Introduction

Welcome to the tenth annual Kalman Research Symposium.

An important central element of the Bucknell experience is to offer our students in all disciplines the opportunity to engage in substantive out-of-the-classroom research projects with faculty. As stated in the mission statement for Bucknell’s Program for Undergraduate Research, these opportunities allow students and faculty

... to participate in collaborative learning processes designed to dissolve the distinction between teaching and research, and to create a community of learners in which scholarship serves as the basis for teaching and learning.

As is evident in glancing through the abstracts of the projects presented herein, this symposium offers a good view of the breadth and variety of undergraduate research taking place at Bucknell. You are encouraged to attend both the oral presentations as well as the poster session to interact with the scholars and to learn more about their work.

This symposium is named in honor of Ernest Kalman, who graduated from Bucknell in 1956. In addition to his service as a University trustee, Ernie’s generosity to his alma mater has taken many forms, one of which was a significant gift in support of undergraduate research.

The Kalman Research Symposium features projects sponsored or supported by the following programs:

- Accenture Technology Discovery Undergraduate Research Fund
- Bucknell Program for Undergraduate Research
- Bucknell Honors Program
- Douglas K. Candland Undergraduate Research Fund
- Fund for Undergraduate Research in Biological & Chemical Sciences
- Joann E. Walthour Undergraduate Research Fund
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- Robert P. Vidinghoff Memorial Summer Internship
- Tague Family Fund Undergraduate Research in Biomedical, Biology and Biochemical Sciences
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Faculty Mentor: Professor Emily Stowe-Evans, Biology

Microbial Community Analysis of Small Water Systems Located in Central Pennsylvania

Complementary chromatic adaptation, the process of altering the pigmentation of certain cyanobacterial species in response to changing light quality, occurs based on the protein composition of light harvesting structures, called phycobilisomes. Phycobilisomes have two structural domains, rods and cones, which are comprised of phycobiliproteins. Each phycobiliprotein is encoded by separate genes, which are expressed depending upon environmental light quality. Species of cyanobacteria that are able to undergo complementary chromatic adaptation, therefore, contain genes for several different phycobiliproteins within their genome and are able to alter phycobiliprotein composition of phycobilisomes in response to changing light quality (Grossman et al., 2001).

The purpose of this procedure was to determine cyanobacterial species diversity in Lake Chillisquaque, Roaring Creek, and The West Branch of the Susquehanna River in hope of finding complementary chromatically adapting species. Water samples were obtained from two depths, surface level and 15 feet. These samples were filtered and bacterial DNA was extracted. Using various primer sets, samples could be cloned, screened, and sequenced. Analysis of this sequencing data measured the diversity of cyanobacterial species in Lake Chillisquaque, Roaring Creek, and The West Branch of the Susquehanna River, and indicated which species present in the lake are known to undergo the process of CCA. Preliminary data has shown a variety of cyanobacterial species including Oscillatoria limnetica, Raphidiopsis D9, Calothrix PCC 7103, Anabaena sp (circinalis), Pseudoanabaena, Woronichinia naegeliana, and Nostocales. Continued sampling and sequencing will lead to a greater understanding of the diversity of cyanobacterial species found in these water sources, ultimately increasing our understanding of real time gene expression in environmental chromatically adapting cyanobacteria.

Tyler Anderson ’11

Faculty Mentor: Professor Douglas Gabauer, Civil and Environmental Engineering

Investigation of Rollover in Vehicle-to-Traffic Barrier Crashes

The purpose of a longitudinal barrier, e.g. a guardrail, is to redirect a vehicle that leaves the road and prevent it from impacting a more dangerous object. Previous research has indicated that one fourth of all vehicle-to-barrier fatalities involve a rollover (Gabler and Gabauer, 2007). Due to this high fatality rate, it is important to further investigate the causes of vehicle rollover in these crashes. One debated issue in the roadside safety community is the effect that barrier type has on vehicle rollover risk. Other factors may also influence the risk of vehicle rollover, including vehicle impact angle and how the vehicle interacts with the barrier during the collision. The purpose of this study is to determine the cause of vehicle rollover in vehicle-to-traffic barrier crashes, and the factors that increase the likelihood of rollover in these crashes.

This study used data from the National Automotive Sampling System/Crashworthiness Data System (NASS/CDS) database. NASS/CDS provides detailed information on approximately 5,000 vehicle crashes occurring in the United States each year. As these crashes are sampled from all police-reported crashes, weight estimates were used to make the cases nationally representative. Cases were selected from a 12-year subset of NASS/CDS (1997-2008, inclusive) and included only cases where a vehicle first impacted a longitudinal barrier on the length of need (excluding barrier ends) portion of the barrier. Since NASS/CDS does not collect detailed barrier or roadside data, available information from NASS/CDS, such as scene photos and diagrams, were used to ascertain the appropriate barrier and roadside feature information needed for analysis. This information included barrier type, vehicle-to-barrier interaction, impact angle and presence of multiple barrier impacts. Two binary logistic regression models were developed using Statistical Analysis Software (SAS) to more fully examine the factors related to rollover in barrier crashes. The final data set used for this analysis included 2,391 raw cases which represent 1,045,611 total vehicle-to-barrier crashes.

From the developed models, vehicles were found to be less likely to roll when impacting a concrete barrier; however, in the event of a rollover, concrete barriers were more likely to be the tripping mechanism. Other findings were that impact angle is more important than the vehicle-to-barrier interaction in determining vehicle rollover risk; more than one barrier impact increases the likelihood for the barrier to be the tripping mechanism, and that LTVs (SUVs, light trucks, and vans) are three times more likely to rollover than cars in vehicle-barrier collisions.

Jacquie Bachand ’13, Olivia Tomeo ’13, Rochelle Vollmerding ’13

Faculty Mentors: Professor Marie Pizzorno, Biology; Professor Emily Stowe-Evans, Biology

Isolation and Characterization of Three Mycobacterium Phage in the Myoviridae family from Soil Samples

Bacteriophage are viruses that infect bacteria. Using the host Mycobacterium smegmatis, we isolated mycobacteriophage from soil samples using both enrichment and direct plating techniques. The bacteriophage were plaque purified several times until medium and high titer lysates were obtained. Throughout the plaque purification process, consistent plaque morphologies were obtained for each phage. The DNA from each phage was isolated and examined through restriction analysis. Each phage
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was also examined under a Transmission Electron Microscope (TEM). The phage discovered (Atlas, Dogwood, and Vixen) were from the C1 cluster and part of the *Myoviridae* family, which have short, contractile tails and large genomes (about 150kb). The average head widths were between 85-95 nm and the average tail lengths were between 75-80 nm. These three phages were taken from similar locations (around Bucknell’s Carnegie Building) and further research could determine if they have similar genome sequences.

Rachel Baird ’11

Faculty Mentor: Professor JT Ptacek, Psychology

**Influencing Factors on Empathic Responding**

Empathy is an important factor in how people respond to those in need. While empathy has been studied in depth, much is still unknown. In order to delve deeper into this issue, my work looked at whether personality factors influenced how people responded to a story of a girl with cancer. Individuals read one of two different stories, about a mean or a nice girl, and then rated how empathetic they felt. They then rated their own personality levels of empathy. Individuals who read the story of the nice girl felt more empathy (*p*=.015), and those who rated their personality as being higher in empathy, also felt more empathy after reading the story (*p*=.008). This is important to the study of psychology as those with unlikable personalities are more at risk after traumatic situations as they may receive less social support.

*Jake Bellucci ’12

Faculty Mentor: Professor Ryan Snyder, Chemical Engineering

**Modeling and Simulation for the Prediction of Crystal Growth Spirals for Organic Molecules of Pharmaceutical Complexity**

Growth of crystals occurs by either a nucleation and growth mechanism or a spiral growth mechanism. In spiral growth, a screw dislocation at a crystal face allows for the formation of an edge. Under the proper supersaturated conditions, this edge grows exposing a new edge. Spiral growth is the dominant growth mode under low supersaturations, and organic molecular crystals are typically grown under those conditions. Therefore, the spiral growth mode will be the primary focus here. Recently, progress has been made in understanding the solid-state chemistry and physics behind the prediction of crystal shapes. This understanding has led to a method to predict morphologies of a certain subset of organic molecular crystals where the intermolecular interactions around each molecule are identical in opposite directions. Thus, the intermolecular bonding network in the crystal is said to be centro-symmetric.

The focus of the research was to expand this mathematical model for spiral shape and growth rate prediction in order to incorporate the crystal formation of organic molecules where the assumption of centro-symmetric growth patterns does not hold. Due to the complexity of organic molecules (especially pharmaceuticals), each layer of the crystal will often not be the same as the previous (which was an assumption in the centro-symmetric system). A MATLAB program was developed that is able to automate the process of predicting growth rate and spiral shape given a set of inputs (which were taken from other predictive methods or experimental results). Along with automating calculations, the program outputs a top down visualization of the crystal growth pattern (Figure 1).

![Figure 1: Sample Image Created by the Program](image)

The program can perform calculations on crystal growth patterns that occur one layer at a time. In the future, the program will be adapted in order to account for the simultaneous growth of multiple layers.


Katherine Bishop ’11

Faculty Mentor: Professor Emily Stowe-Evans, Biology

**Analysis of three green mutants in *Fremyella diplosiphon***

Cyanobacteria utilize light-harvesting antennae called phycobilisomes (PBS) to capture light for photosynthesis. PBS contain pigmented chromoproteins including allophycocyanin (AP), phycocyanin (PC), and phycoerythrin (PE). Structurally, PBS are composed of a central core of AP and six radiating rods formed by the chromoproteins PC and PE and linked by unpigmented linker polypeptides. PC absorbs red light...
and appears green, and PE absorbs green light and appears red. *Fremyella diplosiphon* is a Group III adapter that exhibits complementary adaptation (CCA), which means that the ratio of PE:PC increases or decreases in response to the wavelengths of light available in the environment. The Bk14 mutant is phenotypically black, producing equal amounts of PE and PC in all light conditions. KBG1, KBG2, and KBG3 are mutants of Bk14 that no longer produce PE and are phenotypically bright green. We predict that for each mutant there is a mutation in one of the genes involved in the production of PE and its linkers in Bk14 that gives rise to the KBG1, KBG2, and KBG3 mutants since PC is the only pigment produced. Possible locations of the mutation include the operons cpeBAYZ, cpeCDE, cpeSTR, and pebAB. The operon cpeBA encodes the PE proteins, and cpeCDE encodes the linker polypeptides for PE. And while cpeR is necessary to activate cpeBA, its exact function, as well as the functions of cpeS and cpeT, is unknown. Finally, pebAB is involved in linking PE and the AP core. Using PCR to compare the lengths of the genes in each operon involved in PE production in Bk14 and KBG1, it was determined that the mutation in KBG1 is not located in cpeBAYZ, cpeR, cpeCDE, or pebAB since there were no differences seen in operon length. PCR products comparing the same operons with KBG2 and KBG3 genes are also being analyzed to determine where their mutations are located. The next step if the mutations are not found in these operons would be to create a genomic library and transform the mutants with the library looking for phenotypic complementation. Whole cell scans were performed in order to compare the wavelengths of light that each strain of *F. diplosiphon* can absorb. Wild-type *F. diplosiphon* has peaks for PE in GL and PC in RL, while Bk14 shows the same peaks under RL and GL. KBG1, KBG2, and KBG3 cannot produce PE, and each shows no PE peak under either light condition.

**Kyle Boline ’11**

**Faculty Mentor:** Professor Douglas Gabauer, Civil and Environmental Engineering

**Exploring the Effects of Corrosion on Guardrail Performance**

Guardrails are used to prevent vehicles from traversing a steep slope or impacting a more dangerous fixed object and often sustain minor damage after being installed in the field. Unfortunately, not much is known about the impact performance of a damaged barrier, especially corroded barrier. A better understanding of damaged barrier performance would help highway agencies more effectively maintain guardrail systems using only the limited funding that they have available. This study specifically investigated the effects of corrosion on w-beam guardrail performance. A total of 52 specimens from five different guardrail sections, with varying degrees of corrosion, underwent quasi-static tensile loading and Rockwell hardness tests. The degree of corrosion was quantified by the percentage of mass loss using a rust-removal product called EVAPO-RUST™. For the five sections tested, the approximate range of corrosion was between 0.25 to 5 percent. Minimum tensile requirements for guardrails are specified by AASTHO M180. Of the five sections, all of the sections passed the minimum elongation requirement of 12 percent. Only one of the sections, on average, did not pass the minimum tensile strength requirement of 70,000 psi. At these relatively low levels of corrosion, a strong correlation between quasi-static performance and the level of corrosion was not found.

**Ben Bouffard, Graduate Student**

**Faculty Mentor:** Professor Mala Sharma, Mechanical Engineering

**Corrosion Characteristics and Mechanical Properties of Aluminum Coatings Applied by the Cold Spray Process**

Chromate conversion coatings are currently utilized to protect aluminum substrates from corrosive environments. Unfortunately, these coatings are harmful to those applying the coatings and can have detrimental effects on the environment. As an eco-friendly alternative, pure aluminum coatings have been proposed as a substitute by taking advantage of the high velocity particle consolidation process (HVPC). This method is unique in that it uses low temperatures to apply the coating, thereby eliminating problems such as recrystallization and grain growth in the coating. A battery of tests was conducted in order to evaluate the corrosion protection offered by these coatings, including electrochemical experiments, atmospheric exposure, long term immersion, and accelerated cabinet testing. Rotating bend fatigue testing was also completed to evaluate the performance of the coating by simulating aircraft wing loading conditions. The tests were carried out on each proposed coating and compared to the performance of conventional coatings currently employed. A rubric was devised which ranked each proposed coating within each test, and then used to determine which coatings provided the best overall corrosion resistance. Failed fatigue specimens were examined using scanning electron microscopy in order to characterize specific failure mechanisms and location (i.e. coating, interface, substrate). The pure aluminum coatings were found to offer similar corrosion protection when compared with conventional coatings, while increasing the fatigue life of the underlying substrate.

**Carolyn Breden ’12**

**Faculty Mentor:** Professor Matthew Higgins, Civil and Environmental Engineering

**The Presence of Phthalates in Drinking Water Treatment Process**

The ultimate goal of this project is to quantify levels of phthalates in samples taken from several drinking water treatment plants in the Susquehanna River Valley region. Phthalates are a group of compounds that are considered endocrine disrupters and function as plasticizers in a wide range of materials including PVC pipes, vinyl shower curtains, and medical supplies like blood and fluid bags. The methods we have developed over the course of this project for detecting these compounds have
been plagued with several problems. Using liquid desorption to recover the phthalates from polyacrylate-coated stirbars and analyzing the results with a GC-MS resulted in RSDs that averaged 30 percent and were as high as 71 percent in some instances. Limits of detection were barely low enough to detect the presence of phthalates in tapwater and results were generally not very reliable. Using thermal desorption to recover the phthalates from the stirbars improved sensitivity 24 to 543 times as compared with our previous method, but variability continued to be a major problem. Possible sources of variability included variations among the stirbars themselves, changing and retightening sample tubes between each run, evaporation, and excess methanol in the sample tubes, among other possibilities. Currently, rather than use the coated stirbars, we are experimenting with pumping samples through columns of XAD-resin in order to extract the phthalates. These columns are then flushed with methanol and the sample is concentrated with a stream of nitrogen before being run through the GC-MS unit. We hope that this method will give us a better combination of sensitivity and reliability and enable us to begin testing samples from the treatment plants.

Sarah Brownlee, Graduate Student
Faculty Mentor: Professor DeeAnn Reeder, Biology
Flight Maneuverability and Sensory Stimulation Thresholds in White-Nose Infected Little Brown Bats

In 2006 a fungus was found growing on the muzzles and forearms of bats in New York. This fungus was later connected to the death of at least a million bats in the Northeastern United States. The relationship between the fungus, Geomyces destructans, and the disease, known as White-Nose Syndrome (WNS), is now at the forefront of bat research. The fungus is thought to infiltrate their skin and possibly disrupt the physiological properties of their wing membranes. The fungus is also thought to disrupt hibernation patterns and possibly have a neurological impact. The goal of this research is to examine some of the behavioral abnormalities associated with WNS – the investigation of which has been identified as an area of high research priority. This goal is being met by testing the relationship between disease progression and flight maneuverability, using an obstacle course, and by measuring sensory thresholds, by measuring the thermoregulatory response to touch in hibernating animals. Preliminary results indicate that bats with more advanced WNS are impaired, when it comes to flight maneuverability or time to arouse in response to touch than bats in the earlier stages of infection.

Leigh Bryant ’11
Faculty Mentor: Professor JT Ptacek, Psychology
Personality Factors Among Women Participating in College-level Sports and Dance

There exists some degree of discrepancy considering the overall health and well-being of women in sports and performance domains. The current study aimed to examine self-reported levels of body esteem, perfectionism, and perceived social support among collegiate student-athletes and dance company members, and to explore the influence that these three constructs might have on health and performance. A total of 103 female athletes and dancers (M age = 19.37, SD = 1.15) from a small liberal arts university completed a series of randomly-ordered questionnaires intended to capture each of the major variables of interest. Descriptive statistics showed significant differences in BMI for lean versus non-lean sport athletes and performers as well as higher levels of body esteem for non-lean athletes. Although social support did not meaningfully relate to any of the other major study variables across all participants, analyses illustrated higher levels of social support and perfectionism among lean sport athletes, with the exception of being concerned over mistakes. Not only were many of the body esteem and perfectionism measures significantly correlated with one another, but moreover the association between social support and body esteem was significant and positive for the lean sport athletes and nonsignificant and negative among non-lean sport athletes. Implications and limitations are discussed.

Joseph Budzinski ’10
Faculty Mentor: Professor Tristan Stayton, Biology
The Relationships Between Turtle Skull Shape and Diet, Habitat, Phylogeny, and Shell Shape

The turtle skull performs multiple functions and thus is shaped by multiple selective pressures. By investigating the relationship between skull and shape and multiple potentially correlated factors, it is possible to determine the relative contribution of a variety of factors in shaping turtle skull morphology. This can provide insight into the response of other multi-function structures to varied evolutionary pressures. In this study we investigated the relationship between multiple possible selective factors and turtle skull shape. Specifically, we tested for relationships between multiple aspects of skull shape, diet, and shell shape. We hypothesized that all aspects of turtle skull shape would be correlated with the dietary ecology and habitat (terrestrial or aquatic) of these animals, but that only aspects of shape related to the height of the skull would show a relationship with shell shape. Photographs of turtle skulls and shells were digitized in dorsal, lateral, and ventral view. We used these data to obtain a series of shape variables for both skulls and shells. We then used the Mantel test, with phylogenetic distance as a covariate, to compare the relationship between skull shape and shell shape. As predicted, skull shape in lateral view is...
Hydrogen Abstraction Followed by Nitroxide Mediated Polymerization: Synthesis of 2,7-Dibromofluorene-Labeled Polystyrene

Chromophore end-labeled polystyrene was synthesized through the use of nitroxide mediated polymerization (NMP) by decomposing 2-2’-azoisobutyronitrile (AIBN) or benzoyl peroxide (BPO) in the presence of fluorene derivatives. End-labeling was dependent upon the thermally produced radical species selectively abstracting a hydrogen atom from the 9-position of the fluorene species prior to initiation of a styrene polymerization. From gel permeation chromatography (GPC) data and UV-Vis analysis, it was found that AIBN initiation, compared to BPO, led to a more controlled polymerization system, producing polymers with predictable molecular weights, with narrow polydispersity index (PDI) values (<1.3), and higher amounts of end-labeling. In terms of the reaction parameters, no consistent trend was observed as a function of the timing of styrene’s addition or the temperature at which the hydrogen abstraction phase was performed. Analysis of the chromophore content by UV-Vis spectroscopy demonstrated that the presence of bromine atoms on the 2 and 7-position of the fluorene species led to higher percent labeling of the chromophore species, presumably due to a more facile abstraction of the hydrogen at the 9-position.

Will Butcher ’13
Faculty Mentor: Professor Eric Tillman, Chemistry

Marger Cain ’13, Adam Meier ’13 and Patrick Reilly ’13
Faculty Mentors: Professor Marie Pizzorno, Biology; Professor Emily Stowe-Evans, Biology

Discovery of 13 Novel Mycobacteriophages from Soil

This work describes the discovery and characterization of 13 different novel mycobacteriophage, viruses that infect members of the genus Mycobacterium, by the ‘Phage Hunters’ class at Bucknell University. The host bacterium used was Mycobacterium smegmatis (M. smegmatis), which is a non-pathogenic relative of the bacteria that causes tuberculosis. Phages are by far the most abundant biological entity known, and the phage described here will be used by researchers to learn about diseases such as tuberculosis and leprosy. Starting with raw soil from across the Northeastern United States, the students isolated and characterized 13 phages. The phages were plaque purified and then high titer lysates were isolated. The phage genomic DNA was separated from the protein coats for analysis. Polymerase Chain Reaction (PCR) analyses were used to classify some phages into specific clusters based on genetic similarities to other phages in the same cluster. In addition, the phages were imaged using Transmission Electron Microscopy in order to determine structural properties of the heads and tails. Ten of the phage belong to the family Siphoviridae, with long, flexible tails and the other three belong to the family Myoviridae, having short, contractile tails. Ultimately, the phage will be archived and have their genomes sequenced and annotated. In all, the ‘Phage Hunters’ class isolated, purified, characterized, and assigned clusters to 13 novel phage.

Brooke Campbell, Graduate Student, Allyson Hopper ’11, Leigh Bryant ’11, Katherine Lang ’11, Andrea Massa ’12, Jenni Whalen ’12 and the Bucknell Sexual Assault Research Team
Faculty Mentor: Professor William Flack Jr., Psychology

Hooking up, Alcohol Consumption and Sexual Assault: Differentially Risky Behaviors

Previous research has demonstrated a significant association between sexual assault and alcohol consumption between unwanted sexual experiences and hooking up (Flack, Daubman, et al., 2007). In the present study, we tested these relationships more directly by asking sexual assault victims to indicate the primary reason(s) that their assault took place and the type of hook-up, if any, in which they occurred. Participants in this study were 373 female Bucknell students (sophomore through senior) who completed an online survey that included measures of sexual assault, alcohol intoxication, and hooking-up. The overall prevalence rate for any type of sexual assault was 44.2 percent. Specific prevalence rates for non-invasive contact, rape, and attempted rape were 39.7 percent, 22.3 percent, and 22.5 percent, respectively. Within all types of sexual assault, the most
prevalent hook up type was hook ups with acquaintances and the most common reason given across all seven types of assault was incapacitation due to intoxication. These findings demonstrate direct, significant relationships between sexual assault and hooking up and between sexual assault and alcohol intoxication. If replicated, we would hope that these findings would be used to educate students in future efforts to prevent sexual assault.

**Anthony Carter ’12**

**Faculty Mentor:** Professor Robert Stockland Jr., Chemistry

**Hydrophosphinalation of Internal Alkenes**

The end results of this summer’s research produced the creation of five new compounds. Each of these compounds contains strong electron withdrawing groups that can be used with heterocyclic groups. Heterocyclic groups are being heavily studied throughout the chemistry world because of their ability to help cure diseases, specifically some types of cancers and diabetes. The products are created by performing phospho-michael addition and hydrophosphinylation. One of the more unique components to the creation of these new compounds is the use of the synthetic microwave. The synthetic microwave allows these reactions to be completed in only 35 minutes. Normally these types of reactions take several hours to days to complete, and they also require specific conditions for each type of compound. This faster way to create these types of new compounds will open the door to a more efficient accepted way to make these compounds, and also allow more compounds to be created that could not previously be created using the older method.

The future plans for this summer’s research starts with completely purifying the products that were made. Only one of the five compounds created was completely purified, the others mostly had small amounts of either water or solvent. Once these compounds are successfully purified then the final goal of publishing them in a journal article will be the next and final step of the research project.

**Angela Chouinard ’11**

**Faculty Mentor:** Professor Ruth Tincoff, Psychology

**Lexical Development in Adult Beginning Second Language Learners**

This research examines the relationship between knowledge of derivational morphology and vocabulary acquisition in beginning adult second language learners. Knowledge of derivational morphology was tested through the use of a forced-choice translation task. Lexical development was measured by priming L2 responses through direct translation and conceptual (picture) primes, which are representative of the formal and L1 lemma mediation stages of Jiang’s (2000) theory of lexical development. The results support the existence of a relationship between knowledge of derivational morphology and acquisition of second language vocabulary. Theoretical and applied implications are discussed.
Laura Cook ’11  
**Faculty Mentor:** Professor Timothy Raymond, Chemical Engineering  
**Investigation of Hygroscopic and Morphological Properties of Atmospheric Aerosols**

The study of atmospheric aerosols has become increasingly important as aerosols have been linked to air quality degradation and subsequent health issues, visibility degradation, and climate change. The effect of aerosols on climate change is complicated through direct and indirect effects with respect to radiative forcing due to aerosol-water interactions. Directly, aerosols scatter and absorb radiation. Indirectly, aerosols alter the rate of chemical reactions in the atmosphere that may form or destroy pollutants. Additionally, the aerosols may influence secondary factors, such as precipitation, which control how aerosols deposit. To model and analyze aerosol-water interactions, the growth of organic and inorganic particles through the use of a humidifier system and an Environmental Scanning Electron Microscope (ESEM) are studied.

A Vibrating Orifice Aerosol Generator (VOAG) is used to create larger (> 2 µm) particles for analysis under an ESEM, where a variable relative humidity environment allows for controlled growth of particles. By slowly increasing the RH of the particle environment, growth can be observed and growth factors \( \frac{Dp(RH\%)}{Dp(RH\% < 30\%)} \) can be determined.

Particles less than a micron are also generated by atomizing a solution of known concentration and composition. Once generated, the aerosols enter a series of three driers filled with silica gel and two driers filled with zeolite. The aerosols are then size selected by electrical mobility by a Differential Mobility Analyzer (DMA) before proceeding through a humidifier, a secondary DMA and a particle counter, where the final growth size and concentration is recorded for a given RH. Growth factor curves are created from this data and compared with theory (e.g. Aerosol Inorganic Model, UNIFAC) and data from past research. From the growth factor curves, deliquescence relative humidity (DRH) or hygroscopic growth measurements can be obtained.

Emily Daniels ’11  
**Faculty Mentor:** Professor Stephen Buonopane, Civil and Environmental Engineering  
**Case Studies of the Preservation Process for Historic Bridges**

Historic bridges are artifacts of the United States’ industrial and social heritage. Preserving historic bridges is important to ensure that society’s culture and knowledge are preserved. Federal laws such as the National Historic Preservation Act of 1966 (NHPA) and the U.S. Department of Transportation Act of 1966 are the basis for preserving historic properties and are used by Departments of Transportation (DOT) in historic bridge cases. Section 106 of the NHPA and Section 4(f) of the DOT Act were later written into the United States Code (U.S.C) and the Code of Federal Regulations (C.F.R). These laws, however, cover a wide range of preservation issues including parks, animal refuges, and cultural resources. Although the laws incorporate historic bridges into their jurisdiction, they are not specific to bridges. The ambiguity allows each state to interpret the laws differently with regard to bridges, causing inconsistent decisions in the historic bridge management process. This project examined the historic bridge rehabilitation and replacement processes of various states, federal regulations such as Section 106 and Section 4(f), and two specific case studies, namely Lindbergh Viaduct (1927) in Reading, PA and Carrollton Bridge (1927) in Carroll County, IN.

Robert De La Rosa ’11, Peter Kole ’12  
**Faculty Mentor:** Professor Michael Gross, Chemical Engineering  
**Investigation of dimensional stability of infiltrated LSCO-YSZ and Ni- YSZ anodes**

Samples comprised of infiltrated LSCO and Ni in porous yttria stabilized zirconia (YSZ) were prepared and investigated. YSZ samples that ranged in porosity from 37–64 percent had been previously created using graphite, poly-styrene, or a combination of both. These samples were infiltrated to create specimens with 0, 5, 10, 15, 20, and 25 percent loading of a nickel oxide solution and 10, 20, and 30 percent loading of a LSCO solution. Following this process, the specimens were individually tested in a thermal mechanical analyzer (TMA) and the coefficient of thermal expansion was determined for each sample. It was determined that the type of pore former used in the creation of the YSZ sample and the porosity of the sample affect the thermal expansion coefficient.

The procedure employed to create these samples was, Nickel and Lanthanum Strontium Cobalt solutions were synthesized following a ratio provided by Prof. Gross. Using the known concentration of each solution, the quantity required to achieve the desired loading in each of the samples determined. A syringe for each sample was filled up with the previously determined amount of solution. Each sample was infiltrated till sample would no longer absorb any more solution. At this point the samples were placed in a furnace. The Ni infiltrated YSZ samples were place in a furnace set to rise to 450°C at a ramp of 40°C per min. with a 10 min hold once the desired temperature was reach. The LSCO infiltrated samples were submitted to the same process except for the furnace these samples were placed in was set to rise to 700°C. This was an iterative process that was continued until the each sample had absorbed all of the solution in its corresponding syringe. The Ni infiltrated YSZ samples had to then be reduced, so they were heated to 800°C and a ramp of 10°C per min. and held at that temperature for 30 min. in a hydrogen rich environment. The LSCO and Ni infiltrated YSZ samples were then individually tested in the thermal mechanical...
sequencing. The complete genome contained 106,327 base pairs of the course. Thibault's genome was sequenced using 454 for annotating and gene analysis during the second semester. The class voted to have Thibault's complete genome sequenced to Bucknell's campus in the first semester of Phage Hunters class.

Mycobacterium phage Thibault was isolated using direct plating. Mycobacteriophage Thibault

Professor Emily Stowe-Evans, Biology

Facult Mentors:
Professor Marie Pizzorno, Biology;
Chelsea Dieck '13, Sarah Thibault '12

FOCUS headform.

area-normalized energy, which may have implications for the insight into the relationship between intraocular pressure and models of the eye for impact events. Second, this data offers pressure data that can be used to validate computational anthropometric headforms. First, this study provides intraocular eye injury prediction tools: computational models and injury mechanism for globe rupture.

A total of 130 impact tests on 63 porcine eyes were conducted using 6 projectile sizes, with 35 trials resulting in globe rupture. Each specific impact test was analyzed to determine the peak pressure experienced during impact as well as the area-normalized energy for the impacting projectile. It was found that the size of the impacting object influenced the injury mechanism that was observed in globe rupture and is believed to be the first parametric study to observe the transition between blunt and penetrating injury mechanisms.

The results from this study may also be useful for two other eye injury prediction tools: computational models and anthropometric headforms. First, this study provides intraocular pressure data that can be used to validate computational models of the eye for impact events. Second, this data offers insight into the relationship between intraocular pressure and area-normalized energy, which may have implications for the experimental evaluation of eye injury risk using tools such as the FOCUS headform.

Chelsea Dieck '13, Sarah Thibault '12

Facult Mentors: Professor Marie Pizzorno, Biology;
Professor Emily Stowe-Evans, Biology

Analysis of Genome of Mycobacteriophage Thibault

Mycobacterium phage Thibault was isolated using direct plating technique from soil obtained next to the Biology building on Bucknell's campus in the first semester of Phage Hunters class. The class voted to have Thibault's complete genome sequenced to use for annotating and gene analysis during the second semester of the course. Thibault's genome was sequenced using 454 sequencing. The complete genome contained 106,327 base pairs and Thibault was determined to be a J cluster phage. The genome was scanned with programs which showed "suggested" genes or coding potential in each reading frame based on their start and stop sequences (Glimmer, GeneMark, and GeneMarkTB) as well as programs which marked Shine-Dalgarno sequences and their respective strengths. The class manually analyzed the entire genome in segments so that every potential gene was analyzed at least twice to check the accuracy of the suggested genes and to edit them as needed. Using the BLAST (Basic Local Alignment Search Tool) via the NCBI website, predicted amino acid sequences were compared to previously known proteins. Thibault was found to be closely related to other J phages such as Omega, but other sections of the genome were found to be highly similar to other phage clusters as well as previously undiscovered proteins.

Alper Dincer '11

Faculty Mentor: Professor Elizabeth Marin, Biology

The Role of Broad-Complex in Determining Neuronal Composition

The ability of the developing nervous system to be plastic, to adapt to specific environmental and physiological conditions, contributes to the survival and reproductive success of the individual animal. Although the genetic basis of conserved developmental programs is widely studied, the molecular mechanisms underlying plasticity remains an area largely unexplored.

The mushroom body (MB), a prominent structure in the Drosophila brain essential to olfactory learning and memory, is an excellent model to study the molecular mechanisms underlying the developmental plasticity of neuronal composition. The axons of neurons that compose the MB form five distinctive types of lobes (γ, α', α, β', β) (Yang, et al. 1995). During development, three different classes of neurons (γ, α'/β', α/β) are generated sequentially from four neuroblasts (Lee et. al, 1999). The three distinct types of MB neurons are born and project into their respective lobes coincident with certain developmental periods; γ lobes are generated until mid-3rd instar, α' and β' are generated between mid-3rd instar and puparium formation, and α and β lobes are produced during metamorphosis.

Evidence suggests there are hormonal as well as inherited transcription factor influences in mushroom body neuronal composition. (Zhu et al., 2006; Maurange et al., 2008; our unpublished data). Expression of the transcription factor Broad-Complex (BR-C) is regulated by both ecdysone and juvenile hormone, and BR-C is known to be involved in the transition of larvae into metamorphosis. Currently, overexpression and knockdown experiments are being conducted to elucidate the role of the four individual BR-C isoforms on neuronal composition. By counting the number of neuronal subtype cells in the mushroom body at a specific developmental timepoint, any significant differences from control groups might be indicative of a role for BR-C in the mechanism for mediating neuronal subtype identity.
Erin Donaghy ’12
Faculty Mentor: Professor Carl Kirby, Geology

A Study of the Effectiveness of the Buffalo Creek Acid Precipitation Treatment System and its Ecological Effects on Buffalo Creek, Union County, Pennsylvania

Surveys indicate that the Buffalo Creek headwaters and the upper portions (approx. 7-8 miles in total stream length) of the stream do not comply with Pennsylvania Water Quality Standards. Therefore, the Buffalo Creek Watershed Alliance (BCWA) installed the Buffalo Creek Acid Precipitation Treatment System (BCAPTS) in 2009 to remediate the effects of acid precipitation on the stream. The primary purpose of conducting this research was to further the understanding of how BCAPTS is affecting the water chemistry of Buffalo Creek by monitoring seven different sites along seven miles of the stream. Geochemical data was collected at all sites along with water samples to later measure alkalinity, cation and anion concentrations, and dissolved calcium and magnesium concentrations in the lab. The secondary purpose of conducting this research was to determine ecological effects BCAPTS has on Buffalo Creek. Macroinvertebrate samples were collected at three of the seven sites along Buffalo Creek in order to establish an Ephemeroptera, Plecoptera, Trichoptera (EPT) Index to use as a reference to the overall stream health at the different locations. Data collected from sites upstream of BCAPTS were compared to downstream sites to determine the overall effectiveness BCAPTS has on Buffalo Creek.

Steven Duff ’12
Faculty Mentor: Professor Nathan Ryan, Mathematics

A Statistical Look at the Gauss-Kuzmin Distribution

The Gauss-Kuzmin distribution predicts the distribution of terms in the continued fraction expansion of almost all real numbers. Unfortunately, it provides no characterization of the set of full measure for which the distribution holds. Finding elements contained in this set would tell us more about this set and about continued fractions in general. We develop a framework for experiments to determine if a number is contained in the set of full measure. An important part of describing this framework is developing and implementing algorithms that generate random continued fraction expansions.

Stephanie Evans ’11
Faculty Mentor: Professor Erin Jablonski, Chemical Engineering

Modeling Small Molecule Elution from a Hydrogel using a Microfluidic Technique

Drug release from a fluid-contacting biomaterial is modeled using a microfluidic device with channels defined by dye-loaded hydrogel. Photolithography is used to cure a solution of poly(ethylene glycol) diacrylate (PEG-DA), dye, and photoinitiator inside a microfluidic device with a channel through the center of the gel. As water is pumped through the channel, dye diffuses out of the hydrogel and into the water. Channel sizes within the devices range from 300-1000 µm to simulate vessels within the body. Digital image analysis of the dye diffusion captured by a stereomicroscope is used to generate dye concentration v. depth profiles. These data are modeled to determine diffusion coefficients and the dye release profile with respect to time and position in the hydrogel. Analysis of the eluted fluid is performed using ultraviolet-visible (UV-Vis) and Fourier transform infrared (FTIR) spectroscopies to determine a short-time diffusion coefficient. Diffusion coefficients are correlated with those obtained from Nuclear magnetic resonance (NMR). The properties of the hydrogel are characterized by the extent of PEG-DA crosslinking and the swelling ratio in the gel, which is related to the UV exposure dosage, and the initial water and dye content in the PEG-DA solution. Diffusion coefficients for the dye in PEG hydrogel calculated using data from the various characterization methods are in reasonable agreement.

Alex Fielding ’11
Faculty Mentor: Professor Katsuyuki Wakabayashi, Chemical Engineering

Characterization of Pla/Clay Nanocomposites Fabricated Using Solid State Shear Pulverization

Bio-based polymers offer a sustainable alternative to traditional polymers from petroleum derivatives, especially in short lifetime products such as packaging materials. Derived from natural organic resources, these types of polymers degrade under natural conditions in a time period ranging from several weeks to several years. Neat forms of many bio-based polymers, however, exhibit many undesirable physical properties, often associated with low glass transition and melting temperatures. Incorporating small amounts of nanoscale fillers, such as layered silicates (clay), into the biodegradable polymer matrix can improve mechanical, thermal, and other physical properties to make them applicable in commercial applications. Studies involving nanocomposites of poly(lactic acid) (PLA), a common bio-based, compostable polymer, and montmorillonite clay have shown significant property enhancement when complete exfoliation and good dispersion of the clay sheets are achieved. However, common processing methods used to prepare PLA/clay nanocomposites, such as in situ polymerization and melt processing, have practical limitations.
We herein propose solid-state shear pulverization (SSSP) as an effective processing method to disperse clay-based nanofillers in bio-based polymer nanocomposites. SSSP has proven to successfully compatibilize immiscible polymer blends and exfoliate silicate sheets in more traditional polymer/clay nanocomposites. Unlike conventional nanocomposite fabrication techniques that often require chemical modification, solvents, and/or heat, SSSP processes the polymer nanocomposites simply by maintaining the polymer below its glass transition temperature and subjecting the material to high shear forces, promoting filler exfoliation and dispersion. Thus nanocomposites prepared via SSSP are not limited by thermodynamics or transport issues. The continuous operation of SSSP allows for facile scale-up for industrial use in applications such as biodegradable packaging materials.

Commercial grade PLA and pristine and organically-modified clay were processed under different SSSP conditions. X-ray diffraction was employed to investigate the exfoliation and dispersion of clay sheets. Differential scanning calorimetry and thermogravimetric analysis were employed for thermal characterization. Mechanical properties were measured using static and dynamic mechanical tests, and the barrier properties were obtained from oxygen permeation and water vapor transmission testing. An in-house biodegradability test was developed to assess the degradation of PLA/clay nanocomposites under aerobic composting conditions. Results from these tests were used to compare the performance of PLA/clay nanocomposites processed via SSSP to that of neat PLA and PLA/clay nanocomposites processed via traditional twin-screw extrusion.

Kevin Foley ’12

Faculty Mentor: Professor Elizabeth Durden, Sociology and Anthropology

Disparate Opinions on Capital Punishment: Does One’s Race Impact their Opinions Towards the Use of Capital Punishment in Cases of Murder?

The purpose of this research is to explore opinions on the use of capital punishment as a sentence in cases of murder. Using data from the 2004 General Social Survey, crosstabulations and binomial logistic regressions are used to examine the main relationship being studied, as well as the influence demographic and socioeconomic variables have on that relationship. The results of the research illustrate that the relationship between an individual’s race and their opinion on the use of capital punishment is significant. The findings show that factors such as gender are important, as females are 46.6 percent less likely than males to show support for capital punishment, and those who have obtained a high school degree are the most likely to support the use of capital punishment. Furthermore, those who identify as extremely conservative are 81.7 percent more likely than those who identified as extremely liberal to support the use of the death penalty, consistent with previous literature.

Lauren Fry ’11, Kelsey Malone ’11, Beau Traber ’13, Shibani Walia ’11 and Jessica Yingst ’12

Faculty Mentor: Professor William Flack, Jr., Psychology

Gender Differences in Emotional Reactions to Different Hooking Up Behaviors

Our present research looks to explore the relationship between the emotional responses of college students to different hooking up behaviors. An email was sent out to 1,800 undergraduates with a short description of the study and a link, which they could follow to take the web-based survey. The survey included a demographic questionnaire, SDS, PANAS, AUDIT, and a measure of hooking up modeled after those used in Glenn & Marquardt (2001) and Owens et al. (2010). This measure of hooking up asked participants the frequency with which they participated in eight different types of hooking up varying by degrees of familiarity to their hook up partner and whether the hook up was coital or non-coital, as well as their emotional responses to the behavior and their perception of the emotional responses of their partner. We expect to find that females will experience more negative emotional reactions to hooking up behaviors and males will experience more positive emotional reactions to hooking up behaviors. We also expect to find that females experience more positive emotions with hook up partners they are more familiar with and with behaviors that are less physically intimate, when compared with males. In contrast, we expect to find that males experience more positive emotions with hook up partners they are less familiar with and with more physically intimate behaviors, when compared with females. This research will add to the relatively small body of literature on hooking up behaviors. An email was sent out to 1,800 undergraduates the emotional responses of college students to different hooking up behaviors. An email was sent out to 1,800 undergraduates the emotional responses of college students to different hooking up behaviors. Using data from the 2004 General Social Survey, crosstabulations and binomial logistic regressions are used to examine the main relationship being studied, as well as the influence demographic and socioeconomic variables have on that relationship. The results of the research illustrate that the relationship between an individual’s race and their opinion on the use of capital punishment is significant. The findings show that factors such as gender are important, as females are 46.6 percent less likely than males to show support for capital punishment, and those who have obtained a high school degree are the most likely to support the use of capital punishment. Furthermore, those who identify as extremely conservative are 81.7 percent more likely than those who identified as extremely liberal to support the use of the death penalty, consistent with previous literature.

Morgan Furze ’12, Cathy Meade ’11

Faculty Mentor: Professor DeeAnn Reeder, Biology

Onset of Sexual Maturity in Male Flying Foxes, Pteropus vampyrus and Pteropus hypomelanus

Flying foxes are highly social, fruit-eating bats that live in the tropical and subtropical Old World. These mammals typically reproduce once annually, giving birth to a single pup. At what age these pups reach sexual maturity is unknown. The purpose of this ongoing study is to determine this developmental timeline by measuring testosterone levels in plasma samples from male flying foxes of two species, *Pteropus vampyrus* (N=11) and *Pteropus hypomelanus* (N=6). Monthly blood samples were collected from experimental subjects between the age of 4 months and 24 months. During sampling, forearm measurement and body mass were measured in order to calculate body mass.
index (BMI). Plasma samples were stored at -20 °C. Testosterone levels will be measured using enzyme immunoassay (EIA) kits (Cayman Chemical Company, Michigan, USA) and a rapid rise in testosterone levels will indicate puberty.

Yifan Ge ’13
Faculty Mentor: Professor Kundan Nepal, Electrical Engineering

Design of an Autonomous Unmanned Robotic Vehicle

The main purpose of this robot is to use the signal inputs from different sensors and images from a camera to precisely control its robotic arm and motor base in order to locate certain objects at different levels. In this project, we used a bright blue plate as our object. The design and implementation of the robot took us through three main steps. First, we had to design and build the robot itself. In order to locate objects at different levels, we decided to mount a motor-controlled robotic arm to a base with two drive motors. The camera was mounted on the top of the gripper of the arm, and infrared sensors were located at the front of the robot. Second, we had to program the robot using the XBC Robot Controller. XBC Robot Controller uses a Gameboy Advance as a display screen with 8 analog input ports, 8 digital I/O ports, 4 motor control ports, 4 servo control ports, and a camera. We used Interactive C as the programming language. Since the object was bright blue in color, we used the color tracking program to take input from the camera and locate the object. However, when two objects of the same color at different levels or distance were in sight, we used the camera to track the object in two stages based on the distance between the robot and the object, which is determined by the IR sensors. Finally, we improved our robot by initiating the robot with sound activation. We designed the circuit by using audio amplifier LM386 and tone decoder LM567. We then designed a printed-circuit board to further implement the circuit on the robot.

Morgan Gilmour, Graduate Student
Faculty Mentor: Professor Don Dearborn, Biology

Physiological Ecology and Reproductive Effort in a Migratory Seabird

Migratory and wide-ranging animals can be affected by a suite of factors such as food availability and environmental conditions during the breeding and non-breeding seasons, as well as along the migratory route. Because these movements can transcend the jurisdiction of single agencies or countries, knowledge of animals' behaviors, habitats, and how ecological factors affect them are limited, affecting conservation and management of these mobile species. Seabirds exhibit unique life cycles: they are highly migratory, spending the majority of their lives at sea, but are tied to land during the breeding period. Although land-based breeding colonies are accessible, logistical difficulties severely limit information about seabird behaviors and habitat during migration and the winter months. However, measures of stable isotopes in winter-grown feathers provide an estimate of dietary niches, and a new, noninvasive method uses feather samples to measure corticosterone, providing a unique window into physiological stress during this inaccessible time. Additionally, a measure of the genetic quality of an individual is the length of its telomeres. Using these data, I assessed the roles of physiology and environmental factors throughout the breeding and non-breeding seasons that contribute to reproductive effort in these highly migratory animals.

The objectives of this study were to capture a long-lived, migratory seabird, Leach’s storm-petrel (Oceanodroma leucorhoa), at its breeding colony and collect winter-grown feathers in order to: 1) Measure corticosterone as a window into physiological stress during the non-breeding season; 2) Use stable isotope analysis to ascertain winter trophic levels; 3) Combine these analyses with measurement of telomere length, breeding season physiology, and land-based monitoring of reproductive effort to explore the relationships between wintering ecology, individual quality, and reproductive effort.

I sampled winter-grown feathers from approximately 150 Leach’s storm-petrels and collected data on reproductive effort and physiology during the breeding season in 2009 and 2010 at Bowdoin Scientific Station, on Kent Island in New Brunswick, Canada. In order to assess inter-individual variation in wintering ecology, I sampled feathers from the same 58 individuals in both 2009 and 2010. Stable isotopes and corticosterone from feathers, as well as telomere length and acute stress series, provided indices of diet and physiological quality within the population. Preliminary analyses indicate that Leach’s storm-petrels exhibit plasticity in their foraging strategies throughout the breeding and non-breeding seasons, and trophic level did not predict reproductive success. Similarly, corticosterone levels during the breeding and non-breeding seasons were not correlated with diet or reproductive success. Telomere analyses are currently underway. Taken together, these data suggest that physiological ecology during both the breeding and non-breeding seasons likely contribute to the decision to invest endogenous resources into either self-maintenance or reproduction; investment in self-maintenance is predicted for long-lived species.

Ava Ginsberg ’11
Faculty Mentor: Professor Amy Wolaver, Economics

Comparative Study of Informal Health Care Networks and Elderly Health Status in Argentina and Cuba

For my upcoming honor’s thesis and presentation I explore familial and friend support networks and living arrangements among elderly individuals in Latin America and the impact that this support has on the health of the elderly individuals in Argentina and Cuba. Using data from the Survey on Health and Well-Being of Elders (SABE) from 1999-2000, I investigate which
type of social support has a larger impact on overall health, life satisfaction, happiness and anxiety using multivariate probit regression analysis.

My first hypothesis is testing the size of the two different support networks (family and friends) and whether or not these support networks are interchangeable. Hypothesis two is testing whether or not there are differences in the health benefits of family and friend support networks in Argentina and Cuba and the difference in the impacts of each type of care on elderly health.

As the health expenditures in Cuba are much lower than in Argentina, this may lead to the belief that informal care is more important in Cuba than in Argentina. However, since the entire Cuban population is provided with health insurance, whereas universal health insurance is not granted in Argentina, this may indicate that informal care is more important in Argentina than in Cuba.

Overall, the data shows a positive marginal impact of social support on health status, but has mixed marginal impacts on life satisfaction, happiness and anxiety. The marginal impacts appear to be similar between Cuba and Argentina, although the marginal impact of living with a companion is positive in Cuba while negative in Argentina.

Adriana Golding '12
Faculty Mentor: Professor Leocadia Paliulis, Biology

Chromosomal Behavior in Physocyclus Mexicanus and Holocnemus Pluchei

Pholcids, or cellar spiders, are a diverse group of spiders with a very large geographical range. There are 1038 species of pholcids, of which fewer than 2 percent have published karyotypes. Our aim in this study is to determine the karyotypes and sex determination methods of two species of pholcids: Physocyclus mexicanus and Holocnemus pluchei, and also to determine chromosome behavior during meiosis by observing both living and fixed-stained cells. Karyotypes were constructed for P. mexicanus and H. pluchei using information from both living and fixed cells. P. mexicanus has a chromosome number of 2n=15, n=7+XO in males and 2n=16 in females with XO-XX sex determination. H. pluchei has a chromosome number of 2n=25, n=12 +XO in males and 2n=26, n=12+XX in females with XO-XX sex determination. These data contribute to our knowledge of this large and geographically ubiquitous family.

Deniz Gorgun ’11
Faculty Mentor: Professor Xiannong Meng, Computer Science

Designing, Implementing and Testing of an Intelligent Crawler and A Data Collection Merger

Over the summer, we conducted a study on further improving the search engine project developed, by Professor Xiannong Meng, by implementing a data-collection merger. Search Engine Made Easier (SEME) is a prototypical vertical search engine that is designed and implemented by Professor Xiannong Meng, and his team in 2006. The search engine consists of a server, a crawler, an indexer and resulting data collections. For this study, we aimed at improving the crawling capabilities of the SEME module. An intelligent crawler that will support vertical search would help the search engine generate more efficient results for each inputted query of the users.

Each crawling cycle of an individual web site involves collecting terms, linking these terms to the URLs of the pages that contained them, and finally creating a map of the terms to the URLs. The compilations are then written into individual data collections. We have worked on the idea of merging these pre-crawled data collections that would allow us to work on larger sets of crawled data to test our intelligent search algorithms. The data merging operation would allow us conduct better experiments with more results. Moreover, with the merger we can organize the crawling/re-crawling process faster and with less effort. The implementation of the merger over the current search engine module, SEME, has two main steps, first the concatenation of the initial collections and creating the final collection and later creating the mappings from terms to the URLs, taking into consideration any overlaps and carefully reconstructing the statistics related to these terms. As a future development to the project, we are aiming at generating crawled data collections of various sizes. We will then implement tests on the search performances on both separate collections and merged collections as the final part of the project.

Randy Gowat, Graduate Student
Faculty Mentor: Professor Douglas Gabauer, Civil and Environmental Engineering

Secondary Collisions Revisited

A study conducted by Ray et al. (1987) called attention to secondary collisions and found an increased probability of serious and fatal occupant injury for barrier crashes resulting in a secondary collision compared to those with no secondary collision. The data examined in this study, however, is now over 20 years old and is no longer representative of the current vehicle fleet and installed roadside hardware devices. In addition, the study was limited to crashes occurring in two states and may not be nationally representative. There have also been some minor changes in the crash-test evaluation of secondary collision risk since post-impact vehicle trajectory requirements were established in NCHRP 230. The current characteristics of secondary collisions and the effects of the crash test procedure changes on real world barrier performance are not known.

The purpose of this study was to provide a present-day assessment of secondary collisions following an initial barrier impact. The analysis included over 2,500 barrier impacts that were selected from 13 years (1997-2009) of in-depth crash data available through the National Automotive Sampling System (NASS) / Crashworthiness Data System (CDS). For each
suitable case, the scene diagram and available scene photographs were used to determine elements not collected by NASS/CDS investigators. These data elements include whether the vehicle penetrated the barrier and a classification of the trajectory of the vehicle following the barrier impact. Results will be presented with respect to secondary collision rates by barrier type, injury consequences of secondary collisions, as well as distribution of objects struck in secondary collisions. A better understanding of secondary collisions is hoped to provide an improved method of assessing post-impact vehicle trajectory during full-scale crash testing or lead to better guidance for roadside designers tasked with placing barriers appropriately.

Laura Grieneisen, Graduate Student
Faculty Mentor: Professor DeeAnn Reeder, Biology

White-Nose Syndrome and the Disease Triangle
The objective of this study is to determine the relationship between hibernacula microclimate and susceptibility to the emerging infectious disease White-Nose Syndrome (WNS) in Little Brown Bats (Myotis lucifugus). Anecdotal evidence suggests that bats that hibernate in colder and drier caves and mines are less affected by WNS, most likely due to an interaction between hibernation energetics and growth dynamics of the fungus Geomyces destructans, the putative WNS causative agent. Microclimate (temperature and humidity) was examined at the level of the individual bat to determine what role microclimate plays in survivability, in relation to WNS status, sex, frequency of arousal bouts, and body condition. The results from this study will be immediately applicable to predict which hibernacula and species are more likely to be infected next winter and determine if direct mitigation strategies, such as altering the microclimate of mines, will be effective ways to combat the spread of the fungus.

Stephanie Hardenstine '11
Faculty Mentor: Professor Ryan Snyder, Chemical Engineering

Alternation of Crystallization Properties of $\alpha,\omega$-Dicarboxylic Acids
The goal of this research was to investigate specific properties pertinent to crystallization and determine if these properties alternate with the number of carbons in the molecular chain of an $\alpha-\omega$ dicarboxylic acid. The specific properties on which we initially focused were solubility and morphology. The first goal of this project was to verify existing alternating data for solubility in water. The experimental and expected solubilities at 25°C in water are displayed in Figure 1.

![Figure 1: Experimental and MSDS Solubilities of $\alpha,\omega$-Dicarboxylic Acids at 25°C](image)

As can be seen in Figure 1, the experimental and expected solubilities agree within reason and the solubility method used was validated. The second goal of this project was to determine whether the alternation phenomenon present for the solubility of diacids in water is also present in other solvents (or solvent mixtures). Data analyzed from these experiments has shown that alternation is occurring in both succinic and sebacic acids in ethanol. Data is still in the process of being collected for the remaining diacids in ethanol. The last goal of this project was to determine if there is any alternation that can be identified for crystal morphology. Growth experiments using glutaric and suberic acids were performed in solvents of water, acetone, and ethanol. Crystals from these experiments were examined under an optical microscope for shape characterization.

Ian Hasson '11
Faculty Mentor: Professor Michael Gross, Chemical Engineering

Strontium Doped Lanthanum Vanadate Materials as a Potential Electron Conductor in Solid Oxide Fuel Cell Anodes
Fuel cells are energy conversion devices that directly convert chemical energy into electrical energy. Solid oxide fuel cells (SOFC), a particular type of fuel cell, have many advantages over traditional power generation systems including higher efficiencies, lower emissions, increased fuel flexibility, and increased scalability. Current SOFC anodes consist of a nickel yttria stabilized zirconia (Ni-YSZ) composite. Nickel, however, possesses many limitations which have prevented SOFCs from reaching their full potential. Nickel is not stable during cycles of reduction and oxidation (redox cycling) and in the presence of hydrocarbons. One solution is to replace Ni, which serves as both an electron conductor and catalyst, with two separate materials acting as electron conductor and catalyst independently. One potential material, which is stable in hydrocarbons, is strontium doped lanthanum vanadate. Through the use of X-ray diffraction, thermal gravimetric analysis, and conductivity testing we have found that strontium doped lanthanum vanadate materials also maintain a stable single phase after undergoing redox cycling.
and possess suitable conductivity to serve as a potential electron conductor in SOFC anodes.

Laney Hayssen ’13, Rebecca Howell ’13, Faria Sanjana ’13 and Josephine Vargas ’13

Faculty Mentors: Professor Marie Pizzorno, Biology; Professor Emily Stowe-Evans, Biology

Isolation and Characterization of 13 Novel Phage

The 2011 Phage Hunters class spent the fall semester isolating mycobacterium phage. Direct plating and enrichment were used to obtain phages that were able to infect Mycobacterium smegmatis. After phage were obtained, they were purified by multiple rounds of plaque purification to insure there was only one strain of phage isolated. Morphologies of individual plaques determined that there was only one phage type present on each plate. A high-titer lysate was harvested and viewed using transmission electron microscopy. The DNA was isolated and digested with various restriction enzymes and was run through gel electrophoresis to determine the length of the genomes and restriction patterns. This pattern, along with data from polymerase chain reaction, was used to determine which phage cluster each phage belonged to. The isolated phage were from one of two families: Myoviridae (short-tailed phage) and Siphoviridae (long-tailed phage). The Siphoviridae phage is a more common phage (our class obtained 10 novel Siphoviridae as opposed to 3 Myoviridae). Even though these phage belong to the same family, they differ greatly in their plaque morphology, physical appearance, genome size, and restriction enzyme patterns.

William Holler ’11

Faculty Mentor: Professor Michael Gross, Chemical Engineering

A Highly Conductive Oxide Anode for Solid Oxide Fuel Cells

Ceramic anodes comprised of infiltrated SrMoO₃ in porous yttria stabilized zirconia (YSZ) were investigated. Upon reduction at 1073 K, the electronically insulating SrMoO₃ phase transformed to SrMoO₃⁺, which has a bulk electron conductivity of 10⁸ S·cm⁻¹ under fuel cell conditions. An anode conductivity of 20 S·cm⁻¹ was achieved with a low SrMoO₃ loading of 13 vol% of the total anode. Strontium molybdate does not form secondary phases upon redox cycling and the infiltrated composite is dimensionally stable upon redox cycling. The poor catalytic activity of strontium molybdate required the addition of a separate catalyst to achieve good fuel cell performance.

Allyson Hopper ’11, Brooke Campbell, Graduate Student, Andrea Massa ’12, Jenni Whalen ’12, Katherine Lang ’11, Leigh Bryant ’11, Nicole Shea ’12 and the Bucknell Sexual Assault Research Team

Faculty Mentor: Professor William Flack, Jr., Psychology

Do Women Facilitate the Sexual Assault of Their Female Peers? A Single-Campus Survey Study

National studies indicate that between 20 and 25 percent of women have been sexually assaulted by the time they finish college. Although their male peers are responsible for perpetrating sexual assault, women often seem to engage in behaviors with their female peers that may increase those peers’ risk of being assaulted. In the present study, we sought to determine how often college women, both Greek and Independent, engaged in behaviors that seem likely to increase their risk of sexual assault (referred to as “female facilitation”). Participants in this study were 373 female Bucknell students (sophomore through senior) who completed an online survey that included measures of sexual assault, alcohol consumption, and female facilitation. The female facilitation measure indexed both “facilitator” behaviors (behaviors directed toward others that likely increase their risk of sexual assault victimization) and “facilitatee” behaviors (behaviors engaged in that likely to increase risk of sexual assault victimization), and the two sets of items were counterbalanced across participants. Results demonstrated that the overall prevalence rate for any type of sexual assault was 44.2 percent. Total scores on the facilitator and facilitatee versions of the female facilitation measure were highly correlated. Facilitation was also highly correlated with alcohol consumption, and being on the receiving end of facilitation was moderately correlated with sexual assault. Greek status was significantly correlated with increased alcohol consumption and facilitation behaviors. Our results were consistent with some but not all of our expectations regarding the relationships among facilitation, alcohol consumption, sexual assault, and demographic variables. Limitations of the methods and the implications of our findings for understanding campus sexual assault will be discussed.

Nicholas Horner ’11

Faculty Mentor: Professor Barry Long, Music

The Spirituality of John Coltrane

John Coltrane's movement into free jazz post the 1965 release of his album A Love Supreme was greatly attributed to the spiritual or religious pursuits that he engaged in from 1957 until his death in 1967. Evidence of this connection are found in album titles (OM, Manifestation, Ascension, etc.), composition titles (“Offering,” Amen,” “The Father and The Son and The Holy Ghost,” etc.) as well as through statements made by Coltrane and those musicians, friends and relatives closest to him in this period. Further, Coltrane's spiritual development effected his improvisation by prompting him to explore new musical techniques such as multiparticities and harmonic and rhythmic
conceptions as well as redevelop past musical structures such as blues and modal forms. Finally, John Coltrane's vast understanding of world musical, philosophical and religious traditions allowed him to craft a language and understanding of improvisation that propelled his music beyond the scope of jazz in the 1960’s that has yet to be surpassed to date.

Rebecca Howell '13
Faculty Mentor: Professor Charles Clapp, Chemistry
**S491M Soybean Lipoxygenase-1 Kinetics with Linoleoyl-L-Tryptophan and 13-HPOD Degradation observed using the FOX Assay**

Soybean lipoxygenase is of interest due to its strong similarities to mammalian lipoxygenases involved in many cell interactions such as the inflammatory response and cancer. The active site of SBLO is located near a central iron atom. Our current binding hypothesis involves a tail-first binding mechanism leaving the carboxylic terminus outside of the enzyme. The typical substrate linoleic acid was modified into linoleoyl-L-tryptophan and enzyme kinetics were performed with both SBLO-1 and a mutant form of the enzyme S491M SBLO-1. The $k_{cat}$ was approximately half for the mutant enzyme compared to the wild-type enzyme. The $K_m$ remained essentially the same. The product of kinetics between linoleic acid and SBLO is 13-HPOD. The product is formed quickly, but slowly degrades into a mixture of products. Experiments using Ferric Oxidation of Xylenol (FOX) Orange Assays were performed to determine the presence and rate of degradation of the peroxide located on 13-HPOD. At higher concentrations of linoleic acid relatively rapid degradation of 13-HPOD is observed, but at low concentrations of linoleic acid the concentration of 13-HPOD remained essentially constant. The same result was observed using the S491M SBLO as the wild-type SBLO.

Amy Jewett '11
Faculty Mentors: Professor Ellen Herman, Geology; Professor Dorothy Vesper, Geology and Geography, West Virginia University
**Fluviokarst Conduit Enlargement Potential Due to Sediment and Chemistry Fluctuations During Storm Events at Smullton Sinks, Centre County, Pennsylvania**

Most research on karst development (speleogenesis) has focused primarily on dissolution, assuming that abrasion and mechanical erosion have either very little or no impact on conduit growth. Although the extent to which abrasion affects the growth of a conduit is unknown, the potential for abrasion by transported sediment begins when the conduit reaches 1 cm in diameter and flow becomes turbulent.

To examine the potential for abrasion, we collected suspended and bedload sediment, water level, and chemical parameters across storm events in a fluviokarst setting in Centre County, Pennsylvania. Smullton Sinks is a series of karst windows in Ordovician limestone in anticlinal Brush Valley in the Appalachian Valley and Ridge of central Pennsylvania. Continuous and grab sampling at one and two hour intervals, during two storms, focused on the physical and chemical agents of erosion and revealed fluctuations in chemistry and sediment load on the rising limb of the hydrograph. Sediment samples and turbidity data indicate a flushing of sediment through the system in response to the storm event, with the most sediment entrained near the beginning of the storm with maximum potential for wall retreat occurring at that time. The composition of the bedload sediment was mostly quartz sand and silt, likely derived from the clastics upstream, with a high potential for limestone abrasion and erosion during times of high sediment flux. The detailed sampling regime allows us to compare the potential for chemical and physical processes through the rising limb of the hydrograph at Smullton.

Cody Johnson '13
Faculty Mentor: Professor Charles Clapp, Chemistry
**Substrate Analogue Inhibitors of Soybean Lipoxygenase-1**

Lipoxygenases are a class of enzyme that catalyze the hydroperoxidation of polyunsaturated fatty acids, specifically linoleic acid, utilizing an iron atom in the active site, and molecular oxygen. In an attempt to prove a “tail-first” substrate binding mechanism, in which the methyl-terminus end of the fatty acid backs into the active site leaving the carboxyl-terminus outside the protein, new substrate-analogue inhibitors of Soybean lipoxygenase-1 (SBLO-1) were synthesized with the intent to obtain a crystal structure of the enzyme with the inhibitor bound.

Inhibitors include: the monounsaturated fatty acid, oleic acid bound to tryptophan or phenylalanine making oleoyl-D-tryptophan or oleoyl-D-phenylalanine, respectively, and the conjugated 9(Z), 11(E)-octadecadienoyl-D-tryptophan. These inhibitors were characterized by Michaelis-Menten kinetic analysis, but spectrophotometric data was not optimal due to an observable induction effect, which was hypothesized to be due to binding of the inhibitor to the catalytically inactive Fe(II) form of the enzyme. To rectify this problem, assays are now being carried out in the presence of 13-hydroperoxy-9, 11-octadecadienoic acid (13-HPOD) which oxidizes the Fe(II) to catalytic Fe(III).

We intend to continue studying the substrate analogue inhibitors affects on SBLO-1 by investigating possible enzymatic conformational changes when binding these inhibitors, specifically the phenylalanine derivative. We are currently in
contact with a crystallographer and should hopefully obtain a crystal structure of the SBLO-1 with inhibitor bound before the end of summer 2011.

Kodjo Karikari ’11

Faculty Mentor: Professor Kathleen Page, Biology

Prenatal Exposure to Dexamethasone Alters Hippocampal 5HT1A Serotonin Receptor Function and Behavior in Stressed Male Rats

The main activation route for the stress response is the hypothalamic-pituitary-adrenal axis (HPA) and the sympatho-adrenomedullary system. The HPA axis is a neuroendocrine feedback loop mediated by an array of tissue specific hormones, receptors and neurotransmitters that regulate glucocorticoid (GC) release. Synthetic glucocorticoids (GC) are used to stimulate lung development in fetuses at risk of preterm delivery. Previous studies have shown prenatal exposure to Dexamethasone (Dex) is associated with disturbances in the serotonergic system. The current hypothesis is that prenatal exposure to Dex during the third trimester of pregnancy alters 5HT1A receptor function and compromises spatial learning and memory in male rats. Pregnant rat dams were injected daily with 150ug/ml/kg of Dex (sc) from gestation day 14 through 19. Control dams were treated with saline. Adult male offspring were exposed to behavior testing and immediately sacrificed. Another group was tested and allowed to return to baseline (basal). Hippocampi were analyzed using a radioligand receptor binding assay and GTPγS incorporation (3H-MPPF antagonist and 8-OH-DPAT agonist respectively). Binding maximum (Bmax) increased for the Dex treated animals under basal and stressed conditions. However, no significant change was seen in the binding affinity (Kd) for either group. Receptor effectiveness was reduced in the Dex animals, however, under basal conditions these animals showed no change in behavior. Using GTPγS incorporation assay, we showed that there was no significant difference in the maximum ligand mediated stimulation of 5HT1A receptors between control and Dex exposed animals. However, the intracellular signaling efficiency of hippocampal 5HT1A receptors was diminished. Currently we are examining the effects of Dex and high fat diet on hypothalamic 5HT1A receptors. The data taken from the hippocampal 5HT1A shows a considerable change in the 5HT1A component and we would like to know if hypothalamic 5HT1A receptors are affected in the same manner. I will perform the GTPγS incorporation assay to assess the efficiency of ligand-induced receptor signal transduction via G-protein activation related to the hypothalamic 5HT1A.

Nyein Ko ’13

Faculty Mentor: Professor Donna Ebenstein, Biomedical Engineering

Mapping Local Strains Before and After Stress Softening in the Byssal Threads of the Common Blue Mussel (Mytilus edulis)

The byssal thread, a functionally graded fiber of a marine mussel is very interesting because of the existence of a stiffness gradient along its length to relieve mechanical stress at the interface of distal portion (hard tissue) and proximal portion (soft tissue) under loading. This fiber is expected to provide a valuable model for graded materials, or materials that feature a gradual transition in structure and properties along the length of the fiber. However, whether the byssal thread is continuously graded along its entire length or step-wise graded is not very well understood. The goal of our research is to develop and validate a method to map the local strains along the fiber under uniaxial loading, and use this method to investigate the graded structure of the mussel byssal threads with higher spatial resolution than in previous studies. To perform strain mapping experiments, byssal threads are attached to metal washers fixed on a glass microscope slide at one end and to a free washer on the other end. A rigid probe, attached to a programmable manipulator is then hooked to the free washer. The micromanipulator is then programmed to stretch the fiber to approximately 30 percent of its original length at a rate of 200 um/s while observing deformations using an inverted optical microscope. Videos are captured during straining of different regions of the fiber by using a high speed video camera attached to the microscope. For each region, local deformations were tracked by using a Matlab digital image correlation program, and strains were calculated using an Excel program. This method was validated using elastic fibers, and then applied to 9 byssal threads from the common blue mussels in a pilot study. Three different regions (At two ends and the middle portion) were tested in each of the fibers. Preliminary results suggest that this technique can detect differences in strain between three different regions under the same straining protocols, and confirm that the proximal end of the fiber experiences higher strains than the distal end of the fiber. Another interesting property of byssal threads is its ability to undergo stress softening, stiffening of the thread to prevent further yielding when stretched beyond its yield point. This effect was also analyzed by stretching the threads 40 percent of its original length to induce stress softening before mapping the local strains in the said three regions by using the same protocol in the aftermath of yielding. The local strains are then compared to those in respective regions before yielding to see the effects of stress softening on local strains. A study of more regions in the fiber is planned to determine whether the gradient in the fiber is continuous or limited to certain regions of the fiber.
Self-control in Capuchin Monkeys (Cebus apella)

Cooperation has evolved in many animal species because both individuals mutually benefit from the behavior. One component of some forms of cooperation is the capacity to forego a lesser reward in order to receive a larger reward in the future through cooperation. Humans and other ape species have demonstrated this form of self-control, but it is not highly developed in new world monkeys. Studies of new world monkeys have demonstrated low levels of self-control but only for several seconds and after training. In this study, I investigated whether brown capuchin monkeys (Cebus apella), a New World primate, were capable of self-control without training. Nine capuchins monkeys learned to work for food rewards by turning a lazy Susan-like table so that a reward would rotate into reach. One piece of walnut was placed on one side of the wheel and two pieces of walnut were placed on the opposite side so the capuchin could choose to rotate the wheel one way or the other to receive one or two pieces of walnut. To test for a reward preference, each reward type was placed equal distances from the capuchin on opposite sides of the table. The capuchins took the two piece reward significantly more times than the one piece reward. To test for self-control, the two piece reward was placed at locations further in distance than the one piece reward on the table. The capuchins would demonstrate self-control by inhibiting their impulses and turning the table to get the reward that was larger and harder to obtain instead of the reward that was closer and easier to obtain. To test the limits of the monkeys' self-control, I placed the larger reward at three increasingly farther distances than the smaller reward. When the two-piece reward was one unit of distance farther away than the one-piece reward (approximately 8 cm), monkeys selected the two-piece reward significantly more than the one-piece reward. However, when the two-piece reward was placed at increasingly farther distances away than the one-piece reward (16 and 24 cm) animals no longer selected the two-piece reward more than the one-piece reward. The capuchins demonstrated one component of cooperation by having the capacity to perform a small degree of self-control. This result was promising because the goal of this research is to test pairs of monkeys on cooperative tasks using the same lazy Susan apparatus.

Teacher Resistance to School-Based Consultation: An Analysis According to School Level and Model of Identification for Special Education

Consultation is promoted throughout school psychology literature as a best practice in service delivery. This method has numerous benefits including being able to work with more students at one time, providing practitioners with preventative rather than strictly reactive strategies, and helping school professionals meet state and federal education mandates and initiatives. Despite the benefits of consultation, teachers are sometimes resistant to this process. This research studies variables hypothesized to lead to resistance (Gonzalez, 2004) and attempts to distinguish differences between school level (elementary, middle and high school) with respect to the role played by these variables and to determine if the model used to identify students for special education services has an influence on resistance factors. Twenty-six teachers in elementary and middle schools responded to a demographic questionnaire and a survey developed by Gonzalez, Nelson, Gutkin and Shwery (2004). This survey measures eight variables related to resistance to consultation. No high school teachers responded to the request to participate. Results of analysis of variance indicated a significant difference in the teaching efficacy subscale with elementary teachers reporting more efficacy in teaching than middle school teachers. Results also indicate a significant difference in how able teachers feel with regard to classroom management with teachers who work in schools that identify students according to a Response to Intervention model reporting higher classroom management efficacy than teachers who work in schools that identify students according to a combined method of refer-test-place/RtI combination model. Implications, limitations and directions for future research are discussed.

Solvent-Free, Microwave-Assisted phospha-Michael Addition

The purpose of the project was to probe the steric and kinetic limitations of P-C bond formation. This was accomplished by functionalizing an alkene with di-p-tolyl phosphine-oxide through a phospha-Michael Addition. Four different starting materials were used in the experiment. A microwave reactor was used to determine a temperature profile, and therefore the most effective parameters for product to form. NMR spectroscopy was used to assess the composition of the compounds created. Various methods of purification were used such as column chromatography, trituration and re-crystallization in order to obtain a pure final product.
Given its role in regulating early developmental processes, our specific studies became concentrated on the effect of a hormone called JH, or Juvenile Hormone, on neuronal subtype and number. A loss-of-function experiment was performed by ablating the structure in the mushroom body that produces JH, the corpora allata, and a gain-of-function experiment was performed by feeding the larvae on a dietary analog of JH called pyriproxifen. Subtraction of γ neuron number from total mushroom body neuron number showed a significant increase in the number of non-γ neurons, or α/β neurons given the stage of development, for the gain-of-function experiment, and a significant decrease in the same category of neurons for the loss-of-function experiment. However, these studies also showed fluctuations in the total number of neurons in the mushroom body, as opposed to the maintenance of a constant total number of neurons while the quantities of the individual neuronal subtypes changed. These results suggest that JH does not simply control the switch in production of the different neuronal subtypes during the continuous proliferation of the four neuroblasts.

Currently we are performing a rescue experiment, in which the corpora allata is ablated and the larvae are fed on pyriproxifen. Comparing the neuron and total neuron numbers from these experiments will give us a more complete idea of the role of JH in mushroom body neuronal subtype production.

**Jordan Makansi ’13**

**Faculty Mentor:** Professor Jessica Newlin, Civil and Environmental Engineering

**A Summary of the Hydraulic Conditions of Bridges in the Western Susquehanna Watershed**

Hydraulic conditions raise major concerns that affect durability, safety, and the environmental impact of bridges. There are many types of hydraulic conditions that are relevant to bridges. The hydraulic conditions at a bridge crossing can include scour of sediment around the piers or abutments, deposition of sediment in the opening, the alignment of the bridge with the channel, and the overall stability of the stream or river that the bridge is crossing. Bridges are often designed to handle these kinds of external conditions, but the conditions are not always accurately estimated. As a result, poor hydraulic conditions commonly result in bridge failures.

In a recent study released by the American Society for Civil Engineers (ASCE) analyzing bridge failures throughout the entire United States, poor hydraulic conditions constituted 53 percent of the total causes of failures. The 266 hydraulic failures out of 503 that occurred between 1989 and 2000 raise concerns about the adequacy of our information regarding the conditions of bridges. More information about the current hydraulic conditions of bridges will allow civil and environmental engineers to properly assess the safety and reliability of a bridge. As a result, failures can be prevented, and hence the number of failures, diminished.
We used three different methods to assess hydraulic conditions. One comes from a document issued by the Federal Highway Administration (FHWA) as part of Hydraulic Engineering Circulars (HEC). We used HEC-18, which is used for evaluating scour at bridges. A second method we used is the stream stability assessment method of Johnson (2005). This method includes investigation of scour, flood plain activity, flow habit, channel pattern, entrenchment, bed material, bar development, obstructions, mass wasting, bank slope and bank soil texture and others – thirteen assessment categories in total. Each of the categories for hydraulic conditions is rated on a scale from 1 to 12. The scale is divided into four descriptions: Excellent (1-3), Good (4-6), Fair (7-9), and Poor (10-12). Thirdly, we used existing databases, such as those compiled by the National Bridge Inventory (NBI), to provide data about the bridges in our study.

After data collection on 19 bridges throughout the Buffalo Creek Watershed, we ran various studies to analyze relationships, trends, and interesting anomalies. Using Excel, GIS (geographic information systems), and graph plots, we discovered some interesting geographic and numeric trends (we plotted sediment size distributions). The majority of the bridges were recorded as having stable bridge foundations. The critical ratings of these bridges were also analyzed based on geographic location (physiographic region). Pebble size data also presented an interesting anomaly: when followed downstream, it doesn’t follow the usual decreasing trend.

David Manthos ’11  
Faculty Mentor: Professor Alf Siewers, English  
The Fourth Boom

Public lands owned by the Commonwealth of Pennsylvania are in critical danger of exploitation and environmental damage from questionable regulated extraction of the vast reserves of natural gas contained in the Marcellus Shale. In a state with a colorful but unfortunate history of boom-and-bust resource harvesting, characterized by commercial profit with clean-up costs and environmental impacts transferred to the public, there is little indicator that the Marcellus Shale Natural Gas boom will deviate from the tradition of the timber, oil, or coal booms that have preceded it in Pennsylvania.

Caught in a perfect storm of the recent economic depression and the sudden flurry of activity in the Marcellus play over the last 3 years, the State regulatory agencies have been ill prepared to properly monitor and enforce the laws concerning this resource. With a slashed budget, the Department of Conservation of Natural Resources (DCNR) is being forced to place all of its projects on hold to review and monitor gas drilling on its holdings, cannibalizing a fund dedicated to sustainable resource management, to be used for the operating budget of the agency. Silenced by Harrisburg, the agency has been mandated to generate revenue for the general fund from leasing portions of the 1.5 million acres of public land underlain by the Marcellus Shale. This immensely valuable product (gas industry revenue in the Commonwealth exceeded $2.8 billion dollars in 2008 and is projected to inject over $200 billion into the economy by 2020), has transformed the “Big Woods” of Pennsylvania’s Northern Tier into a hive of industrial activity, economic prosperity, but questionable sustainability. This project sought out community members, a local political activist, local government, and members of the DCNR in Harrisburg, examining the circumstances surrounding the boom, and considering the ramifications for the future. Ultimately, the Commonwealth of Pennsylvania is not prepared for another resource extraction boom, but it is heading rapidly in the direction of repeating its past mistakes.

Allison Martens ’11  
Faculty Mentor: Professor Leocadia Paliulis, Biology  
Delayed Release Of Chromosome Cohesion in Chromosomes That Are Not Attached to the Spindle at Anaphase Onset

In mitosis, release of sister chromatid cohesion allows sister chromatids to separate from one another. In meiosis I, release of sister chromatid arm cohesion allows homologues to separate from one another. Sister chromatids remain connected via cohesion between centromeres, which is released in anaphase II. In this study, we examine the timing and progression of cohesion release in anaphase. We have found that complete release of cohesion takes approximately 5 minutes in both mitosis and meiosis in the grasshopper Melanoplus sanguinipes and in the cricket Acheta domesticus. Cohesion release initiates near centromeres and progresses toward chromosome ends in both mitosis and meiosis. In previous studies (Paliulis and Nicklas, 2004. Current Biology. 14:2124-2129), we showed that release of chromosome cohesion did not require spindle attachment or tension on the chromosome at anaphase onset. We now show that, while chromosomes detached from the spindle with a micromanipulation needle separate in anaphase, the separation is delayed. We propose that spindle attachment speeds separation by allowing transport of molecules required for cohesion release to the chromosome at anaphase onset.

Cathy Meade ’11  
Faculty Mentor: Professor Julie Gates, Biology  
Enabled and Scar Interact to Influence actin cytoskeleton geometry during Drosophila morphogenesis

Development, the transformation of a single cell to a fully functioning organism, relies on the shaping, moving, and joining of numerous sheets of cells. This process, known as morphogenesis, is possible due to a dynamic skeletal structure within cells, referred to as the actin cytoskeleton. Made from repeated units of cable-like proteins, the actin cytoskeleton acts as adaptable scaffolding that can assemble skeletal filaments in a bundled or branched manner based on interactions with various proteins. This adaptability enables the formation of...
long, thin, finger-like projections (filopodia) as well as short, broad projections (lamellipodia) along the edges of cells, which has been shown to aid in cellular movement. The purpose of my research is to better understand how the complex process of morphogenesis is accomplished by examining the relationship between two proteins known to affect the organization of the actin cytoskeleton, Enabled (Ena) and Scar. To address this we use the fruit fly, Drosophila melanogaster. Near the end of Drosophila embryonic development, a gaping hole is present in the embryo’s outer sheet of cells, or epithelial layer. Closure of this hole is dependent on movement of cells (that line opposing edges of the epithelial hole) toward one another, a process known as dorsal closure. Dorsal closure is driven by the actin cytoskeleton. As cells along opposing edges of the hole meet, their respective filopodia and lamellipodia interact, pulling the edges together and closing the hole. Ena has been shown to specifically promote filopodia formation and extension during dorsal closure by binding to actin filaments. Without Ena to promote filopodia extension, the edges of the hole fail to accurately align prior to fusion. In single cell experiments, Scar has been shown to activate a separate protein responsible for promoting lamellipodia formation. Scar’s role in actin cytoskeleton organization within a complete organism, such as during dorsal closure, is unknown. To examine the relationship between Scar and Ena during dorsal closure, I generated Drosophila embryos that had a reduction in the level of Scar protein and lacked functional Ena. These embryos displayed a greater frequency of dorsal closure defects than embryos that only lacked Ena, suggesting that Ena and Scar function together during dorsal closure to influence actin cytoskeleton geometry.

This work was supported by ACS-PRF grant 47262-B6 and NIH grant R15EB003854 from the National Institute of Biomedical Imaging and Bioengineering.

Matthew Micco ’12
Faculty Mentor: Professor Brandon Vogel, Chemical Engineering

Methods Of(Poly) Lactic Acid Synthesis with Dichloromethane, Dimethylaminopyridine, N,N’-Dicyclohexylcarbodiimide, Disopropylcarbodiimide, Scandium Triflate

(Poly) Lactic Acid is a polymer, or long chain of chemical units called monomers, that can be synthesized from lactic acid. These polymers have a wide variety of applications within the medical field, most specifically in the field of controlled drug delivery. The purpose of the research was to use various combinations of the reagents dimethylaminopyridine (DMAP), N,N’-dicyclohexylcarbodiimide (DCC), N,N’-disopropylcarbodiimide (DiPC), and scandium triflate to determine which set of conditions and reagents would produce a polymer of the highest molecular weight. The solvent used for all of the reactions was dichloromethane. A design matrix was set up so that every possible combination of reagents could be tested, the omission of reagents was also taken into account. After flasks were flame dried to ensure a dry environment, the OLA was added along with the DMAP and Scandium Trifate if necessary. These were then allowed to sit under an ice bath for 1 hour before the addition of the appropriate reagent. Flasks were removed from ice and allowed to react for either 2 or 24 hours. Polymer was recovered using the rotary evaporator after the reaction was stopped by exposure to the atmosphere and the addition of wet dichloromethane. The analysis of the product for molecular weight was done using Gel Permeation Chromatography. The highest molecular weight of around 30,000 g/mol was given by the flask that included DMAP, scandium triflate, and DiPC.
Goldenrod Solidago gigantea. Previous evidence from our lab suggests that goldenrod Solidago altissima, and the other with a closely related species. The gall-inducing fly Eurosta solidaginis has been shown to respond to host-race formation in an ecosystem engineer, the beetle, Mordellistena convicta, is undergoing speciation in the presence of this factor. We are attempting to determine whether a facultative predatory beetle, Mordellistena convicta, is undergoing speciation in response to host-race formation in an ecosystem engineer, the gall-inducing fly Eurosta solidaginis. Eurosta solidaginis has formed two distinct host races, one that induces galls on the goldenrod Solidago altissima, and the other with a closely related species. Goldenrod galls, which suggests the possibility that S. gigantea is the ancestral host race. This study is the first to investigate sequential radiation in a facultative predator of an ecosystem engineer.

**Charlie Murphy ’11**

**Faculty Mentors:** Professor Warren Abrahamson, Biology; Mizuki Takahashi, Post-Doctoral Fellow, Biology

**Host Associated Genetic Divergence in the Sequential Speciation of the Gall-boring Beetle Mordellistena Convicta**

We are attempting to determine whether a facultative predatory beetle, Mordellistena convicta, is undergoing speciation in response to host-race formation in an ecosystem engineer, the gall-inducing fly Eurosta solidaginis. Eurosta solidaginis has formed two distinct host races, one that induces galls on the goldenrod Solidago altissima, and the other with a closely related goldenrod S. gigantea. Previous evidence from our lab suggests that M. convicta is undergoing sequential radiation parallel to the differentiation of E. solidaginis, but an estimate of gene flow is necessary to determine the extent of sequential radiation. We are using microsatellites (i.e., simple, non-coding repeat sequences of DNA) to calculate the percentage of contemporary gene flow and currently have 14 primers for DNA synthesis developed. We have also collected data on host-plant distribution and abundance as well as spring temperatures at gall-collection sites in order to see how these ecological factors might affect speciation by acting as barriers to gene flow. Although we are still in the data collection phase, we have found that M. convicta individuals are less common and less massive in S. altissima galls than in S. gigantea galls, which suggests the possibility that S. gigantea is the ancestral host race. This study is the first to investigate sequential radiation in a facultative predator of an ecosystem engineer.

**Chelsey Musante, Graduate Student**

**Faculty Mentor:** Professor DeeAnn Reeder, Biology

**Physiological and Behavioral Responsiveness in Big Brown Bats, Eptesicus fuscus**

Since the winter of 2006, multiple bat species residing in the eastern and mid-western United States have been devastated by the emerging infectious disease known as White-Nose Syndrome (WNS). This deadly condition, named for the growth of a cold-loving white fungus on the nose, face, and wings of hibernating bats, has killed more than an estimated 1 million individuals. Bats vary in a number of traits that may enable them to effectively combat environmental challenges (such as WNS) and survive. Such traits could include immune reactivity, stress responsiveness, and thermoregulatory activity and behavior. Thus, one objective of the present study is to investigate individual variability in these traits. A second objective is to determine whether or not the traits are heritable—that is, genetically passed from parent to offspring (genetic work to be completed by collaborators at the University of Winnipeg, Canada). This study is being conducted with big brown bats (Eptesicus fuscus), a mildly WNS-affected species that is prevalent throughout Pennsylvania. Anticipated results and preliminary data analyses will be presented at the Kalman Symposium.

**William Napoli ’12**

**Faculty Mentor:** Professor Timothy Strein, Chemistry

**Using Capillary Electrophoresis as an Alternative Assay for Total Antioxidant Capacity (Tac)**

This work is aimed at exploring the utility and limitations of commercial capillary electrophoresis (CE) instrumentation and bare fused silica capillary tubes to perform the chemistry of the accepted Ferric Antioxidant Reducing Power (FRAP) assay for total antioxidant capacity (TAC) in beverages. Using the technique of electrophoretically mediated microanalysis (EMMA), the capillary serves as a mixing and reaction vessel, and can be an alternative to slower, larger volume traditional
Fatigue testing of cold spray coated aluminum 2024-T351 was carried out to determine the effect of surface preparation on fatigue life. This work is part of an ongoing research project funded by the Air Force Research Laboratory. Previous fatigue testing had been performed using a tension-tension fatigue testing machine. A rotating bend test was desired to more accurately simulate the fatigue loads that wings of aerospace vehicles are subjected to throughout their life cycle.

A testing matrix was created using the ASTM statistical standard of 5 specimens per condition; stress levels of 26 ksi and 30 ksi and surface treatments of grit blasting with glass bead at a 45 degree angle (GB45) and shot peening were selected. These results were compared to bare 2024 substrate with no surface preparation. Rotating bend fatigue test specimens were created using ISO-1143 for use with the RR Moore testing machine. Substrate samples were manufactured at Bucknell University while surface preparation and coating application were performed at the Penn State University Applied Research Laboratory (PSU ARL).

Fatigue testing revealed that samples with the GB45 surface prep performed better than the shot peened surface prep in both the coated and uncoated conditions. Scanning Electron Microscopy was used to study the failure location for each sample. The results indicated that coated samples failed at the outer surface of the sample where the stress level was the greatest and not at the coating/substrate interface.

This work was supported by NIH grant number R15EB003854 from the National Institute of Biomedical Imaging and Bioengineering.

Travis Nissley ’11
Faculty Mentor: Professor Mala Sharma, Mechanical Engineering

Innovative Corrosion Resistant Coatings for Aerospace Defense Applications

Atmospheric aerosols are fine solid or liquid particles that are small enough to remain suspended in the earth's atmosphere. Natural sources such as sea spray and volcanic activity generate aerosols. Man-made sources, such as automobiles and industrial processes are also responsible for aerosol generation. Ambient air typically contains thousands of particles per cubic centimeter. Aerosol particles vary in size from a few nanometers to several hundred microns. One of the most significant functions of atmospheric aerosols, which is of most interest to the aerosol research group at Bucknell University, is their interactions with water vapor in the atmosphere. Aerosols are the “seeds” upon which cloud droplets form. Because of this important interaction, aerosols play a direct and very influential role in the water cycle and climate change. The main goal of this research project, completed during the summer of 2010, was to collect and image ambient aerosol particles from various locations on the Bucknell University campus. The ability to observe how the collected aerosols were interacting with water vapor in the atmosphere was achieved by sampling particles on both hydrophilic and hydrophobic substrates, and noting the interactions of the particles with these surfaces. Particles were imaged using both SEM (scanning electron microscopy) and AFM (atomic force microscopy). SEM was used to image larger aerosol particles, and the three-dimensional imaging ability of AFM was found to be useful for determining water content of aerosol particles by observing their interactions with the hydrophilic and hydrophobic substrate surfaces.

Kyle Parkinson ’12
Faculty Mentor: Professor Timothy Raymond, Chemical Engineering

Determining Phase State and Morphology of Source-Specific Particulate Pollution Using Atomic Force Microscopy

Billy Raska ’12
Faculty Mentor: Professor Kundan Nepal, Electrical Engineering

Area Overhead of Online Error Detection in Vlsi Design

When designing circuits it is often not enough to just assume that everything will work as designed. However, testing circuit structures after they have been manufactured and packaged as a “chip” is a complex process. The field of Design for Testability (DFT) attempts to add extra circuitry on the chip during the manufacturing process to reduce the complexity of testing. While this extra circuitry can be used to test a circuit immediately after manufacture, most of these modifications cannot be used while the circuit is actually in normal or “online” operation in the field. The main goal of our research was to modify circuits through the use of implications so that they can be tested during runtime. Implications are relationships between different circuit sites that can be monitored to identify an error when one of the sites deviates from its expected value. My specific focus within this broader research was to determine the area overhead required
to add such modifications to the original circuit. The task of determining the exact area overhead requires a time-consuming process where design tools are used to create a “layout” of the circuit to be modified and the physical area taken up by the layout is measured. For large circuits, determining the exact area overhead using this technique takes days (a mid-size circuit with only 7000 gates took three days). My research involved the creation of a tool using Perl that could estimate the area of the additional modifications without requiring a large design effort and time. Using a circuit synthesis tool called Leonardo Spectrum, I first started by identifying the logic gates needed to implement the implications. The area of that implementation was estimated based on the measured area of a logic NOT gate in a standard cell library available from a silicon fabrication vendor. Using my Perl script in conjunction with Leonardo Spectrum we could estimate the number of implications required to achieve a particular percent area overhead within +/-15 percent of the desired overhead in a matter of seconds. This level of inaccuracy was a result of the routing of wires within the circuit, which turned out to be a very difficult thing to predict. If the area of routing was ignored, we were able to predict the area overhead within +/-3 percent. While there is a degree of inaccuracy, our tool could be used by designers to quickly gauge how much additional silicon area a particular modification is going to require without having to wait a few days.

**Paul Reamey ‘11**

**Faculty Mentor:** Professor DeeAnn Reeder, Biology

**Predicting the Impacts of White-Nose Syndrome**

White nose syndrome is an emerging infectious disease that is devastating bat populations in the northeastern USA. Five species of hibernating insectivorous bats (Myotis leibii, Myotis lucifugus, Myotis septentrionalis, Myotis sodalis, and Perimyotis subflavus) are known to be infected and are projected to experience regional extinctions.

The objective of my research is to provide an informed estimate of the potential effects of this predicted extinction. I examined past research to understand the bat-environment interactions in order to determine the probable environmental alterations that could result from this disease outbreak and subsequent species loss. With a better understanding of these impacts, more effort can be put into preventing anthropogenic species loss in the future.

These impacts were estimated by examining the bat-environment interactions that occur under normal circumstances, including rates of insect prey consumption, roosting patterns, and guano deposition. Changes in these variables, most importantly, changes in insect numbers, will influence other ecological factors. I am also using GIS to estimate where WNS is likely to have the greatest impacts. I am comparing species distribution maps with cave locations, mean annual temperature maps, maps of current WNS-affected areas, and other databases. I am also incorporating data about each species’ lifecycle and hibernation patterns. Together, these analyses will allow us to begin to estimate the significant impact that WNS will have on North American ecosystems.

**Bradley Rhodes, Graduate Student**

**Faculty Mentors:** Professor Warren Abrahamson, Biology; Mizuki Takahashi, Post-Doctoral Fellow, Biology

**Host Fidelity in the Sequential Radiation of a Gall-Boring Beetle**

Species diversity itself may cause additional species diversity. According to recent findings, some species modify their environment in such a way that they facilitate the creation of new niches for other species. The occurrence of such sequential radiation is likely common among herbivorous insects and their natural enemies. Herbivorous insects often have close associations with specific host plants and their preferences for mating and ovipositing on a specific host plant can reproductively isolate them and allow speciation to occur. Volatile emissions from host plants can play a major role in assisting herbivores to locate their natal host plants thus facilitate assortative mating and host-specific oviposition. Previous research by our laboratory has established that there are two distinct populations of the gall fly, *Eurosta solidaginis* (Tephritidae), which attack different species of goldenrod, *Solidago altissima* (Asteraceae) and *S. gigantea*. The gall fly’s differentiation may be facilitating the divergence and potential speciation of two groups of the gall-boring *Mordellistena convicta* (Coleoptera: Mordellidae). The beetles exist as two populations of inquilines inhabiting the galls induced by the gall fly. While our previous research has provided genetic and behavioral evidence for host-race formation, little is known about the role of their host plants in assortative mating and oviposition-site selection of the gall-boring beetles’ host-associated populations. The present study investigated the role of the host plants in host fidelity and oviposition preference of *M. convicta* by measuring its behavioral responses to the host-plant volatile emissions using a Y-tube olfactometer. In total, we tested behavioral responses of 615 beetles. Our results show that *M. convicta* adults are attracted to their natal host galls (67 percent of *S. altissima*-emerging beetles and 70 percent of *S. gigantea*-emerging beetles) and avoid the alternate host galls (75 percent of *S. altissima*-emerging beetles and 66 percent of *S. gigantea*-emerging beetles), while showing no preference for, or avoidance of, ungailled plants from either species. This suggests that the beetles can orient to the volatile chemicals emitted by the galls and can potentially use them to identify suitable sites for mating and for oviposition. Thus, host-associated mating and oviposition may play a role in the sequential speciation of the gall-boring beetle.
Jacob Riglin ’11
Faculty Mentor: Professor Constance Ziemian, Mechanical Engineering

Influence of Process Parameters on the Characteristics of Structural Steel Flash-Butt Welded Joints

This project was part of a larger study investigating the effect of flash weld process parameters on specific characteristics of high strength carbon-manganese steel weld joints. ASTM A529-Grade 50 steel angle specimens were flash butt welded and resulting microstructures and mechanical properties were investigated. Various evaluation techniques were used to characterize internal discontinuities, micro-dimples, and microscopic nonmetallic inclusions. Mechanical properties of ultimate tensile strength, yield strength, ductility, and hardness were investigated and analyzed as a function of welding upset current, flashing time duration, and upset dimension. Microstructures of different zones of the test welds were analyzed in an effort to understand the resulting mechanical properties. For all specimens, the maximum hardness was determined to be within the weld zone. The tensile strength increased with heating time due to grain refinement. The ultimate strength of the welds was maximized when the upset current, flashing time, and upset dimension were all set to their high levels.

Peter Rogerson ’11
Faculty Mentor: Professor Christine Buffinton, Mechanical Engineering

Dependence of Stress on Geometry and Stiffness of Calcified Plaque in Arterial Models

Calculation of mechanical stress in models of atherosclerotic arteries or aneurysms based on imaging and material property measurements can aid in predicting disease progression and rupture probability. Most models assume the stiffness of calcified plaque to be similar to non-calcified plaque. The significance of measurements suggesting the stiffness of calcified plaque is more similar to bone was tested using finite element analysis of arterial models.

Two-dimensional models of arterial cross-sections containing normal tissue, atheromatous plaque, and calcified plaque were created in CAD software (Pro/ENGINEER). The models were imported into COMSOL finite element software for calculation of intramural stress and strain. All models were loaded with an internal pressure of 18 kPa (135 mmHg). Normal arterial wall and atheromatous plaque were assigned fixed elastic moduli determined from reported experimental values. The elastic modulus of the calcified plaque varied from 2.3 MPa, the same as the non-calcified plaque, to 10 GPa in five increments. We also studied the impact of the geometric parameters of the calcified plaque inclusion on stress and strain, specifically: shape of region (arc-shaped or circular), distance from the lumen, thickness, and subtended arc angle.

The analyses showed that increasing the stiffness of the calcified plaque increases stress concentrations at the plaque boundary, up to 15 times the nominal von Mises and Tresca stresses. Surprisingly, tissue stress increases as the calcification moves farther away from the lumen and does not increase significantly when the calcified region is enlarged. However, geometry is a huge modifier: even at large stiffness, circular inclusions of calcification have little effect on stress at any size or stiffness. Stress concentrations are much higher at the inner boundary of the arc-shaped calcified regions than at boundaries of the circular regions. In all models, strains were extremely small in the calcified regions. The largest strains (~2 percent) occurred at the artery lumen opposite the calcified region.

These results show that modeling can be an important tool for providing insight into atherosclerotic disease progression. They also emphasize the importance of using both accurate material properties and accurate geometries when calculating mechanical stress from arterial models. Extensions of this work include three-dimensional models, implementation of anisotropic hyperelastic material properties, and study of the boundary adhesion of calcified plaque inclusions.

Robyn Roogow ’11
Faculty Mentor: Professor Ruth Tincoff, Psychology

Analyzing the Comprehension of Verbs at Locomotion Stages in Infants

We sought to determine whether children comprehend verbs at corresponding stages of locomotion development. In this study, 6- to 24-month-old children watched two different split-screen videos showing six actions while hearing a verb that corresponded to specific actions. The two different verb types were independent sitting and independent standing, which were presented at separate visits. Looking time was measured for each participant for each verb type, measuring the amount of time a participant looked at the matched and non-matched verbs. In addition to the split-screen videos, parents and/or guardians completed the following questionnaires: ASQ-III, MacArthur Survey, and a post-survey. These surveys analyzed vocabulary and motor development in infants and toddlers, as well as the vocabulary parents and/or guardians used with their children. We hypothesize that if comprehension is related to motor experience, children will understand corresponding verbs, and thus have increased looking times, at verbs that they have experienced. Analysis of results is still in progress.
A Mechanism for Transient Detection in Metrics Estimated with the NS-3 Network Simulator

When analyzing trends in statistical data, it is important to confirm that the data are an accurate representation of the topic of study. Trends that appear within simulations are a critical component to network research. While the simulator warms up, the results are biased because the simulator is not yet in a steady state, this phase is considered the transient state. To preserve the reliability of trends, it is crucial to remove transient data which are not a true representation of the simulation results. This research project focused on the accurate removal of transient data in an effort to provide more reliable results for the NSF sponsored “Frameworks for ns-3” project. The challenge of this task was to determine at what points transient data end, and to remove those points without greatly influencing the amount of reliable information. Dealing with this transient problem could lead to more reliable results while not requiring substantially more data to be collected. Many heuristics have been created in an effort to assist in transient data removal but a reliability crisis remains within discrete steady-state simulations.

During this research, statistical analysis of the data as well as research on different transient detection algorithms were studied. Moving averages were used to smooth results and make the end of transient phase more obvious. Moving averages take averages of data points within a certain window size and moves through the results until each one has been averaged. To use moving averages effectively, a proper window size must be chosen. We used observation to approximate an appropriate window size. These averages were beneficial to removing the ‘noise’ from data as a first step in finding a clear end to the transient stage. Our final approach to this problem was to take the moving averages over the data twice prior to taking the standard deviation of these results with a large window size. This technique resulted in a clearer graphical representation of the possible end of the transient phase. This result could potentially provide a more reliable method for determining the point at which the network simulation results were true representations of the data trends. The next step in this work is to apply this process to real data and assess its accuracy.

The next step in this work is to apply this process to real data and simulation results were true representations of the data trends. This result could potentially provide a more reliable method for determining the point at which the network transient phase. This research project focused on the accurate removal of transient data in an effort to provide more reliable results for the NSF sponsored “Frameworks for ns-3” project. The challenge of this task was to determine at what points transient data end, and to remove those points without greatly influencing the amount of reliable information. Dealing with this transient problem could lead to more reliable results while not requiring substantially more data to be collected. Many heuristics have been created in an effort to assist in transient data removal but a reliability crisis remains within discrete steady-state simulations.

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the collected field data allowed for a more detailed investigation of the implications of bedload transport on sustainable bridge crossing and stream restoration design and maintenance for similar tributaries to the West Branch of the Susquehanna River.

Jocelyne Scott ’11
Faculty Mentors: Professor Rose Shinko, International Relations; Professor Glynis Carr, English

Eradicating Violence Against Women in Conflict Zones; Why Current Efforts Are Not Working

This is a study of the current conflict in the Democratic Republic of Congo and the use of rape as a war tactic therein. The method of analysis is qualitative and the theoretical approach is feminist. Despite the fact that there are a multitude of nonprofit organizations and peacekeeping forces in place in the area, the use of this horrendous tactic continues. The use of rape in warfare as an accompaniment and in more recent historical examples as a war tactic in and of itself is nothing new; however that does not make it any less disturbing especially considering the fact that gang rape is becoming the status quo. Of course, the repercussions of this for the women in the DRC are staggering: physically, psychologically, and socially. Furthermore, due to the ongoing conflict the necessary services for women who have suffered from wartime rape are largely unavailable and are not easily accessible if they do exist. Due to the collapse of the judicial system as a result of the war and insecurity of the country as a whole, coupled with the fact that the stigma attached to using these services and thereby identifying oneself as a rape survivor is so strong, the vast majority of women forego any services or attempt for justice via arrest or jail. This study concludes with prospects for change and it has found that the only viable long-term solution for the problem of wartime rape is to make societal changes. Until wartime rape is condemned internationally and women are free to speak out about their experiences and receive support and acceptance from society; rape will continue. Moreover, as long as violence against women is normalized in other forms such as domestic violence, rape cannot be eliminated because gendered violence will continue to be somewhat acceptable. The way to prompt and expedite these societal changes requires further study and there is still much to be learned about how to solve this problem and those related to it.

Molly Shoener ’11
Faculty Mentor: Professor David Del Testa, History

An Ethical History of Photography in Combat and of Combat Photography in the United States during World War II

Through the use of interviews with combat photographers Tony Vaccaro and James R. Stephens, and the family of Charles E. Summers, as well as first-hand accounts including interviews and personal memoir, I created a lens through which to view the history and ethics of censorship that shaped combat photography during the Second World War and the images to which we refer as representative of that war today. Drawing larger connections between the stories of the few and the experiences of the military’s combat photographers during this time, provided me with insight into how the censorship influenced the work of these photographers and assisted in understanding how this censorship was able to shape the beliefs about war on the home front, as it changed from strictly showing positive images that idealized war, to more gruesome photos of dead American soldiers.

By focusing on these photographers’ individual experiences and the feelings and thoughts of all combat photographers facing censorship during the Second World War, a more personal, and yet holistic understanding of this topic is illustrated. The center of my research is on combat photographers during the war and the censorship they experienced to protect the Americans on the home-front. What Americans thought happened abroad, due to the censored photographs they were presented with, and what actually happened during the Second World War was explored through the interviews of four men in the middle of it all—the men who got the shot.

Through the use of a poster presentation, I will illustrate the difference between photographs that were passable through the censors and those that were blocked from view by the American public because of either unusable captions or necessary cropping.

Becca Shopiro ’12
Faculty Mentor: Dina El-Mogazi, Bucknell Environmental Center

Green Roof Project during the McKenna Internship: Summer 2010

A green roof is a roof of a building where plants are placed, normally condensed in an area, to decrease the runoff from the roof, increase the lifespan and aesthetics of the roof, and increase the insulation of the rooms below it. Bucknell’s first green roof was installed during a McKenna Internship in the summer 2010 through a project lead by student Becca Shopiro and aided by faculty members Dina El-Mogazi, Dennis Hawley, and Jeff Loss. Bucknell’s green roof is made of 2′X2′X4′ modules with growth medium, a fabric barrier, and flora. There are eight sedum plugs in each module, which are planted in the 4′ deep growth media. The plastic is made from 100 percent post-consumer polypropylene. There are seventy-five modules covering six hundred square feet of space. The green roof is visible from rooms on the second and third floors of Dana, Breakiron, and the parking lot. There is also an extra pre-planted module, which we will use for a display along with an educational sign, which will be posted in front of the Dana building.
Influence of Race on Religious Service Attendance in the United States

The purpose of this research is to investigate differences in religious service attendance by race in the United States. Data was taken from the 2004 General Social Survey (GSS) to examine crosstabulations and multinomial logistic regressions, which were used to explain the main relationship explored, along with other demographic and socioeconomic factors. The results of this research were seen to be statistically significant and show that African Americans do attend religious services more often than whites. Research also found different frequencies of attendance rates by age, gender, and marital status. Household income and educational attainment were also found to be important, but with varying and unpredictable affect on an individual's attendance rates at religious services. The reported results between the religious service attendance by race and other demographic and socioeconomic factors are consistent with prior research completed on this topic.

Jessica Snyder ’11

Faculty Mentor: Professor James Peterson, English

The African American Presence in Comics and Cartoons

The research that I completed was primarily concerned with tracking the African American presence in narrative theory, as well as, examining the intersection of the visual arts with the Black narrative tradition. Paying specific attention to graphic novels, cartoons, and comic books, and under the guidance of Professor James Peterson, I came to a better understanding of the function of the visual arts within the tradition of the African American narrative voice. It was my goal to collect extensive research on both narrative theory dealing with race, and the significance of visual representation and expression. I also focused on amassing a considerable number of images that correspond with the African American narrative tradition within graphic novels, cartoons, and comic books. The compilation of both theoretical and visual research was meant to aid Professor Peterson in his own research, and its application to his anticipated publication Black Graphic: The African American Presence in Comics and Cartoons. Having complete my research, I have successfully collected a catalogue of images and constructed a timeline in order to show the progression of Black imagery in visual media. The Timeline pays close attention to two important periods of Black imagery in the 1970s and 1990s. The poster presentation is meant to spatially and visually represent the growth and development of Black characters, Black heroes, and Black voices in cartoons and comic books, and the importance of this progression to the African American narrative tradition. During our research, Professor Peterson also constructed a visual model for narrative communications, which will also be included in the poster presentation.

Loren Sri-Jayantha ’12

Faculty Mentors: Professor Warren Abrahamson, Biology; Catherine Blair, Biology; Mizuki Takahashi, Post-Doctoral Fellow, Biology

Impact of Host-Race Collapse in a Gall-Inducing Fly on Sequential Speciation of the Gall-Boring Beetle, Mordellistena convicta

Sequential speciation has recently been recognized as one of the important evolutionary mechanisms that have created Earth's immense biodiversity. In particular, insect species account for a significant portion of Earth's biodiversity, which suggests that insects represent an ideal taxon to study sequential speciation. Our
lab has studied goldenrod-insect system and has recently found that the speciation of the gall-inducing fly, *Eurosta solidaginis*, has triggered the sequential speciation of the gall-boring beetle, *Mordellistena convicta*. The galls that the flies stimulate on the stems of host-plant goldenrods, *Solidago altissima* and *S. gigantea*, provide new resources for unrelated organisms including *M. convicta*, which they have exploited and have subsequently genetically diverged via host-specific adaptation. Our previous studies provided behavioral and genetic evidence of the sequential speciation of the gall-boring beetle. However, recent global warming appears to be causing the collapse of one of the gall-inducing fly host races in at least two of our southern-most sympatric collection sites in the Northeastern United States. As a result, the niche that was once available at southerly sites via *S. gigantea* galls, no longer exists within these areas. This field observation raises the important question of whether the sequential biodiversity collapse of the gall-boring beetle could occur. The gall beetles may be undergoing extirpation from southern-most areas or hybridization with the *S. altissima*-attacking host race. Alternatively, the *gigantea* gall beetles may be utilizing alternative resources such as the stems of their natal host plant. To test these hypotheses, we are conducting both a field and a laboratory-cage experiment by using microsatellite markers (i.e., simple sequence repeats of DNA). Preliminary data suggest that the *gigantea* beetle host race may have shifted to the stems of their natal host plant and may be persisting without the presence of the *gigantea* gall fly. The results of our study will provide novel insights into the evolutionary mechanisms that create, maintain, or reduce Earth's biodiversity, the possible repercussions of global climate change on biodiversity, and the role of ecosystem engineers in sequential speciation.

**John Stevenson ’11**

**Faculty Mentor:** Professor Christopher Mordaunt, Mechanical Engineering

**Impact Of Carbon Dioxide Doping on Methane Combustion in an Atmospheric Combustor**

Faced with increased energy usage and growing concern over greenhouse-gas emissions, the need for alternative and carbon-neutral fuels is becoming more evident. One such fuel is the gas derived from anaerobic digestion of food waste. While the majority of the gas produced through this method is CH₄, there is also a high percentage of CO₂. This study served to emulate the combustion of this biomass gas in an atmospheric burner by doping a fully premixed CH₄ fuel stream with increasing concentrations of CO₂. To accomplish this, the Combustion Research Laboratory was outfitted with a secondary gaseous-fuel delivery system, which enabled real-time doping of the primary CH₄ fuel with CO₂. During the test, fuel CO₂ levels were increased to 40 percent by volume of the fuel stream, and pollutant emissions data were recorded to see if the addition of CO₂ significantly increased the combustion process's impact on the environment. It was determined that, as the equivalence ratio was held constant and the percentage of CO₂ in the fuel flow was increased, both the CO₂ and CO levels in the exhaust increased. A series of photographic images were taken for each data point which indicate that the addition of CO₂ changes the flame's appearance, particularly the intensity and radial size. This suggests that increasing the amount of CO₂ doped into the flow decreases the flame's temperature. The images also showed that, while combustion instability occurred in the recirculation zone with the pure CH₄ flame, the addition of CO₂ helped dampen this affect.

**Juliana Su, Graduate Student**

**Faculty Mentor:** Professor Michael Thompson, Electrical Engineering

**Design and Development of an Fpga-Based Distributed Computing Processing Platform**

Recently, there has been growing interest in high-performance computing using field-programmable gate arrays (FPGAs) due to numerous application areas experiencing an increased demand in processing capability. Research conducted over the past twenty years has demonstrated that hardware acceleration using FPGAs yields considerable performance improvements for certain application areas, such as bioinformatics, digital signal processing, cryptography, and network packet processing. Exploiting huge amounts of parallelism using FPGAs is no trivial matter, however. This can be attributed to three aspects of FPGA design: (1) development time; (2) hardware/software partitioning; and (3) size.

One method of exploiting the processing power of FPGAs is to cluster them together and distribute computations among them. The concept of dividing up a problem into smaller tasks and distributing these tasks among separate processing elements is called distributed computing. By using FPGAs in a distributed computing environment, performance is increased through parallelization.

For this work, an FPGA-based distributed computing processing platform was designed and constructed. A performance analysis of the system is currently being conducted to explore the advantage of increasing the number of hardware processing cores and FPGA boards in the system. This data will be compared with the performance of the system using a purely software approach to data processing. In addition, the analysis will be used to identify any performance limitations of the system.

**Sarah Suchoff ’12**

**Faculty Mentor:** Professor Elizabeth Durden, Sociology and Anthropology

**Huipils of Mani, Mexico**

My research focused on the use and construction of huipils among Mayan Mexican women in the village of Mani, Mexico. Mani is an indigenous community of 4,000 inhabitants located in the state of the Yucatan. The huipils of the Yucatan are cotton
dresses, usually white in color, with a heavily embroidered neckline and hem. The making of the huipils is a mainstay of the village of Mani – it is renowned for making and selling these colorful traditional dresses and is an important source of income for families.

Throughout my research I created a photo-catalogue to document the different types of huipils along with the different embroidering techniques and new styles. Qualitative research such as interviews and participant observations, allowed me to discover how the huipil industry creates a power dynamic and hierarchy between the lower, middle and upper class. Lastly, respondents revealed how culture preservation is taking place within Mani to conserve the tradition of embroidery for centuries to come.

Taotao Tang '13
Faculty Mentor: Professor Charles Kim, Mechanical Engineering

Mechanical Design of Appropriate Technology for Uganda

This project formulated and applied mechanical design principles for appropriate technology tasks regarding to the following scopes: i. Are design principles different for design in the third world? ii. What three principles do we want to target? Apply them to three projects. iii. How to use these principles for typical projects iv. Refine cart design.

In the process of achieving these four scopes and finishing a complete process of developing or refining appropriate technology, these steps were followed: Clarify the problem (design specification); Develop and define an initial concept for the design / redesign; Test concept; Make preliminary design; evaluation and fabrication.

In this project, a bicycle trailer was refined based on certain requirements of an appropriate technology and restrictions of the local situation. As an accessory to bicycles used in Gulu district of Uganda, the trailer will help them in their everyday lives, especially with the transportation of goods.

To develop a qualified appropriate technology, the cost of materials and tools should be comparatively low; it can be accepted by majority of the population; it doesn’t require high technical skill on local workers during the manufacturing process. Also, small-scale technology is preferred in the history of appropriate technology because it is close to existing methods, and can be easily applied. In addition, there are some strict requirements which include: effectiveness, reliability, maintainability, reparability and availability.

To consider whether appropriate technology is worthwhile to offer in a certain developing country, the following requirements were examined in the first place:
1. Needs in the third world: What kind of technology fits these local people the best?
2. Material needs: After choosing the right direction of developing appropriate technology, designers need to think about how to get all the material in a developing country.
3. Sustainable development: Both material and energy should be used efficiently.
4. Environmental concerns in the third world: It’s very important to keep a balance between local environment and technology development.
5. Encouragement of an attitude of self-reliance: Local people can improve their life quality and contribute to their country by their own hands.

Janet Tesfai '11
Faculty Mentor: Professor Erin Jablonski, Chemical Engineering

Emulsion Separation and Liquid-liquid Extraction within Milli- and Microfluidic Devices

Liquid-liquid extraction (LLE) is a method used to separate compounds based on their relative concentrations in two immiscible phases. However, conventional liquid-liquid extraction (LLE) typically requires the use of large volumes of fluids to achieve separation, making this process undesirable for expensive materials. By significantly reducing the scale of LLE to the milli- or microfluidic level, this separation process can be made suitable for low volume, high value materials. Microfluidic extraction of a desired compound occurs by the cocurrent laminar flow of an aqueous solvent against an organic solvent, resulting in a stable diffusive interface between the two immiscible liquids.

With a small adjustment to the position of the organic inlet needle, this device for liquid-liquid extraction can be applied to the separation of emulsions after formation within a microfluidic device. The microfluidic device described above is able to achieve separation efficiencies > 90 percent.

Alex Thompson ’13
Faculty Mentor: Professor Maurice Aburdene, Electrical Engineering

Genomic Signal Processing

Genomic Signal Processing is a subset of bioinformatics, the study of genomes using computer methods. This area of research is specifically devoted to analyzing and modeling gene networks with the goal of discovering some type of “Conservation Law” that determines the spacing of particular molecules within a gene sequence. If we are successful in discovering such a function or
principle, it could be applied to a number of areas in molecular biology and would enhance our general understanding of life at a molecular level.

Our research process involved the use of various mathematical models and engineering methods. Specifically, we tried to find a “potential function” between molecules, similar to electrical potential between particles, and we analyzed the mean distances between molecules of the same type for correlations. Our most significant result produced from these trials thus far is a high correlation relating the mean distance between Adenine molecules and the mean distance between Thymine molecules. This may be biologically significant because these two molecules appear in pairs on a double helix. Otherwise, most of these trials have proven inconclusive, but our investigations are ongoing and we are honing in on various intriguing correlations.

Martin Tsvetkov ’13
Faculty Mentor: Professor Michael Thompson, Electrical Engineering

Croupier Application - FINS Framework

Mobile wireless ad-hoc networking is an area that presents unique challenges unlike those found in more conventional networks. Logistical issues have often prevented researchers from carrying out experiments and have kept researchers limited to simulations. As part of the effort to change this and based on previous experience from Professor Thompson, the NSF-sponsored FINS Framework Project will develop tools that will enable and simplify such research. The Croupier application is a sub-project that aims to create a server that will manage multiple computers, while in an ad hoc network, and ensure that they are all up to date and running the required software for the experiment. Through working with the core developers of FINS and frequent feedback and design meetings with Professor Thompson, an application that handled file transfers both to and from client computers, and various control functionality was created. It can be used to remotely initiate and monitor an experiment with little to no work on the client side. Croupier will be distributed as open source along with the FINS Framework software to enable single-point control of tests across networks.

Thet Hein Tun ’13
Faculty Mentor: Professor Jeffery Evans, Civil and Environmental Engineering

Two-dimensional Unsaturated Flow Modeling

I did a collaborative research that involves 2D modeling for soil-bentonite vertical cutoff walls. The ultimate goal of this research is to have predicted results of the suction pressure as a function of time and space for different climate data sets under the fluctuating groundwater table.

During the summer, we initially tried to understand the natures of HYDRUS-2D, the simulation program for two-dimensional unsaturated flow, and, the finite element method (FEM), a numerical technique for finding solutions of the governing flow equation. We started with simpler simulations which could eventually lead to the desired final simulation. In the end of the summer, we were able to simulate a soil profile of a cutoff wall (inserted in a levee that has different soil properties) with various atmospheric data input. Consequently, we were able to produce the graphs of suction pressure as a function of time and space.

Christine Vega ’11
Faculty Mentor: Professor Tristan Stayton, Biology

Is there More Than One Way to Make a Turtle Shell Strong?

A many-to-one relationship between form and function occurs when the same organisal function can be performed equally well by more than one morphology or arrangement of an anatomical part. Systems that show such a relationship can often show different evolutionary patterns than systems that do not show such a relationship. We hypothesized that turtle shell shape and strength would fit a many-to-one model because of a turtle shell’s internal and external complexity. This is potentially very important in the evolution of turtle shell shape, especially given that turtle shells often must adapt to perform many functions with a single shape. Specifically, aquatic turtle species possess specific shell adaptations for enhanced swimming performance and hydrodynamics. If there are multiple ways to make a strong shell, the morphological differences between terrestrial and aquatic turtle shells should not hinder the performance of the aquatic shells under mechanical stress. 103 species’ shells were collected from dorsal, lateral, and ventral views; these data were used to create digital models of the shells for finite element analysis. Twelve load cases were analyzed and the resulting stresses were used to compare the performance of terrestrial, semi-aquatic, and aquatic turtle species. Mantel tests were performed to determine whether the shell data and mechanical data fit a many-to-one or one-to-one relationship. Significant many-to-one relationships for average stress and maximum stress was found for all turtle species, implying that there are many ways to make a turtle shell strong.

Damon Vinciguerra ’11
Faculty Mentor: Professor Margot Vigeant, Chemical Engineering

Measuring Brain Glucose Concentration Using a Microdialysis Probe

Brain functions such as learning, orchestrating locomotion, recalling memory and processing information all require glucose as a source of energy. During these functions, the glucose concentration decreases as the glucose is being consumed by brain cells. By measuring this drop in concentration, scientists can determine which parts of the brain are used during specific
functions and consequently, how much energy the brain requires to complete that function. One way to measure glucose levels in the brain is with a microdialysis probe. Thermodynamically, the drawback of this analytical procedure, as with many steady state fluid flow systems, is that the probe fluid will not reach equilibrium with the brain fluid. Therefore, brain concentration is inferred by taking samples at multiple inlet glucose concentrations and finding a point of convergence. We have created a three-dimensional probe in COMSOL 4.0 that models the diffusion and convection of glucose in the brain-probe system in order to verify experimental results. When simulations were run using published values for physical constants (i.e. diffusivities, density and viscosity), the resulting probe glucose concentrations were within the error of the experimental data. This gives us confidence that the model is a good representation of the physical system.

Andrew Voter ’12

Faculty Mentor: Professor Eric Tillman, Chemistry

An Easy and Highly Efficient Route to Macroyclic Polymers Via Intraomolecular Radical-Radical Coupling of Chain Ends

High yields of macrocyclic polystyrene (PSt) were produced by intramolecular atom transfer radical coupling (ATRC) using dibrominated PSt (BrPStBr) as precursors prepared by ATRP. The slow addition of the BrPStBr precursors into a refluxing THF solution of copper (I) bromide (CuBr), tris[2-(dimethylamino) ethyl]amine (Me6TREN), and copper (0) activated the alkyl bromides at the PSt chain ends, favoring an intramolecular ring closing reaction with only minor competition from intermolecular coupling. Comparison of the gel permeation chromatography (GPC) traces of the BrPStBr precursor to the cyclic product showed a shift to lower apparent molecular weight values, consistent with the reduced hydrodynamic radius of the macrocycle. Quantitative activation of the chain ends was confirmed by 1H NMR, with the resonance due to the C(H)Br methine termini on the BrPStBr precursor absent on the NMR spectrum of the cyclic product, as well as MALDI-TOF analysis of the same.

David Vuong ’12

Faculty Mentor: Professor Brandon Vogel, Chemical Engineering

Synthesis of Functionalized Biodegradable Polyester Using THF

The objective of the research was to obtain the best procedure for synthesizing alpha-hydroxy acids containing functional groups and subsequent steps to polymerize the acid into highly functionalized degradable polymers. Theoretically, synthesizing polylactic acid from its monomer, lactic acid, is similar to forming other polymers from another alpha-hydroxy acid monomer. The plan of work consisted of two phases. The first phase consisted of converting the lactic acid into its oligomer form. Placing lactic acid and a stir bar into a round bottom flask and setting up the Dean-Stark apparatus accomplished this step. The contents in the flask were heated at 150°C. The purpose of the Dean-Stark trap was to remove the water out of the lactic acid solution. After all the water was evaporated off, the oligomer was formed by finally letting the contents in the flask stir at room temperature for about five hours.

The second phase of the procedure involved adding THF, tetrabhydrofuran, to the oligomer lactic acid. For each run, 1mL of THF was added to 1g of the oligomer in a small vial. 0.0901g DMAP, 4-Dimethylaminopyridine, and/or 0.730g scandium triflate was added to the vial and set in an ice bath for at least an hour. After an hour, 0.1527g DCC, N,N'-Dicyclohexylcarbodiimide, or 0.15mL of DiPC, disopropylcarbodiimide, were added to the vial. After thirty more minutes, the vial was placed on a stir plate for either 2 hours or 24 hours. After the specified time, the solution was rotovapped to remove any THF left remaining. Then, dichloromethane was added as the solvent. The solution was washed with hydrochloric acid twice, sodium hydroxide once and water once. Finally, the solution was rotovapped again so only polylactic acid was in the vial.

There were a lot of combinations of DMAP, Sc, DCC and DiPC that I could have used. I followed a matrix that was made for me by Professor Vogel to form the polylactic acid in different ways. Overall, there were 16 different combinations that were possible for forming the polymer with the specified chemicals. The GPC, gel permeation chromatography, was used to determine the molecular weights of the polylactic acid formed. The NMR, nuclear magnetic resonance, was used to determine if the polylactic acid was actually formed.

After several trials, I determined that adding both the DMAP and the Sc dramatically increased the molecular weight of the polymer. Adding DiPC instead of DCC did not influence the results. With both the DMAP and the Sc, I was able to get a molecular weight of about 17000 within 24 hours and 8000 within 2 hours. Without the DMAP and the Sc, the molecular weights were about 250 for both 2 hours and 24 hours. DMAP seemed to be more beneficial than Sc since I was able to get molecular weights of about 2500 with DMAP but only about 900 with Sc. Overall, I believe I had made progress in determining the best method in producing polymer with high molecular weights.

Sarah Wade ’12

Faculty Mentor: Professor DeeAnn Reeder, Biology

Testing Techniques for Measuring Body Temperature in Big Brown Bats, Eptesicus fuscus

Recently some researchers have used infrared laser thermometers to measure mammal body temperatures, despite there being little research to support the accuracy of the readings as reflections of core body temperature. In an effort to determine the reliability
and repeatability of these instruments, body temperatures of 18 big brown bats (Eptesicus fuscus) were taken both in torpor and at normal body temperatures (euthermy) by a NIST certified 12 inch dual laser infrared thermometer (Extech, Inc.) and by a digital rectal thermometer. The two different types of readings were taken within a minute of each other in each bat on each of three days while euthermic and three days later, during torpor. Analyses indicate that the lasers are not reliable. We suspect that the variation seen in the infrared laser readings is due to variation in the reflectance of hair, which will be tested by measuring shaved and unshaved areas of big brown bat carcasses.

Stephanie Walters ’11
Faculty Mentors: Professor Gary Grant, Theatre and Dance; Professor Anjalee Hutchinson, Theatre and Dance; Professor Paula Davis, Theatre and Dance

Learning My Lessons

A successful actor often requires a specific acting method or style to enhance their performance. Through theatrical research, rehearsal and performance, an actor can narrow down their seemingly endless search for the most productive methodology. By researching, studying, and applying the methods of Constantin Stanislavski, Stella Adler, and Tadashi Suzuki to my rehearsal process, I have found my perfect acting style: [pending research]. I utilize this acting method during the performance period of my early professional acting career.

Experimental research for this thesis is still going to be completed in the studio. I will be applying each of the three aforementioned methods to two monologues. The monologues will be contrasting – comedic and dramatic, as well as, contemporary and classical. The results that I gather will help me to decide upon a methodology that will carry me through my upcoming professional auditions. From casting resulting from the auditions, I will employ the methodology to my professional work as an actress.

In order to accomplish the objectives outlined in my thesis, I plan to research Constantin Stanislavski, Stella Adler, and Tadashi Suzuki extensively. Each acting teacher has provided the performance world with a new way to experience their stage time. The methods are very unique and enable the actor to find the most dynamic performance through engaging technical skill.

Ryan Ward ’11
Faculty Mentor: Professor Peter McNamara, Mathematics

Equality of P-partition Generating Functions

Two primary topics of study in combinatorics are partially ordered sets and generating functions. This research lies at the intersection of these topics. To every partially ordered set, one can associate a generating function, known as the P-partition generating function. We prove necessary conditions and sufficient conditions for two partially ordered sets to have the same P-partition generating function.

Yann Wester ’12
Faculty Mentor: Professor Warren Abrahamson, Biology; Mizuki Takahashi, Post-Doctoral Fellow, Biology

Resolving Phylogenetic Relationships in Sequential Radiation: A Case Study of the Gall Boring Beetle, Mordellistena convicta

The sequential speciation hypothesis states that the cause of biodiversity might be biodiversity itself. As a species diversifies, it can generate new niches for other organisms to exploit and possibly speciate, starting a chain reaction of speciation events. The sequential speciation of the inquiline beetle Mordellistena convicta is possible due to the speciation of the gall-inducing fly Eurosta solidaginis. The host-associated divergence in E. solidaginis came about with the single host shift from the ancestral host of late goldenrod, Solidago altissima, to giant goldenrod, S. gigantea, likely in the northeastern US. The goal of our study is to examine the phylogeography of M. convicta in relation to that of E. solidaginis to understand how sequential speciation has progressed in our goldenrod-insect system. We are testing three specific research questions: 1) Is the ancestral host of M. convicta S. altissima or S. gigantea? 2) Where has the host-associated divergence of M. convicta occurred? 3) How many times has this divergence occurred? To investigate these questions, ten to sixty individuals have been collected from 26 sites across the sympatric distribution range of M. convicta host races (eastern and midwestern United States). After the extraction of the beetles from the gall, DNA was extracted from the beetles using DNeasy Tissue kit (QIAGEN). Thirteen microsatellite loci have been developed for M. convicta and will be used for phylogenetic analysis with the stem-boring relatives of M. convicta as outgroups. Based on the topology of the phylogenetic tree, we will examine whether and how the pattern of primary speciation in the gall fly affects the sequential speciation of the gall-boring beetle.

Jeweliet Yost, Graduate Student
Faculty Mentor: Professor Brandon Vogel, Chemical Engineering

Synthesis of High Quantum Efficiency CdSe and CdS QDs via Microwave Heating

Fluorescent quantum dots (QD) are collections of semiconductor atoms on the order of a few nanometers. Their emission properties are dictated by the surface state and traps of the nanoparticles, and the size of the particle. Quantum dots are an emerging alternative to traditional dyes for solar cells and bio-imaging because of the ability to tailor the chemistry of the QD surface, their high quantum efficiency, and their stable emission. One of the draw backs of QDs is the requirement of oxygen and water free synthesis conditions, and difficulty producing high quantum efficiency particles. We present a
general method of synthesizing cadmium selenide (CdSe) and cadmium sulfide (CdS) QDs via microwave heating. This method allows for the controlled synthesis of QDs in a matter of minutes, as compared to the hours required in conventional heating. The nanoparticles are synthesized from commercially available precursors and inorganic capping ligands. We present the effect of varying the capping ligand on the ability to tailor the chemical functionality of the QD surface. We also present a method of altering the surface chemistry of the QDs via treatment with various reducing and oxidizing agents to fill in electronic traps and increase the particles' quantum efficiency. Our current research focuses on determining the effect that each combination of metal, ligand, and reducing/oxidizing agent has on the surface chemistry of the QD.

Kaixiang You '12

Faculty Mentor: Professor Kundan Nepal, Electrical Engineering

Fault Detection by Examining Circuit Structure

From the microscopic point of view, integrated circuits are composed by many gates. Gates are the basic component of the integrated circuit. With the development of modern electronic technology, integrated circuits are having more and more gates in it. The vast number of gates has led to the continuous increasing test cost of the integrated circuits. Therefore, in order to reduce the cost of integrated circuit testing, in our research we used a novel method called “implication” to identify the faults in integrated circuits. The basic idea of this method is we apply an external fault monitoring circuit (called implication) to the original integrated circuits. For example, when Gate A is in a good condition, the output of the implication will show 0; while the Gate A is broken, the implication will demonstrate 1. Therefore, in testing the gates, a 1 displayed by the implication indicates there is an error in Gate A. We wrote some PERL (a computer language) scripts and used a software called FastScan to help us embed and analyze the implications. We discovered that some special implications can let us use less test patterns to test the faults. The combination of these special implications is able to reduce even more test patterns and test time. However, adding too much implications also have a disadvantage, which is it will significantly increase the area of the chip and make the chip's R&D (Research and Development) costs, manufacturing costs and testing costs increase substantially. But at some critical points, the implications can greatly improve the efficiency without increasing the cost too much (the value of critical point depends on different types of circuit). So far we have only covered the stuck-at faults, sequential faults and path delay faults. This semester, we continue to work on this topic and we believe in the near future we will have some new findings.

* Spring 2011 Semester Abroad