

SCHOOL OF SCIENCE AND MATHEMATICS
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Student Research Poster Display

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

Biology

1. Successful Subcloning of Three Candidate Suppressor Genes Involved in Restoring *HOT1*-dependent Recombination in *deg1* Mutant Yeast

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Genetic recombination is essential for maintaining genome sequences in all organisms. It also helps to create novel alleles and gene combinations that drive evolution. Despite its importance, mechanisms of recombination are not completely understood. Easy culture and genetic flexibility allow the yeast *Saccharomyces cerevisiae* to serve as an excellent experimental model for all eukaryotic organisms, including humans. *HOT1* is a recombination hotspot within the ribosomal RNA genes of yeast. It appears to be important for maintaining the integrity of these repeated genes, but its precise role and the enzymatic pathways involved are not fully understood. In *S. cerevisiae*, the *DEG1* gene is needed for *HOT1*-dependent recombination and normal growth. Mutants defective in *DEG1* are temperature sensitive and exhibit lower rates of mitotic recombination. The product of *DEG1* is a pseudouridine synthase that modifies tRNA molecules, and the connection between this activity and genetic recombination is obscure. In an attempt to understand how *DEG1* impacts recombination, a search was made for yeast genes that can suppress the temperature sensitivity of *deg1* mutants. A segment of wild-type genome was identified as an effective suppressor, and DNA sequencing revealed that it contains three distinct genes. To identify which of the three is the true suppressor, these candidate genes were separated from each other using restriction enzymes or the polymerase chain reaction (PCR) and then isolated using gel electrophoresis. Each was inserted separately into the expression shuttle vector YCpLac118 and then transformed into bacterial cells. Successful subcloning was verified using restriction enzyme analysis. To determine if it has an effect on growth and recombination rates in yeast, each gene will be transformed into mutant *deg1* cells for evaluation. Understanding the role of genes involved in recombination will enhance our understanding of the process and may provide insight into cancer and other genetic diseases.

2. Climatic Envelope Modeling of Invasive Dayflowers (*Commelina*, Commelinaceae)

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Faden (2000) discussed the ranges of dayflower (*Commelina*) species in North America and has provided distribution maps. This study expands the work of Faden by including additional herbarium specimens that have been georeferenced using digital gazetteers. Georeferencing and biogeographic modeling software programs were used to model species ranges and make predictions about states and counties in the United States open to further invasion by three invasive species of *Commelina*. A future climate model for

the year 2050 was used to make predictions about the influence of climate change on the spread of these same species. Herbarium collections extend the known and vouchered range of *C. diffusa* provided by Faden (2000) into the following US states: WI, SD, NB, CO, NM, AZ, CA, IA, and IN. The climate model predicts the range to also include UT, WY, MT, MI, PA, NY, OH, and New England. Climate change associated with a doubling of atmospheric CO₂ by 2050 is predicted to expand the range of *C. diffusa* into NV and OR. Herbarium collections extend the range of *C. communis* provided by Faden into OK, IA, KS, and LA. Future climate models predict *C. communis* to extend its range into WI, MI, and New England. Future climatic modeling predicts the range of *C. communis* to expand into Canada and northern parts of WI. Climatic modeling predicts the range of *C. benghalensis* to include the coasts of NC, SC, LA, MS, TX, and AL and the range of *C. virginica* to include WV. Future climatic modeling predicts no significant change in distribution of *C. benghalensis* or *C. virginica*. Herbarium collections of *C. erecta* extend the range provided by Faden into CA, WI, and SD. Climatic modeling predicts no significant difference in the range of *C. erecta*. This GIS work provides a base of geographical knowledge that can be expanded upon to make further conclusions about the biogeography of *Commelina* species in North America. A later study would benefit from additional collections including ones outside of the United States.

3. Functionalization of Nanowire Arrays for the Development of a Biosensor

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As part of an initiative to develop a biosensor for the detection of ovarian cancer using nanowire arrays, gold and silver nanowires are functionalized with a self-assembled monolayer. The purpose of the monolayer is to facilitate the binding of antibodies to the surface of the nanowire array. The monolayer will consist of mercaptoundecanoic acid and a spacer molecule, with a thiol group to bind to the nanowires. The carboxylic acid group of the monolayer acts a site to which antibodies can bind, while the spacer ensures that the antibodies have the space to correctly bind. For this reason, it is important to determine the optimal spacer to use and the optimal ratio of acid to spacer to produce the maximum antibody attachment. Fluorescent microscopy is used to determine the degree of attachment of the antibodies to the monolayer. Results of optimal spacer size and ratio will be presented. A comparison of the attachment of fluorescently tagged primary antibody to tagged secondary antibody will also be presented.

4. The Effect of Distance from a Stream and Aspect on Woody Flora Distribution in Steinman Run Nature Preserve, Lancaster County, Pennsylvania.

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The Lancaster County Conservancy is crucial in maintaining streamside forests including Steinman Run Nature Preserve, a 265 acre preserve located in Martic Township. Using the point centered quarter sampling method, there were two objectives: 1) to conduct a floristic inventory of the woody plant species at Steinman Run Nature Preserve and 2) demonstrate and discuss reasons for changes in plant species distribution and composition with changes in distance from the stream and aspect. Forest metrics of relative density, dominance, frequency, and importance values were calculated for overstory and understory woody vegetation for opposing aspects of north and south and for increasing distances from the stream including 10 m, 25 m, 40 m, 55 m, 70 m, 85 m, and 100 m from the stream. Importance values and Mortison-Horn similarity indexes were used to describe and compare forest dynamics for woody species at varying distances (elevation) from the stream and opposing north- and south-facing slopes. We demonstrated that forest patches that differ with respect to elevation, aspect, and distance from the stream all showed distinctive species assemblages. This was particularly evident in the overstory. In fact, there were four such assemblages: (1) ridge, (2) streamside, (3) a mid-elevation / north aspect, and (4) a mid-elevation / south aspect assemblage.

Liriodendron tulipifera, *Betula lenta*, *Fagus grandifolia*, *Acer rubrum*, *Nyssa sylvatica*, *Quercus rubra*, and *Quercus montana* were the dominant overstory species. The dominant understory species included *Acer rubrum*, *Betula lenta*, *Carpinus caroliniana*, *Hamamelis virginiana*, and *Nyssa sylvatica*. Trends for individual species observed at Steinman Run were consistent with the literature. Little recruitment of *Quercus* species and high recruitment of *Acer rubrum* in the understory was demonstrated, which is well documented in literature pertaining to the Eastern Deciduous forest. The next step of the project is to sample seedling and saplings at this site to predict future successional trends.

5. Neomycin Alters Avoidance Behavior in *Paramecium Caudatum*

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In *Paramecium*, action potentials are elicited in response to an inward flux of Ca^{2+} . The action potentials cause a reversal in the direction of the cell's beating cilia. This ciliary reversal allows the cell to swim backwards away from a noxious stimulus. These reversals in swimming direction are referred to as avoidance behaviors, because they allow the cell to avoid and navigate around microscopic obstacles.

This experiment investigated the effects of neomycin, a Ca^{2+} channel blocker, on swimming behavior in *Paramecium caudatum*. We hypothesized that avoidance behaviors would decrease in the presence of neomycin because it would block the Ca^{2+} channels and thus inhibit the Ca^{2+} mediated action potentials necessary for ciliary

reversal. We also hypothesized that an increased Ca^{2+} concentration in the presence of neomycin would override the effects of neomycin. We counted the number of avoidance behaviors for individual *P. caudatum* in concentrations of neomycin sulfate ranging from 200-2000 μM . Ten people observed avoidance behaviors for approximately 100 different cells. Avoidance behaviors decreased as the neomycin concentration increased; the response was found to be dose-dependent up to 600 μM . At 600 μM avoidance behaviors had decreased by approximately 55% and then leveled off at higher neomycin concentrations. Then, we investigated the effects of increasing the external Ca^{2+} concentration (using 1mM CaCl_2 and 10mM CaCl_2 solutions), at a neomycin concentration of 600 μM . The higher Ca^{2+} concentration partially reversed neomycin's effect on avoidance behaviors. Increasing the external Ca^{2+} concentration also increased avoidance behaviors in the absence of neomycin. The results from this experiment indicate that neomycin inhibits avoidance behaviors in *Paramecium* by blocking Ca^{2+} channels and consequently, the Ca^{2+} dependent action potentials necessary for ciliary reversal. Additionally, this effect can be reversed to some extent by increasing the external Ca^{2+} concentration.

In some respects, paramecia may be thought of as “swimming neurons.” This experiment was easily conducted by a group of undergraduate students in an animal physiology course. It proved to be an inexpensive and effective exercise for illustrating neuronal function and stimulating critical thinking.

6. The Impact of Agriculture and Sedimentation on Ichthyologic Community Structure

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Lancaster County has historically been an agricultural center because of its rich soils. Agricultural processes have resulted in the addition of fertilizers, chemicals and sediment into streams and rivers. One of the most problematic impacts is sediment, which has profound effects on the physiological and the physical make up of a stream. Sedimentation is a combined result of current land use practices throughout a watershed coupled with the historic land uses of the region. We examined the potential impact of sediment on six headwater streams of second and third orders in southern Lancaster County, Pennsylvania (n = 3 agricultural streams, n = 3 forested streams). We collected physical and chemical data to assess the water quality and rate of erosion among these streams. In addition, Geographical Information Systems (GIS) data based on recent Lancaster County maps was used to examine land use patterns and soil type in each watershed. Fish were collected in a 100 meter stretch from each stream using a fish electroshocker in October 2007 and February to March 2008. An Index of Biotic Integrity (IBI) was determined for each stream and used to evaluate ichthyologic community structure and function. The agricultural impacted streams tended to have higher levels of phosphate, total suspended solids, turbidity levels, and erosion rates. There was correlation between the Fish IBI and particular Land Cover of the watershed. It would appear that in 2nd and 3rd order streams the Fish IBI may not be a good replacement for

Macroinvertebrate analysis as a stream assessment tool. However, when comparing streams with similar link magnitude a fish IBI may prove extremely useful in assessing long term watershed health.

7. Antimicrobial Properties of Tree Species Common in Pennsylvania

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Pathogenic bacteria represent health problems for human as well as other organisms such as plants. Historically, antibiotics have been developed and utilized to treat bacterial infections. However, bacterial resistance to common antibiotics is rising and new antimicrobial chemicals need to be identified. Five species of trees and one woody shrub common to Pennsylvania have been selected based on their potential for containing antimicrobial compounds. These include *Ailanthus altissima*, Norway Maple, Sugar Maple, Silver Maple, Indian Cigar Tree, and Spicebush. Antibacterial activity from the plant extracts was tested on *Enterobacter aerogenes*, *Escherichia coli*, and *Pseudomonas fragi*. Plant secondary products were extracted from dried leaf tissue into 50% methanol for 15 minutes. A use-dilution method was used to test for antimicrobial activity. A bacteria-coated glass bead was placed in the extract for ten minutes and then transferred into two mL of nutrient broth and incubated at optimum temperature for 24 hours. To determine the inhibition of bacterial growth, the optical density of each culture was measured at 600 nm. Spicebush extract inhibited 100 % of growth, compared to 0% inhibition of the 50% methanol solvent control. Norway maple demonstrated 92% inhibition of each bacterium. Sugar Maple demonstrated 95% inhibition of *E. aerogenes* and *E. coli*, but had 70% inhibition of *P. fragi*. Indian cigar tree and *Ailanthus* demonstrated 98% and 97% inhibition, respectively, on all bacterial species tested. Silver Maple demonstrated 98% inhibition on all three species. A control treatment of 50% methanol showed no inhibition of bacterial growth. In conclusion, *Ailanthus altissima*, Norway Maple, Sugar Maple, Silver Maple, Indian Cigar Tree, and Spicebush have significant antimicrobial activity. Candidate secondary products include members of the phenolic and terpenoid chemical groups. Further testing and isolation of the plant extracts are in progress to determine the chemical compound(s) responsible for the antimicrobial properties present. The identification of these compounds has beneficial applications in the medical and pharmaceutical fields through the potential development of new antimicrobial treatments.

8. Raman Spectroscopy of Proteins for Biosensor Applications

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Raman spectroscopy is a young field in biomolecular analysis that has been researched substantially to indicate its potential in future biomedical advances in technology. When light energy collides with a molecule, a scattering of photons occurs. Raman scattering occurs when the light energy scatters at a different frequency than it had before the collision occurred. A molecule's vibrational transitions allow for the "fingerprinting" of that molecule using Raman spectroscopy. Raman spectroscopy can be used to measure particular bonds in a molecule since the Raman peaks are spectrally narrow. However, this signal can be greatly enhanced in the presence of nanostructures (less than 60nm) such as nanowire arrays. For this reason, the use of Raman spectroscopy in medical diagnosis is under study. Bovine albumin, both in solid and liquid (dissolved in water) form, was analyzed in the Raman Spectrometer and analyzed for distinguishable Raman bands. Concentrations as low as 1.25mg/ml were measured using quartz cuvettes and concentrations as low as 0.39mg/ml were measured using nanowire array substrates. A chemical "fingerprinting" of the bovine albumin could be visualized on the Raman spectra with the most distinguishable peak occurring at $\sim 1000\text{cm}^{-1}$. Surface enhanced Raman signals were seen when using nanowire arrays, enhancing Raman peak intensity and natural albumin fluorescence. Bovine albumin present in serum was also analyzed to observe if similar Raman bands would occur in comparison to the bovine albumin spectra. Indications of bovine albumin in the serum could be seen on spectral analysis. This showed that macromolecules such as albumin could be visualized in different solution mixtures.

9. Operational Characteristics of Functionalized Nanowires

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The world of nanotechnology is progressing quickly in the world of medicine. We are using small devices to detect analytes found in blood and other bodily fluids. These tiny devices known as nanobiosensors will be able to detect the presence of antigens by the use of antibodies. This technique utilizes tiny parallel nanowires that are about 80 by 120 nm in size made by the Illuminex Corporation. The purpose of these experiments was to note the speed and efficiency of our sensors to detect antigens. The nanowires were prepared by coating them with specific antibodies directed against a desired antigen. Through a series of chemical reactions, a spacer molecule and MUA (11-mercaptoundecanoic acid) was attached to the wires by covalent bonding. This allows for proper spacing of the antibodies, which are also covalently linked to the nanowires. Antigen is added to the device and allowed to bind to the antibodies. In order to analyze

how much of the antigen is binding, a rhodamine-labeled antibody made against a different epitope on the antigen is incubated with the nanowire apparatus. This labeled antibody indicates the amount of functional antigen-antibody complexes attached to the wires. This procedure allows for the study of optimal antigen attachment under varied conditions. The conditions tested include: antigen and antibody concentrations, incubation times, incubation temperatures, and storage abilities of the sensor. The sensor is then observed using a fluorescent microscope. The red fluorescence (which is quantified) indicates that the antigen has attached to the antibody. It has been found that antigen binding to the first antibody is done within only a few seconds of exposure. This is significant to the efficiency of our biosensors because in a clinical setting, the faster and more accurate the results the better the device. It has also been determined that low concentrations of antibodies are sufficient for optimal binding of antigen. For maximum brightness a concentration of 120 μ g/ml of third antibody, 100 μ g/ml of first antibody and 100 μ g/ml of antigen are used. Due to the high cost of monoclonal antibodies used in this technique, the low concentrations necessary for maximum brightness helps to keep the device cost efficient. We also determined that the sensors could be stored for up to a few days, after the labeled antibody has been added, in a humidity chamber at temperatures of about 4 degrees Celsius before the fluorescence of the slides begin to fade.

10. Effectiveness of Single Strand Confirmation Polymorphism Analysis and Enzymatic Mismatch Cleavage for Mutation Detection in a Family with Complete Androgen Insensitivity

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Complete androgen insensitivity syndrome (CAIS) is caused by a defect in the androgen receptor (AR) gene located on the X chromosome. Androgens are essential for proper development of primary and secondary male sexual characteristics. Although individuals with CAIS have an XY genotype, they do not respond to androgens and express an external female phenotype. Previous studies have identified more than 300 CAIS-associated mutations that span the entire AR gene. Development of a single method for identifying carriers of defective AR genes has been difficult due to this vast number of possible mutations and the fact that most gene defects responsible for this syndrome are subtle. To develop a reliable mutation detection test for the AR gene, we evaluated strategies based on single strand confirmation polymorphism (SSCP) or enzymatic mismatch cleavage (EMC) analysis. Distinct methods were compared and optimized for the ability to detect small deletions or base substitutions in genetically engineered exons representing the DNA-binding (exons 2 and 3) and androgen-binding (exons 4-8) domains of the AR gene. EMC detected all types of mutations tested more efficiently than SSCP in these artificial constructs. Both optimized methods were then used to scan for AR gene mutations within the genomes of affected individuals in a family with a history of CAIS. Again, EMC was most effective in detecting single nucleotide differences between sequences of genomic and genetically engineered exons. Comparison of AR exons in CAIS-affected and unaffected individuals using both methods revealed no mutations in exons 2-8. Since cells from CAIS-affected individuals

in this family lack the ability to bind androgen, these findings suggest that the responsible mutation is located in exon 1 and probably results in protein truncation. We are in the process of designing PCR primers to enable comprehensive EMC analysis of this large exon.

11. The Effects of Anti-Herbivory Compounds within *Ailanthus altissima* Leaf Tissue on the Feeding Behavior of the Larvae of *Hyphantria cunea*

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Secondary metabolic compounds play an integral role in plant defense mechanisms. One plant species that contains a number of interesting secondary compounds is the invasive tree species *Ailanthus altissima* (Tree of Heaven). Prior research on *Ailanthus altissima* indicates that secondary metabolic compounds in leaf tissue contribute to the anti-microbial, anti-fungal, and allelopathic (herbicidal) properties exhibited by this species. This study investigated the role of secondary metabolites in the anti-herbivory properties of *Ailanthus altissima* leaf tissue through larval feeding experiments conducted on *Hyphantria cunea* (fall webworm), a generalist herbivore that feeds on a variety of deciduous trees including *Juglans nigra* (black walnut), *Prunus serotina* (black cherry), and *Morus rubra* (red mulberry). Choice larval feeding studies using fresh *Ailanthus altissima*, *Juglans nigra*, *Prunus serotina*, and *Morus rubra* leaf tissue showed a clear avoidance of *Ailanthus altissima* leaf tissue as demonstrated by a lack of consumption. Forced larval feeding studies conducted in the same manner confirmed the anti-herbivory properties of *Ailanthus altissima* as indicated by 25% mean consumption of *Ailanthus* with a 18% larval mortality rate, as opposed to 74% mean leaf consumption with a 0% mortality rate for the other tree species. Forced larval feeding studies using fresh *Juglans nigra* leaves coated with *Ailanthus* leaf extract exhibited a 86% mean mortality rate as opposed to a 2% mean mortality rate in untreated walnut leaves. Experiments regarding the anti-herbivory properties of *Ailanthus* on other Lepidoptera species are in progress. Our current focus is on the biochemical characterization of the anti-herbivory components in *Ailanthus* leaf tissue.

12. Floral Organogenesis and Evolution of the Genus *Tinantia* (Commelinaceae)

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This project focuses on floral morphogenesis (development) of the plant genus *Tinantia* (dayflower family, Commelinaceae) which has yet to be described. Flowers of the genus *Tinantia* have an interesting stamen configuration, composed of three showy, pollen-poor stamens above the ovary, and three inconspicuous, pollen-rich stamens below it. It has been hypothesized that the upper stamens function to distract pollen-feeding insects while the lower stamens deposit pollination-bound pollen on insect abdomens. This proposed deceptive pollination system would be beneficial to members of *Tinantia*, since pollen is energetically costly to produce. Using *Tinantia pringlei* as the representative of the

genus, the objective of this project was to determine the developmental basis for this deceptive pollination system, as well as to compare all aspects of development to other confamilial genera for which comparable data are available. Such a comparative framework will allow for an investigation of broad trends in the evolution of flower form and pollination biology in the family. Based on our floral developmental studies using scanning electron microscopy, we discovered that floral development begins in *Tinantia* as with all other Commelinaceous genera possessing bilateral flowers, where there is precocious development of the upper sepal, which is the largest sepal for the entirety of development. Additionally, the reduced size of the upper 3 stamens at maturity is correlated with their retarded development: that is, they lag behind the lower stamens early in development. To date, the closest relatives of *Tinantia* for which comparable data are available (*Tradescantia* and *Callisia*) have centrifugal patterns of stamen development, in which the inner whorl of stamens develops before outer whorl. In *Tinantia*, the pattern of stamen development is centripetal, which is more typical for flowers in general.

13. The Impact of the Meadow Vole, *Microtus pennsylvanicus*, on the Survival of Sapling Trees in a Riparian Restoration Project

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This is a multiple year study of the effect of the behavior of meadow voles on the survival of sapling trees in meadows undergoing riparian restoration on the Yocom farm in Manor Township, Lancaster County, PA. In May 2005 a randomized block design experiment was initiated that involves six 7.62x7.62 m trapping grids. Each grid contains 23 Sherman live traps placed in or adjacent to vole runways. Three grids were surrounded by fencing to exclude meadow voles and three remained unfenced. Each grid area was planted with 16 sapling trees; each seedling was surrounded by a 0.60m tall plastic tube. After live trapping and removing voles from the exclosure grids vole density on those plots was significantly lower than that on the control grids. In May 2007 additional saplings were planted to increase the total remaining to 20 to 23 on each grid. Although vole density has been maintained at significantly lower levels on the exclosure grids, overall sapling mortality levels are only slightly lower on the exclosure grids than the control grids. To examine the impact of vegetation height on meadow vole's activity, a field study that involved three mowing heights demonstrated a significant reduction in habitat use by voles when vegetation height was below 30 cm. A lab study of foraging activity under light intensities comparable to those in the field vegetation height study demonstrated that voles consumed significantly more food under low light (comparable to the highest mow height) than moderate or high light intensity. Our research suggests that, although the impact of voles on sapling mortality appears minimal, mowing around saplings may increase light intensity sufficiently to inhibit vole activity and foraging near saplings.

14. The Impact of Sedimentation on Macroinvertebrate Community Structure

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Numerous streams throughout Lancaster County are impacted by sedimentation. The sedimentation is a combined result of current land use practices throughout the watersheds coupled with the historic land uses of the region. Trauma from current agricultural practices as well as road and impervious surface area increase due to development can be linked to significant losses in sediment along many stream banks. In addition, many streams have acquired layers of legacy sediments that have been deposited throughout our stream and river valleys within the past two centuries. These sediments are found along streams that have a history of damming, particularly in the Piedmont province of Pennsylvania. We examined the potential impact of sediment on six headwater streams (n = 3 forested; n = 3 sediment impacted streams) in southern Lancaster County, Pennsylvania. We collected water physical/chemical data to assess the water quality and rate of erosion among these streams. Macroinvertebrates were collected using a Surber sampler in October 2007 and March 2008. Macroinvertebrate Aggregated Index for Streams (MAIS) scores were determined based on family-level taxonomic identification and used to interpret the macroinvertebrate community structure and function. The sediment-impacted streams tended to have higher levels of phosphate, total suspended solids, turbidity levels, and erosion rates. MAIS scores from forested streams characterize them as “good” streams. The impacted streams all ranked in the middle of the fair category. Functional feeding groups were also used to characterize the streams with the sediment-impacted streams tending to have significantly larger quantities of collector taxa than would be expected for a forested, headwater stream. Streams with significant water quality issues and erosion rates appear to be compromised in macroinvertebrate community structure within the impacted study reaches.

15. The Role of Late Migrating Trunk Neural Crest Cells in the Formation of the Turtle Plastron.

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The turtle shell consists of more than 50 bones, most of which have no equivalent in other vertebrates. The bones of the ventral shell (the plastron) form directly, without first creating a cartilage template. No other bones in the trunk of other existing vertebrates form this way, but the bones of the skull do. The bones of the skull are produced by cranial neural crest cells, which migrate away from the developing brain. Trunk neural crest cells, which migrate away from the developing spinal cord, do not have the ability to form bone in other vertebrates. However, the cells that form the plastron bones can be stained with antibodies that are normally used to detect neural crest cells. If they are neural crest cells, they migrate through the embryo at a later stage than the ‘typical’ ones. This suggests that the plastron bone-forming cells are an unusual subpopulation of neural

crest cells. We set out to use a more definitive method to identify neural crest cells – the ability to migrate away from the developing central nervous system, the neural tube. We isolated neural tubes from turtle embryos and cultured them to allow neural crest cells to migrate. We were able to observe neural crest cells migrating away from the neural tube from embryos at the stage where plastron-forming cells migrate. We are now testing the potency of these late-migrating neural crest cells to determine if they have properties in common with cranial neural crest cells. We will report on our efforts to clone the turtle homologue of Id-2, which is expressed in cranial, but not trunk neural crest cells in chicks. These data supports our hypothesis that turtle embryos contain a unique, late-migrating neural crest subpopulation that is responsible for the formation of the turtle shell, a novel structure that has provided a challenge to evolutionary theory.

16. Sexual Risk and Behaviors Among MU Students

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Adolescents, aged 15 to 24 years of age, experience the highest incidence of STIs in the USA. Annual averages of Chlamydia, gonorrhea, and syphilis are at high numbers. Re-infection and risk perception have been implicated as reason for high numbers of STIs among children less than 18 years of age. These results have not been validated among college students. Determinants of partner re-infection and markers of health seeking behavior in this age group are dynamic and not fully examined. The purpose of this study was to characterize partner notification, risk perceptions and health seeking practices among college students in Pennsylvania. A survey was constructed and approved by the Millersville University IRB. The survey was then loaded onto an online survey site (QuestionPro). An email was sent out to 6,940 MU students with a link to the survey, and all data were compiled without record of names or emails. One thousand and nine surveys were completed and tabulated. Fifty percent of the students completing the survey stated that they had vaginal sex without a condom. Only 39% of students said they use a condom for 75-100% of their sexual encounters, while -75% of students do not consider themselves at risk for contracting an STI or HIV. Of the students that do not think they are at risk, 53% answered that the biggest reason not to have unprotected sex is pregnancy. Only 34% of the same students answered that the biggest reason is contracting HIV. This information will help inform public and school health programs on how to help youths adopt positive and protective sexual health behaviors.

17. Synthesis and Characterization of Copper Nanowires

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The synthesis of copper nanowire arrays using a templating process will be presented. The synthesis process allows for the growth of nanowires to the desired height and diameter. The resulting copper nanowire arrays are characterized using scanning electron microscopy. Results of production scale-up experiments will also be presented.

18. Functionalized Poly(lactic Acid) Micro- and Nanoparticles for Targeted Drug Delivery

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There is great interest in developing techniques for functionalizing biodegradable drug loaded nanoparticles with receptor targeting molecules. Poly(lactic acid) is a polymer that is commonly used to encapsulate drugs for controlled release. However, the polymer does not have reactive surface groups for conjugation of ligands. We used layer by layer (LbL) self assembly to introduce amine groups on the surface of poly(lactic acid) micro- and nanoparticles. Optimal conditions for formation of the layer by layer films were investigated by monitoring growth of films on quartz using UV-Vis spectroscopy. Scanning electron microscopy (SEM), atomic force microscopy (AFM), optical and fluorescence microscopy were used to characterize functionalized and non functionalized nanoparticles. Results show formation of a surface active film on the micro- and nanoparticles that can be used to conjugate ligand molecules.

19. Analyzing Everyday Samples in Biochemistry Experiments

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Students at all levels connect to experiments that involve common samples. We are exploring options for expanding published protocols to include a wider range of experimental samples for use in biochemistry courses. Lipid extraction and cholesterol analysis from eggs and walnuts has been described. We have explored similar analysis of isolates from common foods, including a variety of both plant and animal sources. Analysis of biochemical molecules using GC/MS is an important skill for biochemistry students. By adapting a GC/MS protocol for quantifying cocaine residue on paper currency, we hope to appeal to students interested in the forensics field. We have also used a protocol designed for sports drink analysis to do the same taurine analysis of vitamin-enhanced water. We plan to adapt this procedure to possibly analyze other amino acids being used as additives in products marketed as healthy.

20. Online Shipping Testing Software Using CakePHP – Phase One

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Using a database backend, the shipping testing software simulates a working electronic shipping business which interfaces with an online banking site to form part of the ecommerce testing software. To reproduce a 'live' environment, the site will have a number of security holes implemented into the code design. These security holes range from non filtration of user mistakes, to hard coded vulnerabilities of which experienced users are able to advantage. By purposely introducing security holes into the code, we are building a training platform for security professionals. The shipping software is developed, in conjunction with the banking software, to allow the trainee to identify different vulnerabilities, assess how they affect the system, deduce where to look for such vulnerabilities, and most importantly, how to fix it. This online shipping software is a subset of an overall software testing infrastructure. This particular project is phase one of a two-phase project, with phase two providing a set of patches for these security holes and a means of "scoring" the trainee on his/her security expertise. The project uses the latest technologies such as CakePHP, an open source web application framework written in PHP, which will make it easier for the user to interface with the database with active records.

21. Interactive Google Map Application Using Ruby on Rails and Ajax

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Using the Google Maps API (Application Programmer Interface), Ruby (a scripting language for quick and easy object-oriented programming), and Rails (an alternative to traditional Web development environments such as Java and .NET) we are creating an online mapping application to create Web-based interactive plant species distribution maps. Visitors to this site will be able to add precise locality records for plant species in Pennsylvania. Additionally, visitors will be able to edit data and upload photos of plants. This application will help to monitor the health of native plant species populations (particularly those threatened or endangered species) and will help to track and to mitigate the spread of invasive plant species in Pennsylvania.

22. Bayesian Networks in Video Games

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This project is aimed at utilizing Bayesian networks as a method for implementing an artificial intelligence system for video games. Using these networks we attempt to control simple behaviors for game agents that can be applied to multiple game genres. We describe the networks that were developed for certain behaviors and describe further projects that we intend to pursue. While not always completely successful, these behaviors provide some insight into the possibilities and problems of incorporating Bayesian networks into video games.

23. Relating Encrypted E-Mail and its Routes to Discrete Structures with Algorithms and Graph Theory

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Encrypted email vs. unencrypted email is analogous to sending a message within a sealed envelope vs. on a postcard. We study the nature of algorithms, dot-decimal and hexadecimal notation, and graph theory with respect to transmitting encrypted email. Encrypting email involves algorithms that are difficult to reverse unless there is a key to decrypt the message. Graph theory, including bipartite, is used to analyze networks especially with respect to network security as the encrypted email is transmitted through the media. Graph theory is also used to find the correct e-mail server provider using dot-decimal (IPv4) or hexadecimal (IPv6) notation. We investigate how the email encryption technologies, within the complex systems of the Internet, can be structured in terms of discrete structures.

24. Does the Real-Time Java Specification Form a Viable Real-Time Programming Language?

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As technology increases in power and decreases in size, embedded systems have become more and more common. Everything from simple toys to cars and complex vehicles are handing control over to embedded systems. With the growth of embedded systems has come the need to program them at a higher level than assembly. Languages developed real-time extensions, but portability has proven difficult. In 1998, the Java Community Process released JSR 001: Real-Time Specification for Java. With the development and release of this specification, Java could finally compete in the real-time community. But how does Real-Time Java compare, as a real-time language, to other, proven-reliable languages? This project takes a look at real-time system needs and real-time language

requirements, and examines how Java's Real-Time specification meets or fails those needs, at a language level.

25. Online Banking Testing Software Using ASP.Net – Phase One

Kunder, Justin; Parera, Pasan and Hardy, Nazli*

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Using ASP.NET (a web application framework) and Visual Web Developer Environment 2008 (software package for developing ASP.NET applications), we created an online banking software to provide training for security professionals. The banking software was developed, in conjunction with the shipping software, to allow the trainee to identify different vulnerabilities, assess how they affect the system, where to look for such vulnerabilities, and most importantly, how to fix it. This online banking software is a subset of an overall software testing infrastructure. This particular project is phase one of a two-phase project, with phase two providing a set of patches for these security holes and a means of "scoring" the trainee on his/her security expertise. The project uses the latest technologies and incorporates the same database as seen on popular sites such as: Best Buy.com, Walmart.com, Google.com, and Overstock.com just to name a few. This banking application will be a key role in the overall e-commerce simulation software that is the basis of this project.

26. The Algorithms, Logic, and Graph Theory of Video Gaming

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The development of video games combines many different elements of discrete mathematics, but especially the application of algorithms, graph theory, and logic. We study the nature of the algorithms that control the movements of objects and structures. We look at the aspects of graph theory that defines the networking for the communication to enable online video gaming via the Internet. Finally we study the proposition logic that subsumes the programming of video games. We find that Artificial Intelligence and Networking and Logic are disciplines that contribute prominently to video game and we relate these to algorithms, graph theory and propositional logic to identify the direct link to discrete structures and video gaming.

27. Efficient Rendering of Binary Space Partitioned Maps with the MUDirectX Toolkit

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We enhanced the MUDirectX toolkit, a Direct3D based game engine, to load fully-textured worlds comprising 50,000+ polygons with support for non-trivial real-time physics. Added functionality includes the loading of Binary Space Partitioned (BSP)

maps from Valve's Half Life 2 series of games. We optimized rendering efficiency by implementing occlusion and frustum culling. Efficiently rendering a world allows the distribution of processing power to other functions such as physics, artificial intelligence, and general game logic. The toolkit now also supports positional sound, skinned mesh character animations, and rigid body dynamics.

28. Increasing the Immersiveness of the IDV Environment

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This work continues our extension of the Integrated Data Viewer (IDV), a Java™-based software framework for analyzing and visualizing geoscience data. Having allowed the user to navigate and probe a dataset simultaneously, we now fully leverage IDV's plug-in architecture so that our additions can be easily distributed to IDV users. In the process of separating our code from the IDV base, we restructured our enhancements to offer a cleaner, more maintainable and extensible project.

We allow a user to perform navigable vertical soundings by incorporating MUProbeTuples into a dataset, a combination of MUDataProbes and a single MUVerticalProfile, both of which are extensions of IDV objects. Unlimited MUProbeTuple objects can be created, as well as multiple MUDataProbes per tuple. This gives the user considerable flexibility in examining areas of interest.

MUDataProbes can also be constrained by various parameters using our new architecture. Parameters are easy to specify, and enable users to follow trends such as a constant barometric pressure. We implemented basic parameters that allow the probing of constant latitudes, longitudes, and/or altitudes.

By including the ability to load arbitrary 3D geometry to replace the boxes currently used to represent probes and dropsondes, we have significantly enhanced the simulation visuals. Airplanes and other models can be substituted to increase the level of immersion.

Earth Sciences

29. Characterization of Local Air Quality over Lake Clarke at Long Level, Pennsylvania

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Air pollution and meteorology were studied over a dammed portion of the Susquehanna River – Lake Clarke - during the time period of June through August 2007. The site area is located at Long Level, York County, approximately 8.5 km upriver from the Safe Harbor hydroelectric power plant in south central Pennsylvania. This study focused on: 1) measurement of criteria pollutants along the lake shore, 2) comparison of these data with regional concentrations obtained from the PA Department of Environmental Protection (DEP) monitoring sites in York and Lancaster Pennsylvania.

On-site measurements of criteria air pollutants, O₃, CO, NO_x, and SO₂, as well as particulate matter (PM) data, were continuously recorded by instruments located inside a trailer that was situated about 20 meters from the west bank of Lake Clarke. These data were compared to the DEP measurements of criteria pollutants and PM for York and Lancaster Pennsylvania. Both DEP monitoring sites are located near the urban centers of their respective cities, so that their data represent the worst-case scenario for proximity measurements. Basic meteorological data were collected at the trailer and the DEP sites. The research presented herein focuses on a case study for O₃.

O₃ concentrations were very similar for the three sites when meteorological conditions were near the climatological norm. However, when the area was under the influence of an extreme sub-tropical air mass, O₃ concentrations at Long Level peaked higher than the DEP sites, and remained consistently higher throughout the corresponding nighttime hours. During these time periods, O₃ concentrations at the DEP sites possessed a greater diurnal variation compared to the Long Level site. The higher nightly concentrations of O₃ at Long Level, while not at dangerous levels, nonetheless subject people who live next to the river to greater long term health risks.

30. Correlation of Meteorological Variables and Major League Baseball™ Home Runs

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Our research examines correlations between game-time meteorological variables and home runs for the 2006 Major League Baseball™ season. The data were gathered for every open-air, Major League Baseball™ stadium throughout the season. The meteorological variables used in the analysis include: temperature, dew point, pressure,

long-wind (toward center field) and cross-wind (left to right field) components. Home-run statistics include: home runs per at bat, home runs per hit, and the percentage of home runs to left, right, and center fields. Scatter plots were then constructed between combinations of the meteorological variables and home-run statistics for each stadium, and for all stadiums combined. Correlations between the meteorological variables and home runs were analyzed and were determined to be weak or nonexistent for this dataset. The variance in home-run statistics due to meteorological factors appears to be minimal.

31. An Interactive Instructional Pathway to LEAD Portal Data and Tools

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Linked Environments for Atmospheric Discovery (LEAD) is making meteorological data, tools for visualization and analysis, and forecast models available to a broad range of users from educators to researchers. One of the principal goals of LEAD is to not only democratize the availability of advanced weather technologies for research and education, but to also enable users with different levels of knowledge and ability. The LEAD education initiative has been focusing on means to integrate data, tools, and services used by researchers into undergraduate meteorology education to provide an authentic and contextualized environment for teaching and learning. Towards this goal, meteorology undergraduate students at Millersville University have teamed with undergraduate students in computer science at the University of Illinois at Urbana-Champaign (associated with the National Center for Supercomputing Applications Cybereducation Group) to design and develop learning materials, new tools and features to enhance the use of the LEAD portal and its capabilities in an educational setting. The development of educational materials has been focused on promoting the accessibility and use of meteorological data and analysis tools through the LEAD portal by providing instructional materials, additional custom designed tools related to Unidata's Integrated Data Viewer (IDV), and an interactive component that takes the user through a specific task utilizing multiple tools. In collaboration with the Unidata IDV group, a number of these custom designed tools are now available to the community and can be accessed directly through IDV. Some elements of this collaborative effort are modeled after the Biology Student Workbench project developed by NCSA for bioinformatics education. This collection of materials, interactive guide, and customized tools accessed through the LEAD portal will serve as an instructional pathway that a wide range of users can follow through the LEAD environment.

32. Geophysical Fluid Experiments in Undergraduate Education

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An NSF-funded partnership with the Massachusetts Institute of Technology as lead institution and five other universities representing diverse undergraduate programs in the

physical sciences, by using portable rotating and non-rotating tanks as methods of laboratory-based teaching of geophysical fluid dynamics. This poster will report the work done over the summer and fall semester concerning the 3-D portable rotating tank, 2-D wave tank and its experiments by students at Millersville University.

By using the portable 3-D rotating tank during the summer and fall semester 2007, we were able to supplement the theoretical treatment of fronts, Ekman layers, the Hadley circulation, baroclinic instability, western boundary currents, free convection, and thermohaline circulations. The 3-D tank was used to represent large-scale atmospheric circulation patterns that arose from density gradients influenced by rotation, as well as the evolution of patterns as rotation rate varied. Through the use of a 2-D wave tank, we were able to represent free convection and the development of secondary circulations which showed excellent visual examples of over-shooting tops of thunderstorms, the subsequent generation of gravity waves and how the anvil is produced. The 2-D tank also shows key concepts in the ocean as well as the atmosphere. Examples of ocean up-welling and return circulations from persistent wind forcing across a water surface.

By understanding the concepts and the theory behind these experiments, we were able to provide visual support to the professors that are lecturing in undergraduate oceanography and meteorology classes. Some of the senior level courses used to demonstrate these experiments are: climate dynamics, meso-and storm-scale meteorology, synoptic meteorology. Junior level courses consisted of atmospheric dynamics and thermodynamics.

33. An Analysis of Future Climate Predicted for the Chesapeake Bay Watershed by the IPCC AR4 Models

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The purpose of this study is to analyze the projected climate over the Chesapeake Bay Watershed using the IPCC AR4 models. The A2 and B1 emission scenarios are analyzed because they bracket a business as usual emissions scenario and a more proactive emissions reduction strategy, respectively. The mean model is defined as the

average of the individual models has been shown to yield the most accurate 20th century climate. By removing some poorly performing models, the mean model showed a statistically significant improvement as compared with 20th century data. With an improved mean model, it is projected that mean annual temperature will increase across the watershed by 4.65 degrees Celsius under the A2 emissions scenario and 2.49 degrees

Celsius under the B1 scenario. Additionally, annual precipitation is projected to increase by 5.04% under the B1 scenario and 7.18% under the A2 scenario with the greatest increases projected for winter and spring. It is possible to speculate that changes in precipitation may alter the time and duration of the spring freshet. Flooding events and drought conditions may increase as there appears to be an upward trend in the amount of maximum 5 day rain fall, the number of consecutive dry days, and the number of extreme temperature events—particularly under the A2 scenario.

34. Retrieving Maximum Wind Gusts from Low-Frequency Wind Speed Data

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Forty-six days of high-frequency (10 Hz) wind observations were acquired from the National Center for Atmospheric Research (NCAR) Earth Observing Laboratory (EOL). The data were collected during the Hudson Valley Ambient Meteorology Study field experiment in 2003 (HVAMS03). The data are being analyzed to see if peak wind gusts can be inferred from lower frequency (1-minute) instantaneous observations. If successful, this technique may be useful for forensic meteorologists attempting to estimate peak wind gusts from low-frequency wind observations.

35. Compiling a Climatology of Smoke Plume Injection Heights from Satellite Measurements

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Wildfires and other types of biomass-burning devastate vast areas of forest lands, grass lands, and agricultural lands across the globe. A major product of these fires is the tremendous amount of smoke that is emitted into the atmosphere annually. Smoke comprises aerosol particles and trace gases which impact life and the environment in various ways. Although the actual amount of smoke released by fire is very important in determining the impact of smoke on health, air-quality, weather, and climate, the height of smoke injection is also a critical factor in determining how long the smoke lasts in the atmosphere, and how far it is transported away from its source, which determine how long and widespread the impact of the smoke will be. Most estimates of smoke injection heights are derived from plume-rise models. Compiling the climatology of smoke plume injection heights from observations and measurements would provide a good comparison or validation against model output. In this study, visible satellite images acquired by the MODerate-resolution Imaging Spectro-radiometer (MODIS) from 2000 to 2007 were examined, and locations of fires associated with distinct smoke plumes were identified. Using the fire location information, corresponding atmospheric profiles from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and stereo-height products from the Multi-angle Imaging SpectroRadiometer (MISR) were obtained in order to extract smoke plume heights for each of the identified fires. CALIPSO was useful for some fires dating back to April 2006, when it was launched, while MISR, which was launched onboard the Terra satellite in December 1999, provided data for a longer time period. Overall, smoke plume height values were obtained for about 145 fires around the globe. Based on this analysis we were able to produce a global map of typical smoke plume heights, and found the global average smoke plume height to be 2.33 km, while North America has an average of 3 km, with a range of 0.4 to 5 km.

36. The Daily Cycle of Winds at Estación Obispo, Mexico, during the North American Monsoon

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The North American Monsoon (NAM), which occurs over the southwestern United States and northwestern Mexico, has an immense effect on the climate in this region. Multiple global atmospheric general circulation models (AGCMs) have had difficulty predicting the convective precipitation observed with the NAM, possibly due to the inability of the models to correctly simulate the daily cycle of winds in this region. Hartten et al. (2007) studied the daily cycle of winds over northwestern Mexico during the North American Monsoon Experiment-2004 using winds collected by 915-MHz Doppler wind profilers. This research builds on their work by constructing the mean daily cycle of winds for the lower troposphere at Estación Obispo during the summers of 2005 and 2006. By examining the mean profiles over the entire deployment, as well as the summer-mean daily cycle, we documented the interannual variability in the daily cycle of winds at Estación Obispo. The mean direction profiles showed low-level southwesterlies veering to easterlies in 2004 and 2005, compared to low-level southwesterlies backing to southeasterlies in 2006. The summer mean daily cycle depicted a consistent sea breeze feature over all three years. The summer mean daily cycle also showed southeasterlies at 3000 m in 2004 and 2006, whereas in 2005 easterlies persisted at this height throughout most of the day. The results of this research provide modelers with documentation of the daily cycle of winds, which they can use to verify their models.

37. Analysis of Long-term Temperature Trends in the Upper Atmosphere

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Climate change, be it in the troposphere or the upper atmosphere, is one of the most critically pressing issues in our society today. Meteorologists and climate scientists have demonstrated that the lower atmosphere has been experiencing alarming rates of warming, but only recently has the space weather community begun to address the question of whether there is an observable signal in the upper atmosphere. Largely this is because of the scarcity of data. Now for the first time, a large enough database of observations is readily available for extensive analysis of temperature trends in the ionosphere. Data acquired from 1978 to 2007 by the Millstone Hill incoherent scatter radar (46.2 °N, 288.5 °E) have been analyzed in order to provide a direct estimate of temperature trends between 250 and 550 kilometers. These long-term trends indicate significant daytime-hour cooling, varying between approximately -3.5 K/Year to -8.0 K/Year depending on altitude and time of day. These measurements are accurate both for ion temperatures (T_i) and neutral temperatures (T_n) with daytime standard deviations as

low as 0.8 K/Year, showing that these are very reliable results that are considerably larger than theoretical predictions based solely on increasing concentrations of greenhouse gases in the lower atmosphere. This poster presents some of the preliminary findings gleaned during a summer internship at the MIT Haystack Observatory.

38. Geochemical Controls on Epidote-Group Mineral Weathering

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This study examined epidote-group mineral compositions in order to determine if there is a relationship between ferrous iron content and the weatherability of these minerals. Ferrous iron content may be a better metric of epidote-group mineral solubility than simply classification as an epidote or allanite.

This study analyzed published chemical composition data for 329 epidote group mineral samples. This data was compared to the chemistry of North Carolina allanites which are known to weather rapidly, and the chemistry of North Carolina epidotes which are known to be very resistant to weathering.

It has been determined that higher ferrous iron content minerals are more likely to weather than those containing ferric iron. From the data we deduced that allanites typically have a ferrous iron stoichiometry greater than 0.25; this value provides a boundary above which epidote-group mineral weathering is likely. Epidote tends to have ferrous iron stoichiometry of less than 0.15 and is less likely to weather. Rare earth element (REE)-rich epidote ferrous iron stoichiometry falls in a range between 0.2 and 0.5. Therefore, depending on the specific ferrous iron stoichiometry a REE-rich epidote may either experience increased weatherability or increased resistance to weathering.

39. Detecting Harmful Algal Bloom-Karenia-brevis

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Harmful Algal blooms, like *Karenia brevis* that occur along the West Florida shelf affect both marine life (e.g. fish kill) and humans (respiratory problems). Although these harmful blooms occur naturally, human induced perturbations have been shown to increase the frequency and spatial extent in recent years. The major physical factors that contribute to the blooms of *Karenia brevis* along the inner West Florida shelf include the influence of the variations of the loop current, river discharge in the area, rainfall, pollution from agriculture and changes in both watershed and human population of South Florida. In this investigation we use satellite images to monitor the location and timings of the bloom and numerical output to identify probable causes for the bloom.

40. The Effect of Cleared Land on Erosion Rates and Stream Suspended Sediment

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Suspended sediments in streams are a major contributor of pollution. This is especially evident in Pennsylvania, where sediment has a devastating effect on habit degradation. In particular, Lancaster County is one of the most significant contributors of sediment to the Susquehanna River, via the Conestoga River, and ultimately to Chesapeake Bay.

In this study we determined the suspended sediment flux for three different Lancaster County watersheds influenced by various percentages of cleared land. This data was then combined with data from a previous study to give a total of four watersheds, all with different percentages of cleared land.

Suspended sediment flux was divided by the long term physical erosion rate in order to normalize the data for geomorphic differences in the watersheds (e.g., aspect, relief, slope, etc.). The relationship between percent of cleared land and suspended sediment flux yielded an R^2 value of 1. This leads to the conclusion that the percent of cleared land has the greatest effect on physical erosion rates, and consequently increased amounts of suspended sediment in streams.

41. Multivariate Linear Regression Analysis to Assess Atmospheric Ion Deposition at PA47

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Over the past century acid rain and other conditions that are the result of ion fluctuations in rain water have been shown to deleteriously affect lives and ecosystems. Air contaminants originating from countless point sources and extended sources become entrained in air parcels and are advected away from the source to be later removed from the atmosphere by either dry or wet deposition processes. The NADP network is interested in the concentrations of ions that rain-out (wet deposition).

This study will focus on the PA47 (Millersville) National Atmospheric Deposition Project (NADP) and National Trends Network (NTN) database. Many factors affect the concentrations of ions measured at a particular site. Arguably, the most important of these factors is the meteorology of the region and its affect on the amount of precipitation deposited from passing weather systems. Consequently, average monthly and annual concentrations can be very different from one period to the next.

The following research will attempt to quantify the effects of various meteorological variables on ion concentration fluctuations through the use of multivariate linear regression modeling. By converting Millersville University Weather Center data (temperature, vector wind, dew point/humidity, precipitation amount, station pressure,

total solar insolation) into weekly averages and estimate regression coefficients for each relevant weather variable. Once the slopes and correlation coefficients are computed, we will test the ability to predict future fluctuations based on measured meteorological variables.

It is anticipated that this model will help to differentiate between the impacts of passing weather systems and other external factors affecting the concentration of ions in precipitation. Our research goal is to create and test preliminary model output statistics relating weather variables to ion concentration before expanding the research to include other factors that can affect ion concentration in precipitation such as industrialization, agriculture, and geographical influences that could increase pollutant concentrations in the region. Qualitative inferences will be made regarding these factors by comparing the regional database with local measurements.

42. Petrographic Catalog of Epidotes and Allanites from the Persimmon Creek Gneiss, Western North Carolina

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The epidote-group minerals are common hosts of the radioactive elements uranium (U) and thorium (Th). The effects of radiation can be identified by damage to the crystal structure known as metamictization. It is also known that epidote-group minerals contain significant quantities of calcium (Ca) and that metamictization may increase their solubility. Because Ca bonds with dissolved CO₂ in the oceans to form calcite, epidote-group mineral weathering may influence the global carbon cycle.

This study identified allanite and epidote grains in thin sections of samples collected from the Persimmon Creek Gneiss, North Carolina. Unweathered epidote-group mineral grains were identified that contain a core displaying void space and a herringbone pattern. The herringbone pattern reflects the chemical zoning of the pre-metamictized allanite core, and the void space appears to be a result of the metamictization. This herringbone and void space texture was previously believed to be a manifestation of chemical weathering rather than metamictization alone. It was determined that the observed structure is a pre-chemical weathering feature and that the literature has not accounted for this factor.

43. Numerical Study of the Mid-Atlantic Low-Level Jet

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The Millersville University Weather Researching and Forecasting Modeling System (WRF) is being used to simulate the summertime Mid-Atlantic low-level jet (MALLJ). The MALLJ forms as a result of differential heating and cooling, which is strengthened by the sloping terrain between the Appalachian highlands and the coastal region,

followed by the decoupling of the friction layer around sunset. The rapid cessation of turbulent mixing and the reduced frictional influence cause the winds to accelerate in an attempt to adjust to the new force balance. The Coriolis force acting on the wind exerts an acceleration that results in an inertial oscillation of the wind field, which leads to the formation of the LLJ about $\frac{1}{4}$ pendulum day ($\frac{1}{4}$ inertial period) after sunset, or around midnight in the mid-latitudes. LLJs are known to be significant conveyors of momentum, heat, and moisture, as well as pollutants.

While the Great Plains LLJ (GPLLJ) has been studied extensively, the behavior and evolution of the Mid-Atlantic (MA) LLJ has not received as much attention. Even though the observed speeds of the MALLJ are about half that of the GPLLJ, its ability to transport pollutants along the northeast (I-95) corridor has the potential to have a deleterious influence on the health of this highly populated region. MALLJs are a recurring feature of nearly every major pollution episode in the northeast U.S. This research focuses on characterizing the behavior and evolution of the MALLJ, with an emphasis on the timing, spatial extent, and meteorological conditions attending its formation. The WRF is initialized using NAM-meso-eta fields for a two day period from 1-2 July 2002. The model results will be compared to observations obtained during a field study near Philadelphia, PA (Processes Controlling Urban Air Pollution – PCUAP 2002) for which 915 MHz wind profiler, Raman Lidar, measurements using a tethered balloon, and a suite of surface observations are available.

44. Interactions between Individuals during Response to Tornado Warnings

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The Engineering Research Center (ERC) for the Adaptive Sensing of the Atmosphere (CASA), funded by the National Science Foundation, is integrating a broad spectrum of end-users into the development of remote sensing technology at all levels of design. One such important and yet often-overlooked end-user group is the public. Our research focuses on enhancing our general understanding of group response to tornado warnings. In particular, we seek to understand how group (e.g., coworkers, friends, family, neighbors, or community organizations) structure and interaction impact the warning response process. Role conflict theory and emergent norm theory provide insights into collective behavior and how it could be applied to the public's response to warnings. Previous research on warning response highlights the importance of communication and the role that social conformity plays during periods of emergencies or disasters. We seek to further explore these issues by using data from in-depth interviews (n=52) conducted in Louisiana, Missouri, and Tennessee following tornado warnings. This data was collected as part of a quick-response study by the Disaster Research Center (DRC) at the University of Delaware. Our research identifies and analyzes the stages in the warning response process and explores trends in group structure and interaction.

45. Trends and Sources of Aerosols in Alaska

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Aerosols were collected from Denali National Park and Preserve from 2 March 1988 to 29 May 2006 using the Interagency Monitoring of PROtected Visual Environments (IMPROVE) air quality network. Data included aerosol concentration measurements (2.5 μm and smaller) and derived quantities totaling 52 different parameters. Of the 52 different parameters, 27 were analyzed, HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model back trajectories were calculated, and sources were identified using the EPA-CMBv8.2 model. The seasonality of combinations of the aerosol sets correlates to previously identified sources of aerosols in Alaska such as Arctic Haze, Asian Dust, Alaskan forest fires, sea spray, and aerosols produced by burning of wood or furnaces during the winter season.

Mathematics

46. Double Bubble Experiments in the 3-Torus

Brubaker, Nicholas; Linn, Sherry; Peurifoy, Stephen; Kravatz, Daniel; Evans, Sean; Carter, Stephen; Walker, Ryan (2007) and Umble, Ron*

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In the spring of 2007, our undergraduate research seminar directed by Drs. Ron Umble of Millersville University and Frank Morgan of Williams College studied surface-area-minimizing double bubbles in the three-torus. A double bubble is formed when two bubbles are joined together separated by a shared membrane. The three-torus can be thought of as a cube with opposite sides identified. In 2001, Miguel Carrion, et al. conjectured that a surface-area-minimizing double bubble in the three-torus is one of ten distinct topological types. The goal of our project was to determine whether or not these ten types can physically exist. To do this, we constructed two Plexiglas box models of the three-torus then blew soap bubbles into the boxes. By successfully producing each of the ten conjectured topological types, we proved that each type can physically exist. In this talk we describe the techniques we used to produce these ten particular types.

47. New Examples of A_∞ -bialgebras

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A *bialgebra* is a vector space H equipped with a compatible multiplication $\mu : H \otimes H \rightarrow H$ and a comultiplication $\Delta : H \rightarrow H \otimes H$. An A_∞ -*bialgebra* is a vector space H equipped with a family of compatible operations $\{\omega^{i,j} : H^{\otimes i} \rightarrow H^{\otimes j}\}$. This talk examines examples of vector spaces equipped with three operations: a multiplication μ , a comultiplication Δ , and an operation $\omega : H \otimes H \rightarrow H \otimes H \otimes H$. We verify that our examples satisfy the compatibility axioms of an A_∞ -bialgebra. These are the first examples of this particular structure discovered. We are interested in A_∞ -bialgebras because every loop space has an associated A_∞ -bialgebra model. Whether or not every A_∞ -bialgebra models some loop space is an open question.

48. Diagonal Approximations on an N -gon and the Cohomology Ring of Closed Compact Orientable Surfaces

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This paper deals with diagonal approximations on an n -gon. I will define a linear function Δ on the cellular chains of an n -gon P and show that Δ satisfies the criterion for a diagonal approximation. I will provide a geometric representation of Δ as a tessellation of P . Furthermore, I will show that Δ is a non-coassociative comultiplication. By identifying the appropriate sides of a $4n$ -gon P_n , we obtain a closed compact orientable surface T_n of genus n . Think of this identification as a quotient map $\pi : P_n \rightarrow T_n$ and dualize the cellular chains of T_n to obtain its cellular cochains $C^*(T_n)$. The diagonal Δ induces a multiplication Δ^* on $C^*(T_n)$ and a differential graded ring structure with trivial differential. Consequently, the cohomology ring of T_n is exactly the ring $C^*(T_n)$.

49. Nursing Students Impaired by Sleep Deprivation: Implications for Students, Faculty, and Safe Practice

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Most schools of nursing have policies that address student impairment from drug and alcohol use, but fail to recognize the negative effects of fatigue and sleep deprivation as impairment. According to the literature, decision making, clinical judgment, and cognitive function are adversely affected by sleep deprivation, thus causing the inability to practice safely. The purpose of this project was to determine the sleep habits of nursing students who attend a local community college, and increase faculty and student understanding of the effects of sleep deprivation. An informal questionnaire completed by first semester nursing students provided information about student sleep patterns, work habits, and impaired functioning from sleep deprivation. An information sheet about impairment from fatigue and sleep deprivation was provided to faculty and discussed at a monthly staff meeting. A voluntary workshop was offered to all nursing students to discuss the impact of sleep habits on health, cognitive functioning, and the provision of safe patient care. This project is an initial step in increasing faculty and student awareness of the effects of sleep deprivation.

50. Breastfeeding Self Efficacy in American Women

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Limited amounts of research have examined the modifiable factors that affect breastfeeding initiation and duration rates in American women. One modifiable factor that has been identified in literature outside the United States is breastfeeding self efficacy. The purpose of this study was to determine what relationship exists between breastfeeding self efficacy in American mothers and breastfeeding duration. Using a breastfeeding survey at specified time intervals, American mothers (with the intention to breastfeed) were asked questions that determined their level of breastfeeding self efficacy. The scores from the surveys were compared to the duration of breastfeeding. It was expected that the higher the score on the survey, the longer the duration of breastfeeding.

51. Dielectric Relaxation in an Electrolytic Capacitor

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Dielectric relaxation can cause an increase in capacitance with increasing duration of the voltage applied to the capacitor. A simple model of the dielectric material uses rigid electric dipoles which rotate in a viscous medium. For longer duration electric fields, the dipoles rotate more completely in line with the applied field. Using both the real and imaginary parts of the measured dielectric constant, we can determine a relaxation time of about 0.4 ms in an 220 μ F, 35V, electrolytic capacitor. Measurements at higher and lower capacitors temperature can confirm, respectfully, lower and higher relaxation time constants. Unfortunately, in an attempt to cool the capacitor well below freezing, a shift in a relaxation time constant has yet to be identified.

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