michelson interferometer. The cell can contain a gas or fluid which changes the optical path length. The change in optical path length can be calculated from the number of fringes displaced when the content of the cell is changed. The experiment has been used to calculate the geometry of the cell two within half a wavelength and to measure the refractive index of air as a function of pressure.

20. Electrical Anisotropy in Sculptured Thin Film

Schreck, John and Gilani, T.H.*
Physics Department, Millersville University, Millersville, PA 17551

Chiral Sculptured Thin Films (STFs) exhibit a property of unidirectional nonhomogeneity which is responsible for a subsequent electrical anisotropy in the films. The H.C. Montgomery method is used to measure the anisotropic resistivity in the films which is used to map the dimensions of the anisotropic sample to those of an equivalent isotropic sample with a uniform resistivity. The goal of this project is to characterize STFs and understand the relationship of electrical anisotropy to the structural nonhomogeneity of the film. In particular, we are investigating a columnar-angle dependence of the electrical anisotropy, where the angle is measured with the reference to the normal to the surface. The films of Cr on glass substrate with different columnar angles were prepared at department of engineering sciences, Penn State University. The angles ranged from zero to 85 degrees and   the thicknesses of the films were in the range from 200-3000 nm. We found a non-linear relationship between the anisotropy and columnar angle, which indicates the tunneling of electrons from one column to another. By interpolation of the resistivity anisotropy Vs columnar angle graph, we estimated the maximum anisotropy between 70 degree and 80 degree.

I N D E X