Eleventh Annual
KALMAN
RESEARCH SYMPOSIUM

Bucknell
UNIVERSITY

MARCH 31, 2012
Introduction

Welcome to the eleventh 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
■ Drs. Anthony and Joyce D. Kales Undergraduate Research Fund
■ Kalman Fund for Bio-Medical Education/Fellows Fund
■ Kalman Fund for Undergraduate Research in the Sciences
■ The Katherine Mabis McKenna Environmental Internship Program
■ PPL Undergraduate Research Funds
■ James L.D. and Rebecca Roser Research Fellowship
■ Tague Family Fund Undergraduate Research in Biomedical, Biology and Biochemical Sciences
■ Robert P. Vidinghoff Memorial Summer Internship
■ Joann E. Walthour Undergraduate Research Fund

James P. Rice, Associate Provost and Dean of Graduate Studies
Mitchell I. Chernin, Professor of Biology

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  Faculty Mentor: Professor Mizuki Takahashi, Biology

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  Laura Duffy '13
  Faculty Mentor: Professor Erin Jablonski, Chemical Engineering
  Tyler Erhard '14
  Faculty Mentor: Professor Christine Buffinton, Mechanical Engineering
  Rebecca Howell '13
  Faculty Mentor: Professor Charles Clapp, Chemistry
  Andrew Klein '12
  Faculty Mentor: Professor Charles Kim, Mechanical Engineering
  Joshua Kurtz '12
  Faculty Mentor: Professor Indranil Brahma, Mechanical Engineering
  Yang Lu '14
  Faculty Mentor: Professor Katsuyuki Wakabayashi, Chemical Engineering
  Allison Mongan '12
  Faculty Mentor: Professor Lori Smolleck, Education

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  Faculty Mentor: Professor Kelly Salyards, Civil and Environmental Engineering
  Jeff Madrak '13
  Faculty Mentor: Professor Michael Thompson, Electrical Engineering
  Nicholas Noss, Graduate Student
  Faculty Mentor: Professor Kelly Salyards, Civil and Environmental Engineering

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  Faculty Mentor: Professor C. Tristan Stayton, Biology
  Hayley Nordstrom '12
  Faculty Mentor: Professor C. Tristan Stayton, Biology
  Kirstin Rudd '12
  Faculty Mentor: Professor Elizabeth Marin, Biology
  Diane Schrom '12
  Faculty Mentor: Professor Marie Pizzorno, Biology
  Anna Uehara '12
  Faculty Mentor: Professor Kathleen Page, Biology

- Graduate Studies Program
  Adam Andersen, Graduate Student
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  Kelly Carver '11, M'12
  Faculty Mentor: Professor Ryan Snyder, Chemical Engineering
  Sarah Heath, Graduate Student
  Faculty Mentor: Professor T. Joel Wade, Psychology
  Justin McKnight, Graduate Student
  Faculty Mentor: Professor Joseph Murray, Education
  Richard Natelli '12
  Faculty Mentor: Professor Brandon Vogel, Chemical Engineering
  Scott Radzinski, Graduate Student
  Faculty Mentor: Professor Eric Tillman, Chemistry

- Hobar Undergraduate Research Fund
  Aleem Naqvi '12
  Faculty Mentor: Professor Charles Clapp, Chemistry

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

- (over)
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Faculty Mentor: Professor Emily Stowe-Evans, Biology

Lindsay Regruto '12
Faculty Mentor: Professor Julie Gates, Biology

Darshan Shah '12
Faculty Mentor: Professor Kathleen Page, Biology

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Faculty Mentor: Professor Morgan Benowitz-Fredericks, Biology

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Faculty Mentor: Professor Christopher Mordaunt, Mechanical Engineering

Leonard Joseph '13
Faculty Mentor: Professor John T. Ptaeck, Psychology

Brennen Kim '12
Faculty Mentor: Professor Amy Wolaver, Economics

Cameron McConnell '13, Anthony Carter '12
Faculty Mentor: Professor Robert Stockland, Chemistry

Ian Rafter '12
Faculty Mentor: Professor Indranil Brahma, Mechanical Engineering

The Katherine Mabis McKenna Environmental Internship Program

Jeremy Byler '12
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Faculty Mentor: Professor Jeffrey Trop, Geology

Hallie Kenan '12
Faculty Mentor: Professor Peter Wilshusen, Environmental Studies

Carmen Lamancusa '12
Faculty Mentor: Professor Tim Raymond, Chemical Engineering

Alex Liggett '13
Faculty Mentor: Professor Michael Gross, Chemical Engineering

David Moffat '12
Faculty Mentor: Professor Alf Siewers, English

Rebecca Shopiro '12
Faculty Mentors: Professor Richard Crago, Civil and Environmental Engineering; Professor Kevin Gilmore, Civil and Environmental Engineering

Masha Zhdanova '13
Faculty Mentor: Professor Tim Raymond, Chemical Engineering

Professor Timothy Strein's NIH Grant

Brandy Taylor, Graduate Student
Faculty Mentors: Professor David Rovnyak, Chemistry; Professor Timothy Strein, Chemistry

PPL Undergraduate Research Funds

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

James L.D. and Rebecca Roser Research Fellowship

Steve Allison '14
Faculty Mentor: Professor Eric Tillman, Chemistry

Stephen M. Brouse '13
Faculty Mentor: Professor Katsuyuki Wakabayashi, Chemical Engineering

Stefan Ivanovski '12
Faculty Mentor: Professor Geoffrey Schneider, Economics

Alexander Lunde '12
Faculty Mentor: Professor Mary Beth Gray, Geology

Oudam Meas '12
Faculty Mentor: Professor Ronald Ziemen, Civil and Environmental Engineering

Adam Meier '13
Faculty Mentor: Professor Timothy Strein, Chemistry

Mark Paleafico '13
Faculty Mentor: Professor Ryan Snyder, Chemical Engineering

Lily Pfiefer '12
Faculty Mentor: Professor Christopher Daniel, Geology

Mike Synodis '13
Faculty Mentor: Professor Michael Gross, Chemical Engineering

Tony Veloz '14
Faculty Mentor: Professor Eric Tillman, Chemistry

Damon Vinciguerra '12
Faculty Mentor: Professor Margot Vigeant, Chemical Engineering

Katherine Wiley '14
Faculty Mentor: Professor Erin Jablonski, Chemical Engineering

Tague Family Fund Undergraduate Research in Biomedical, Biology and Biochemical Sciences

Chelsea Dieck '13
Faculty Mentor: Professor Ken Field, Biology

Jim McMichael '13
Faculty Mentor: Professor Ken Field, Biology

Robert P. Vidinghoff Memorial Summer Internship

Alexandra Clayton '12
Faculty Mentor: Professor Matthew Travis, Biology

Joann E. Walthour Undergraduate Research Fund

Jaclyn Kirna '12
Faculty Mentor: Professor Lori Smolleck, Education
## Kalman Research Symposium
### March 31, 2012

### Program Schedule

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<td>Masha Zhdanova</td>
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*Spring 2012 Semester Abroad

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<td>ELC 256 (Center Room)</td>
<td>Yue Hua, Nicholas Noss, Hallie Kennan, Rebecca Shapiro, Brian</td>
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**BUCKNELL UNIVERSITY**

**KALMAN RESEARCH SYMPOSIUM**
Jack Ingram ’13
Faculty Mentor: Professor Cathy Myers, Bucknell University Environmental Center
Complementing Marcellus Shale Leases with Conservation Easements
The natural gas industry in Pennsylvania will prove to operate as a lasting entity within the state, for the duration of an economic production span over the course of this century. While some environmentalists are voicing concerns over the technology of hydraulic fracturing, little has been done to actually mediate the polarized debates, pitting industry vs. anyone who reads anti-fracking media. The hectic and warring arguments actually offer an opportune time to set aside more acreage under conservation than ever before. By using the timeliness of the environmental concerns associated with fracking, environmental interests within Pennsylvania can potentially utilize Marcellus growth for environmental benefits.

Conservation easements offer the potential to serve as the landowner’s tool for the reasonable development of the Marcellus Shale in Pennsylvania, while guaranteeing the integrity of the lands for future generations of Pennsylvanians. In addition, conservation easements provide the capacity for the localization of Marcellus Shale regulation—which will prove to benefit local conservancies, the industry, and the landowners. Blanketing conservation easements over lands under lease agreements is a major opportunity for energy companies to promote reputable causes for environmental stewardship under the accountability of local oversight.

V. David Munteanu ’14
Faculty Mentor: Professor C. Tristan Stayton, Biology
A Morphological Analysis of the Differences Between Aquatic and Terrestrial Turtle Shells and the Effect on Turtle Locomotion on Shape and Strength
The shells of aquatic and terrestrial turtles differ in shape, and certain differences appear to relate to locomotion. We hypothesized that terrestrial turtle plastra would be narrower than aquatic turtle plastra as terrestrial turtles must direct their limbs downward to support their weight against gravity. We also hypothesized that aquatic turtles would have a smaller bridge than aquatic turtles, as aquatic turtles must make broad lateral swimming strokes and a smaller bridge would maximize the range of motion for the limbs. Based on these predictions, we also hypothesized that the plastra of aquatic turtles will be stronger than the plastra of terrestrial turtles and the bridges of terrestrial turtles will be stronger than the bridges of aquatic turtles, given that smaller plastra or bridges would have smaller cross-sectional areas, and thus lower resistance to stresses. We found that terrestrial turtles do in fact have narrower plastra than aquatic turtles in the anterior of the plastron and also have a wider bridge than aquatic turtles. Terrestrial plastrae were also found to be stronger than aquatic plastrae, and terrestrial bridges were stronger than the aquatic bridges. These findings illustrate the ways in which selection for increased biomechanical performance in one function (locomotion) can have negative consequences for performance in other functions (shell strength and defense against predators).

Richard Natelli ’12
Faculty Mentor: Professor Brandon Vogel, Chemical Engineering
A General Approach Towards the Development Of Amido Functionalized Alpha Hydroxy Acids for the Use in Ring Opening Polymerization
This research deals with the synthesis of cyclic diesters from pendant group functionalized amido-functionalized α-hydroxy acids. The current methods used to synthesize cyclic diesters are focused on activation of the carboxyl acid functional group. This allows for the formation of heterogeneous and homogenous cyclic diesters, which can be used to create polymers of varying monomer compositions. The goal of synthesizing functionalized cyclic diesters is to develop high molecular weight polymers with tailored chemical properties that may improve the capabilities of existing biodegradable polyesters for applications in controlled release pharmaceuticals.

Hayley Nordstrom ’12
Faculty Mentor: Professor C. Tristan Stayton, Biology
Functional Mechanics of the Concave Plastron in Male Turtles
Many species of terrestrial turtles have males who possess concave plastrae, or ventral shell plates. This shape may serve as an evolutionarily derived means for maintaining stability during mating. However, it has been demonstrated that the concave plastron is significantly weaker than its flat counterpart. For this reason, it is likely that these species have experienced an evolutionary trade-off between stability during mating and plastral strength. Very little is known about this pattern, and a better understanding of it could contribute to our knowledge of the evolutionary history of turtle species. For this reason we set out to answer several questions relating to this pattern, namely: What is the relationship between plastral concavity and stability during mating? What is the relationship between plastral concavity and shell strength? What is the range of plastron shapes that optimizes stability and strength? Do actual turtle shells fit the prediction of a trade off? Using both geometric morphometric and finite element analysis, we showed that a concave plastron shape allows for positioning of the male’s body at a lower angle during mating, bringing the center of mass forward and increasing postural stability. We also found that plastron with higher degrees of concavity experience significantly higher stresses than flat plastron, indicating that concavity weakens the shell. We then gathered concavity measurements of 23 species of turtle specimens from the Smithsonian collection in Washington D.C. to analyze the relationship between stability gain and strength loss in real turtle species. We determined that up to about 4% concavity there is little sacrifice of shell strength, which led us to predict that species exhibiting concavity would likely have developed plastron with at least 4 percent concavity. However most species examined displayed plastron with less than 4 percent concavity, suggesting that indentation may be limited by some other factor, perhaps body cavity volume. Generally, however, surveyed species displayed a negative relationship between stability gain and strength loss, supporting the idea that certain species have sacrificed shell strength and evolved a more concave plastron to increase stability. This balance may have increased fitness in some ancestral turtles, leaving the pattern evident in certain species today.
Tom Shull '13
Faculty Mentor: Professor Amy Wolaver, Economics

How Does the Level of Primary Care Received by Medicaid Patients Enrolled in HMO Programs Differ from Those Enrolled in Fee-For-Service Programs?

Congress created Medicaid in 1965 to provide medical care for vulnerable portions of the population such as low income adults, their children and the disabled. The legislation requires that states establish their own Medicaid programs, but the federal government provides oversight and partial funding. In the 1990s, many states shifted to Medicaid managed care (MCO) programs in an effort to reduce costs and improve quality of care. These efforts both succeeded and failed to varying degrees. Law makers in Pennsylvania took a nuanced approach and set up mandatory MCO policies in certain counties, mandatory Primary Care Case Management (PCCM) fee-for-service in other counties, and mixed programs in the remaining counties. In this paper we compare the performance of the various Medicaid programs in the state of Pennsylvania based on hospital admission rates by zip code for ambulatory care sensitive (ACS) conditions using 2009 inpatient discharge data from Pennsylvania collected by the Pennsylvania Health Care Cost Containment Council (PHC4). Our findings reflect the strengths and weaknesses of the different approaches to providing Medicaid and indicate that although Medicaid managed care can reduce costs; it does not improve the availability of primary care for Medicaid recipients.

Masha Zhdanova '13
Faculty Mentor: Professor Tim Raymond, Chemical Engineering

Influence of Local Vegetation on the Production and Properties of Atmospheric Particulate Pollution

Aerosols are solid or liquid particles that are contained in the atmosphere and interact in various ways with water vapor. The particles’ size ranges from a few nanometers to a hundred of microns, thus their concentration in the atmosphere is very high (typically to 2,000-20,000 particles/cm3 in a rural area). By creating those particles from plants and trees, we can understand and predict certain atmospheric processes, influence air quality, and learn how to best control air pollution. Using an Atomic Force Microscope (AFM), Differential Mobility Analyzer (DMA), Condensation Particle Counter (CPC), and Cloud Condensation Nucleus Counter (CCNC) this summer, we have been studying the behavior of aerosol particles and their three-dimensional surfaces. By simulating reactions between ozone and organic compounds from tree samples collected in the Bucknell Arboretum and analyzing the nano-particles that are produced, we were able to see how their size and shape are affected by an absence or presence of UV light or a high or low humidity level.

Eastern White Pine samples were placed in a specially constructed smog chamber where atmospheric oxidation processes that convert complex organic vapors (naturally given off by vegetation) into condensable low-volatility compounds were simulated. The natural environment was simulated as closely as possible, and as a result, it was determined that the presence of UV light does not affect particle number or mass growth rates or the ozone drop level. Increasing the total mass of vegetation samples in the chamber affected a total increase in mass, but not in number of particles per cm3. In addition, various other tree samples were tested to determine particle concentration and diameter growth over time.

As part of the research project, 0.66 μL of Acros Organics® α-pinene was mixed with ozone in the smog chamber. Experiments were run in two ways: 1) adding the volatile organic compound, VOC (α-pinene) first and 2) adding the ozone first. Having identical experimental conditions, it was determined that adding the VOC first followed by ozone produces a high amount of particles (75,800 pt/cm3) of average diameter of 92.3 nm, while adding the ozone first produces significantly less particles (34,100 pt/cm3) of average diameter of 99.0 nm.
Noel Lampazzi '13
Faculty Mentor: Professor Mizuki Takahashi, Biology
Promoting Amphibian Conservation Through College Classrooms: Detection of Batrachochytrium dendrobatidis Among Local Amphibians
Alex Liggett '13 and Nguyen Vo '14
Faculty Mentor: Professor Michael Gross, Chemical Engineering
The Effect of Vanadium Deficiency on the Catalytic Degradation of Solid Oxide Fuel Cell Electrodes
Yang Lu '14, Evan Shemonsky '13
Faculty Mentor: Professor Katsuyuki Wakabayashi, Chemical Engineering
Biodegradability Measurement in Polymers and Polymer Nanocomposites
Alexander Lunde '12
Faculty Mentor: Professor Mary Beth Gray, Geology
Progressive Deformation at the Allegheny Front: A Study of Structural Geology, Associations, and Kinematics, Lycoming County, Pennsylvania
Jeff Madrik '13
Faculty Mentor: Professor Michael Thompson, Electrical Engineering
Cloud Computing: I.T. for the Future
Andrea Massa '12, Nikki Shea '12, Marie Charlon '12, Aly Lebowitz '12, Libby Munson '12, Jenni Whalen '12, Jessica Yingst '12, Kristen Born '13, Tricia Collins '13, Tom Latosek '14
Faculty Mentor: Professor William Flack, Psychology
Acquaintance Hook Ups, Alcohol, and Male Peer Support for Woman Abuse Are Related to Perpetration of Sexual Assault by Men
Cameron McConnell '13, Anthony Carter '12
Faculty Mentor: Professor Robert Stockland, Chemistry
Establishing the Limits of Phosphorus Arilization via Palladium Catalysis
Justin McKnight, Graduate Student
Faculty Mentor: Professor Joseph Murray, Education
Thought Control Interventions: Men and Student Conduct Cases
Jim McMichael '13
Faculty Mentor: Professor Ken Field, Biology
Expansion of Myeloid Derived Suppressor Cells Upon Treatment with Farnesyltransferase Inhibitors
Oudam Meas '12
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Modeling Yield Surfaces of Various Structural Shapes
Adam Meier '13, Aravinda Seneviratne M’12, Derek Schildt M’07, Diana Scherbaum ’05
Faculty Mentor: Professor Timothy Strein, Chemistry
Toward Understanding Transient Isotachophoresis of an In-line Product Using EMMA
David Moffat '12
Faculty Mentor: Professor All Siewers, English
The Wonderful Structure of the World: Joseph Priestley and the Developing American View of Nature
Allison Mongan '12
Faculty Mentor: Professor Lori Smollick, Education
Changes in Preservice Teachers’ Self-Efficacy: From Science Methods to Student Teaching
Dick Muyumbi '12
Faculty Mentor: Professor Jeffrey Evans, Civil and Environmental Engineering
Design of Geotechnical Equipment and Methods to Determine Properties of Cohesionless Soils Subsequent to Liquefaction and Resedimentation
Aleeq Naqui '12
Faculty Mentor: Professor Charles Clapp, Chemistry
Synthesizing Halogenated Lipoygenase Inhibitors
Nicholas Noss, Graduate Student
Faculty Mentor: Professor Kelly Salyards, Civil and Environmental Engineering
Development of a Laboratory Test Program to Examine Human-Structure Interaction
Brenna O'Neill '12
Faculty Mentor: Professor Amy Wolaver, Economics
Ambulatory Care Sensitive Conditions in Pennsylvania-Oral Presentation
Mark Paleafico '13
Faculty Mentor: Professor Ryan Snyder, Chemical Engineering
Isolation of Glycine Polymorphs by Crystallizing Monodisperse Droplets
Stefan Petrovic '14
Faculty Mentor: Professor Thomas Selby, Chemistry
Mechanistic Characterization of the Streptomyces Antibiociniositol-specific Phospholipase C (PI-PLC) Enzyme
Lily Pfeifer '12
Faculty Mentor: Professor Christopher Daniel, Geology
Evolutionary Aspects of Mesoperotrocerous Deposition, Regional Metamorphism and Deformation in North-Central New Mexico: Metamorphic Monoclinal Detrital Zircon Geochronology in the Picuris Mountains
Chris Porter '13
Faculty Mentor: Professor Ryan Snyder, Chemical Engineering
Systematic Method to Determining Slow Growing Edges and Faces of Organic Molecular Crystals
Scott Radzinski, Graduate Student
Faculty Mentor: Professor Eric Tillman, Chemistry
Selective Formation of Diblock Copolymers by Atom Transfer Coupling Reactions
Ian Rafter '12
Faculty Mentor: Professor Indranil Braham, Mechanical Engineering
Diesel Smoke Characterization
Lauren Rambo '12
Faculty Mentor: Professor Ruth Tincoff, Psychology
Infant Understanding of Words Referring to Physical Objects and Familiar Events
Billy Raska '12
Faculty Mentor: Professor Kundan Negi, Electrical Engineering
Design of an Open-Source Hardware/Software Embedded Platform
Lindsay Regruto '12
Faculty Mentor: Professor Julie Gates, Biology
Roles of the SKIP Protein During Egg Development in Drosophila melanogaster
Jordan Rivera '13
Faculty Mentor: Professor Charles Kim, Mechanical Engineering
Robotic Safe Joints
Kirstin Rudd '12, Danielle Alaimo '12, Gnna Freehling ‘15, Chuqiao Ren ‘15, Anthony Cillo ‘10, Faculty Mentor: Professor Elizabeth Marin, Biology
Antp and Ubx Regulate Segment-Specific Survival and Morphology in the Postembryonic Ventral Nervous System of Drosophila melanogaster
Diane Schrom '12
Faculty Mentor: Professor Marie Pizzore, Biology
Determination of Protein-Protein Interactions between two Drosophila Proteins, Skip and Ena
Brian Schultz, Graduate Student
Faculty Mentor: Professor Jessica Newlin, Civil, and Environmental Engineering
Monitoring and Mathematical Modeling of the Sediment Processes at In-Stream Restoration Structures in the Vicinity of a Bridge Crossing
Matthew Segar '12
Faculty Mentor: Professor Brian King, Computer Science
De Novo Assembly of Second Generation Genome Sequencers
Darshan Shah '12
Faculty Mentor: Professor Kathleen Page, Biology
Alteration in SHT1A Receptor Activity from a Prenatal Exposure to Dexethamethone in a Stressed and Non-Stressed Adult Male Rat
Nikki Shea '12, Andrea Massa '12, Marie Charlon '12, Aly Lebowitz '12, Libby Munson '12, Jenni Whalen '12, Jessica Yingst '12, Kristen Born '13, Tricia Collins '13, Tom Latosek '14
Faculty Mentor: Professor William Flack, Psychology
Disclosing Sexual Assault Victimization to Others
Rebecca Shopiro '12
Faculty Mentors: Professor Richard Crago, Civil and Environmental Engineering; Professor Kevin Gilmore, Civil and Environmental Engineering
Runoff Water Quality and Pollutant Mass Loads from Extensive Green Roofs
Loren Srijayanth '12
Faculty Mentors: Professor Warren Abrahamson, Biology; Dr. Catherine Blair, Biology; Professor Mizuki Takahashi, Biology
Impact of Host-Race Collapse in a Gall-Inducing Fly on Sequential Speciation of the Gall-Boring Beetle, Mordellista convicta
Lauren Stenz '12, Kara Plane '12
Faculty Mentors: Professor David Dean, Psychology
Investigating Rural Youth Health Behavior and Decision Making
Alexandra Stough '14, Kate Wisterman '14
Faculty Mentor: Professor Jennie Stevenson, Psychology
Characterization of Estrogen Regulation of Oxytocin Neurons and Release in Female Prairie Voles
David Sulon '12
Faculty Mentor: Professor Nathan Ryan, Mathematics
Verifying Harder’s Conjecture
Kaitlyn Sweeney '12, Colleen Garrehy '12, Kimberly Fisher '14
Faculty Mentor: Professor Morgan Benowitz-Freidickers, Biology
Effects of Yolk Testosterone Levels and Post-hatch Food Availability on Wound Healing in Male Domestic Chicks (Gallus gallus)
Mike Synodis '13
Faculty Mentor: Professor Michael Gross, Chemical Engineering
Using Computer Modeling to Assess the Effects of Infiltration of Sifted Oxide Fuel Cells
Emily Richards '13, Marisa Taddeo '13
Faculty Mentor: Professor Kevin Myers, Psychology
Rapid Detection of Intrastragic Glucose Enhances Intake
Brandy Taylor, Graduate Student, Thomas Mann '11
Faculty Mentor: Professor David Rovnyak, Chemistry; Professor Timothy Strein, Chemistry
NMR Chemical Shifts Report on Bile Salt Self-Aggregation and Intermolecular Interactions: Effects of pH, Temperature, and Concentration
Ahmad Tawajq '12
Faculty Mentor: Professor Kelly Salyards, Civil and Environmental Engineering
Investigation of Dynamic Crowd Loading Using the Load Estimation Method and In-Service Acceleration Data
Christian Treat '13
Faculty Mentor: Professor Peter Judge, Animal Behavior
Personality Assessment in Captive Hamadryas Baboons (Papio hamadryas)
Anna Uehara '12
Faculty Mentor: Professor Kathleen Page, Biology
The Effects of Altered Melatonin Levels and Hippocampal Gene Expression in the Male Rat
Tony Veloz '14
Faculty Mentor: Professor Eric Tillman, Chemistry
Synthesis of Telechelic Polymers via Atom Transfer Radical Coupling
Damion Vinciguerra '12
Faculty Mentor: Professor Margot Vigante, Chemical Engineering
Mathematical Model of Hippocampal Microdialysis: Validation of in vivo methodology
Allyssa Ward '12
Faculty Mentor: Professor Amy Wolaver, Economics
Behavioral Economics and Physician Behavior: The Availability Heuristic
Yann Wester '12
Faculty Mentors: Professor Warren Abrahamson, Biology; Professor Mizuki Takahashi, Biology
Resolving Phylogenetic Relationships in Sequential Radiation: A Case Study of the Gall Boring Beetle, Mordellista convicta
Katherine Wiley '14
Faculty Mentor: Professor Erin Jablonski, Chemical Engineering
Liquid-liquid Extraction of a Model Small Molecule Pharmaceutical Agent in a Milli-fluidic Device
Kate Albertini ’14
Faculty Mentor: Professor Warren Abrahamson, Biology;
Dr. Catherine Blair, Biology
Effect of Plant Volatiles on the Host-associated Divergence in *Mordellistena convicta* Stem Beetles

The mechanisms of insect diversification are an important topic of study because they can provide insight into how speciation occurs. It is thought that if a barrier arises and restricts gene flow between two populations, speciation can occur. One such barrier is an insect’s preference to return to the same species of plant from which it was born in order to mate. The tumbling flower beetle *Mordellistena convicta* uses ten different host-plant species and attacks both the stem and galls on two of these hosts for a total of twelve hosts. Additionally, *M. convicta* is a species complex that is divided into seven morphologically identical, but genetically different species. Within one of these species (species 1), there are two genetically different populations, one of which uses *Euthamia graminifolia* stems as a host and the other which uses *Solidago altissima* stems. The purpose of this study was to investigate if species 1 *M. convicta* stem beetles rely on volatiles from their host plant to locate the plant for use as a mating location. We hypothesized that species 1 beetles should react positively to the volatiles of their natal plant and avoid the volatiles of their nonnatal plant. Beetles were reared from locally-collected stems for use in a y-tube olfactometer behavioral test. A y-tube olfactometer pulls air through a closed system, splitting the air past a control and either a host or nonhost plant. A beetle is placed into the bottom of a glass y-tube and given 10 minutes to crawl past a decision line in either arm of the y-tube in response to the volatiles. After testing, the beetles were sexed, ground up, and run on gels for allozyme analysis to determine their species. Preliminary data show that both male and female species 1 stem beetles do not exhibit a preference for host plant volatiles, nor do they exhibit an avoidance of nonhost volatiles. Final data will be displayed on the poster. We expect that these data will not support our hypotheses and therefore conclude that species 1 *M. convicta* stem beetles do not rely on host volatiles to locate their host plant. They may instead use other cues such as tactile and visual cues, or use these cues in combination with volatile cues.

Steve Allison ’14
Faculty Mentor: Professor Eric Tillman, Chemistry
Using Tetrabutylammonium Halides to Alter the Controlled Radical Polymerization of Styrene

Initially the effect of tetrabutylammonium X (BuNX, X=Br, Cl, F) on atom transfer radical polymerization (ATRP) was tested by adding different ratios of Bu4NX:Styrene. It was found that even at low ratios of Bu4NBr:Styrene (1:50, 1:100, etc.), Bu4NBr shut down standard ATRP reactions. High percent conversion of monomer into polymer was then achieved by altering the method of ATRP; instead of using Cu(I)Br as a catalyst, Cu(II) Br2 was used. Polystyrene was synthesized by combining Cu(II)Br2;Styrene:(1-bromomethyl)benzene:N,N’,N’”,N”’-Pentamethyldiethylenetriamine (PMDETA);BuNX in a ratio of 1:50:1:1 or 0.5. High yields of polymer were achieved in ratios of 0.5:1 for Bu4NBr, Bu4NCl, and Bu4NF. In ratios of 1:1 Bu4NX:Styrene both Bu4NCl and Bu4NF yielded polymer, but Bu4NBr reactions were shut down. Low polydispersity index (PDI) values and average molecular weights (MN) were also obtained in reactions that went to completion.

Adam Andersen M’12, Andrew Klein ’12
Faculty Mentor: Professor Charles Kim, Mechanical Engineering
Sustainable Eyeglasses Project for the Developing World

In order to develop appropriate technology that will engender lasting change, sustainability must be prominent in the design. This is achieved through the use of a set of questions used to evaluate and guide design for sustainability. Using these questions to evaluate several existing projects aiming to bring inexpensive, prescription eyeglasses to the developing world, we created a new approach. As opposed to creating adjustable eyeglasses, this new approach called for a redesign of the equipment needed to manufacture lenses.

This project aimed to redesign a pattern lens edger, the most expensive and crucial piece of equipment for preparing lenses. The goal was to prototype a new tool that could be manufactured in the developing world and at the lowest possible cost. However, the prototype needed to demonstrate the ability to cut lenses to a similar degree of accuracy. We created a design and manufactured it in the developed world as a proof of concept. We tested this design extensively, leading to the discovery of precision issues due to the multiple simplifications made. These issues would necessitate a future redesign.

In order to fabricate a proof of process prototype, it was important to work in the developing world. A trip was taken to a rural village in Guatemala where production took place. With the assistance of several nationals, we attempted to manufacture the existing prototype. After we encountered several stumbling blocks, we developed and fabricated a new design. Overall, this work was essential to discover challenges presented in the developing world that would impact future design changes.

Eric P. Balaban ’14
Faculty Mentor: Professor Kathleen Bieryla, Biomedical Engineering
Improving Clinical Balance Measures in Older Adults via Xbox Kinect Training

Introduction: Among those age 65 and older, falls are the leading cause of injury death [1]. To help improve clinical measures of balance, exercise that includes repetitive body movements, such as Tai Chi programs, are encouraged because they may benefit those at risk for falling [2]. The Kinect for Xbox 360, which allows the user to play games by utilizing a hands-free body movement tracking system, may be a novel way to improve
measures of balance in older adults. The purpose of this study is to evaluate the effect of training using the Kinect on clinical measures of balance. It is hypothesized that training with the Kinect will significantly improve an older adult’s scoring in clinical tests of balance such as the Fullerton Advanced Balance (FAB) Scale and Berg Balance Scale (BBS).

Materials and Methods: Thirteen older adults from a senior living community, 82.3 years old ± 5.1 (mean ± S.D.), participated in this study. The study was approved by Bucknell’s Institutional Review Board and informed consent was obtained. Each subject was evaluated before and after an intervention using clinical tests including the FAB (maximum score of 40) and the BBS (maximum score of 56). After initial testing, subjects underwent three weeks of training using the Xbox Kinect. Times each week, six subjects were led through the same custom routine that lasted approximately 30 minutes. The first half of the routine was comprised of Your Shape: Fitness Evolved’s Zen sessions (Stream 1 and 2), and the second half was comprised of games from Kinect Adventures. Seven subjects did not train and served as the control group. Once the training was completed, identical clinical measures of balance as taken before the test were taken again. The results were then compared to pre-training data using a paired t-test with an alpha level of 0.05.

Results and Discussion: Each subject who completed the training either improved or remained consistent in both BBS and FAB scoring. The experimental subjects improved by 2.7 ± 1.8 points in the BBS and 2 ± 1.3 points in the FAB (Fig. 1). The control group’s progress was not as consistent, with a range of differences (Post – Initial) -3 to 9 points in the BBS and -8 to 5 points in the FAB. A paired t-test revealed a significant increase in BBS (p = 0.007) and FAB (p = 0.006) score for the experimental subjects. There were no significant increase in BBS (p = 0.145) or FAB (p = 0.289) score for the control subjects.

Conclusions: The study suggests that training with the Xbox Kinect can potentially be used by older adults to improve measures of balance because of significant increases in BBS and FAB balance scoring among experimental subjects. Informal feedback obtained from the experimental group after intervention indicated that training with the Kinect was entertaining and enjoyable. By offering a more appealing form of exercise, older adults may be more inclined to exercise regularly. In future studies, more subjects should be used to increase the power of statistical tests. Also, a workout routine involving different Kinect exercises and games could be implemented to better generalize the results to the gaming system.


Kate Berner ’12
Faculty Mentor: Professor Deborah Abowitz, Sociology and Anthropology
The Quest for the Dress: Making Meaning and Magic at the Bridal Shop

Using ethnographic data collected from a bridal shop in central Pennsylvania, I studied the traditions, ideals, and notions of the sacred associated with women’s selection of their bridal gown. I hypothesized that the experience of choosing a wedding gown would carry multiple meanings, and that the gown as a sacred object would transcend its literal meaning. As part of the shared meaning-making I expected that in selecting a dress, brides would exhibit the need for their mother or family’s approval, as well as an awareness of the importance of tradition in the bridal shop setting.

Field research was carried out from February to August of 2011 though participant observation. I was able to observe women and collect their personal “memories” about trying on different gowns with their families present. Data comprised of detailed notes taken during and after clients entered the shop, extensive discussions with the shop’s owner and seamstress, and hours of client observations. In some cases, there were multiple sessions observing the same client. Using these detailed field notes and previous theoretical research on weddings, wedding gowns, and the nature of rituals underscored how women view the “sacredness” of the dress and the dress selection process.

In this sample of bridal shop clients, there was little religious association with this segment of wedding preparation, but the bride and her family considered the moments associated with picking out a dress to be “sacred.” The experience of choosing a wedding dress was momentous for these brides-to-be because the dress, typically a profane object, became elevated by its function as one of the most significant symbols in the wedding ceremony. Sacredness was manifested among these women in the tradition of passing jewelry or other accessories between female family members, the ritual of trying on as many dresses as possible before finding “the one,” and the constant need to achieve perfection in appearance on the wedding day. My research highlighted the importance of the mother-of-the bride’s approval of the dress selection, the shared meaning of the dress as a sacred object, and how concepts of womanhood, beauty, and perfection are all a product of women’s shared traditions. They are dependent on the bride and her mother, but rely on the sacred nature of the gown and its significance in the forthcoming ritual to create shared meaning and memory among women.
Emily Blum ’12
Faculty Mentor: Professor Ruth Tincoff, Psychology
Analyzing the Comprehension of Verbs in Infants
The aim of the present study is to determine what infants understand about words that label actions. Changes in locomotive abilities can alter infants’ experience with the environment as infants become capable of being both the observer and the subject of an action (Huttenlocher et al., 1983). The question we ask is if experience with these new motor abilities change infants’ comprehension of verbs.

Infants are recruited from the community between the ages of 9.5 and 20.5 months. We look at two types of verbs; verbs that label actions that can be produced in a seated posture, such as eating and blowing bubbles, and verbs that label actions that require upright bipedal locomotion, such as walking or running. We test for comprehension of the verbs with a preferential looking paradigm. A large monitor displays a split-screen video of two action events. Simultaneously, the infants hear a verb produced over a hidden loudspeaker that matches one of the events. We conclude that infants comprehend the link between a word and the corresponding video if the infants look longer at the matching video compared to the non-matching video.

We predict that infants who have experience with seated and upright actions will recognize the correspondence between the verb and action for both seated and upright verbs. In contrast, we predict that younger infants, who mainly have experience with actions in a seated posture, and little experience with actions in an upright posture, will only look longer at the video that matches the audio for seated verbs.

Daisy Bourne ’15
Faculty Mentor: Professor Amy Wolaver, Economics
Health Care Policy Research
For my research project I studied the effects of neighborhood socioeconomic status on the birth weight of newborns. Using the 2009 Inpatient hospital data provided by the Pennsylvania Healthcare Cost Containment Council (PHC4) in conjunction with census data, I studied birth weight and how it relates to socioeconomic status indicators such as race, average household income in the zip code, and type of medical insurance. With low birth weight as my indicator of newborn health, I measured the link between socioeconomic status and infant health. Preliminary results show that lower socioeconomic status is correlated with lower birth weights and poorer newborn health.

Kate Bowen ’12
Faculty Mentor: Professor Julie Gates, Biology
SKIP and Ena are Potential Binding Partners During Drosophila Embryonic Development
Development is the extraordinary biological process in which a single cell is transformed into a mature organism. To achieve this, cells must undergo division and growth, specialize based on a set of functional instructions, and organize into tissues and organs. Throughout these processes cells practice particular cellular behaviors, including alteration of cell shape, migration to new locations, cell rearrangement, and following directed paths. One of the driving forces behind cell movement and alteration of shape is a cellular structure located under the cell membrane, known as the actin cytoskeleton. The actin cytoskeleton consists of a network of proteins, referred to as actin filaments. The filaments work together to influence both cell movement and cell shape. The filaments organize relative to other filaments into crisscrossed networks or parallel arrays to modify cell shape. Individual filaments are composed of subunits that bind to each other. Subunits may be added or removed to the filament to alter the length. A number of proteins interact with these subunits or the actin filaments to either mediate changes in length or organization. One group of such actin binding proteins is the Ena/VASP protein family. Proteins in this family mediate elongation by binding to the end of the actin filament, allowing additional subunits to bind, and ultimately resulting in an increase in length of the filament. To study how Ena/VASP proteins function in an intact organism, we use the fruit fly Drosophila melanogaster. This model organism has a single Ena/VASP protein family member called Ena. Ena is a protein that not only influences actin filament growth, but also has the ability to interact with other proteins. Another lab carried out a study and identified over 30 different proteins that directly bind to Ena. Shal K’ Channel Interacting Protein (SKIP) was one of the proteins that was shown to interact with Ena. This interaction in a test tube suggests that SKIP may be involved in regulating Ena’s function in a biological system. To examine this possibility, we generated genetically mutant Drosophila lines that did not contain the SKIP protein. Preliminary data suggests that SKIP and Ena may function together during the developmental process of dorsal closure. Dorsal closure is one of the final stages of Drosophila embryonic development. During this process, a gap that exists on the dorsal side of the developing larva is closed due to the migration of cells on opposing sides of the gap. Once the opposing cells meet, the gap is zipped shut and development of the embryo is complete. Ena is required for the successful completion of dorsal closure. Our current data suggests SKIP is also involved in dorsal closure and may function as a negative regulator of Ena.

Reina Brenn ’13, Zach Oberholtzer ’13
Faculty Mentor: Professor Brandon Vogel, Chemical Engineering
Mesoporous Silica Coated Polylactic Acid Nanoparticles for Targeted Drug Delivery
The overall purpose of this project is to successfully coat Polylactic Acid (PLA) nanoparticles with silica while still allowing for diffusion through the shell. These nanoparticles could be used for targeted and controlled release drug delivery. To accomplish this goal, a modified Stober method was carried out employing an ammonia catalyzed reaction between Tetraethyl...
orthosilicate (TEOS) and Polyvinyl Pyrrolidone (PVP) coated PLA nanoparticles. Scanning Electron Microscopy was used to characterize the resulting products from varying reaction parameters.

Stephen M. Brouse ’13
Faculty Mentor: Professor Katsuyuki Wakabayashi, Chemical Engineering

Polymer Processing by Simultaneous Solid-State and Melt-State Extrusion (SSMSE)

Production of commercial polymeric materials, such as neat and recycled plastics, polymer blends, and polymer nanocomposites, often rely on industrial-scale, continuous processing technique based on extrusion; kneading of the material in the melt state and subsequent shaping under pressure are the basic features of the simple, high-throughput process.

Recent technological advances in specialty polymers, polymer blends, and polymer nanocomposites call for processing techniques with higher capacities for vigorous mixing of the materials and effective exfoliation of dispersed components. An alternative TSE-based processing method is solid-state shear-pulverization (SSSP) [1,2], which applies high amounts of shear and compressive forces at temperatures below the melt and/or glass transition temperature of the polymer. This unique, industrially applicable technique has been shown to produce effective polymer blends [1] and nanocomposites [2] in the past, but can have several practical limitations such as low throughput, high cost of manufacturing, and tedious handling of finely powdered output.

This poster discusses the newly developed processing technique called solid-state/melt-state extrusion (SSMSE) which combines the features of the novel SSSP and conventional TSE techniques in one instrumental setup. The SSMSE process applies intense shear and pulverization in the initial chilled zone, and successively applies conventional melt-state kneading and homogenization in the subsequent melt zone. Preliminary results show that the SSMSE output of a model thermoplastic polymer run is in the form of uniform molten polymer strands, like that of typical TSE, and a throughput rate significantly higher than that of the equivalent SSSP process. Mechanical and thermal characterization of model polyethylene-organically modified montmorillonite nanocomposites show that the SSMSE-processed samples retain high thermal stability and good mechanical properties; in some cases, the mechanical behavior of the nanocomposite processed via SSMSE is more enhanced than those by other processing techniques (TSE alone, SSSP alone or SSSP followed by TSE).


Jeremy Byler ’12
Faculty Mentors: Professor Mary Beth Gray, Geology; Professor Robert Jacob, Geology

Geophysical Investigation of the St. James Fault Complex and Possible Implications for Karst in the Western Region of Nippenose Valley, Central Pennsylvania

The St. James Fault Complex in Nippenose Valley, Central Pennsylvania, is mapped as a folded, low-angle thrust fault separating Ordovician carbonate and clastic rocks (Faill and Wells, 1977; Lloyd and Carswell, 1981). Although the fault complex is not exposed at the surface within this doubly-plunging anticline, offset formation contacts require a 7.5 km long composite trace length with a maximum 150 m stratigraphic separation. The carbonate-bearing formations of the Nittany anticlinorium are known to be karstified, typically along fracture networks. Thus, we examined the extent to which karst is localized by the St James Fault Complex. We attempt to overcome the lack of surface exposure with multiple geophysical methods, such as ground-based gravity readings. Nearby limestone surface mines generate obfuscating seismic noise that required us to develop a new approach to collect both accurate and precise gravity data sets on both limbs of the anticlinorium using an auto-leveling, tide corrected gravimeter. We collected 50,000+ gravity measurements at 300+ locations, and report the average values, along with the respective 95 percent confidence intervals, at each location. Gravity readings with confidence intervals greater than ±0.020 mgal, were recollected to limit uncertainty. We used an RTK-GPS combined with OPUS-correction to measure the latitude, longitude, and elevation of each location with an accuracy and precision of ±0.05 m. The combination of high quality spatial information and the modified collection procedure lead to a majority of the gravity readings with precisions ±0.003 to 0.007 mgal. Modeling efforts are ongoing; however, these data clearly show a regional increase in gravity towards the fold hinge from the middle Ordovician clastic and carbonate formations to the lower Ordovician dolomites within the Bellefonte Formation. Local gravity deficits, typically ranging from 0.1-1.4 mgsals constrained within 10-80 m, will be used to model karst features within the anticlinorium. Our gravity survey clearly demonstrates that high resolution gravity data, in corroboration with complementary geophysical data sets, can be used to constrain the locations of the bedrock contacts and karst features within Nippenose Valley and allow us to confirm or adjust the location of the fault trace previously mapped.

Margo Cain ’13
Faculty Mentor: Professor Mitchell Chernin, Biology

Angiotensin II Differentially Regulates Annexin V and Glypican 6 in MC3T3 Cells and B16 Melanoma Cells

Mouse MC3T3 cells (non-cancerous) and B16 melanoma cells were transfected with a synthetic gene that expresses angiotensin II (Ang II) directly under the control of a CMV promoter. Previous studies using MALDI-TOF/MS identified several
candidate proteins for western blot analysis; Annexin V and Glypican 6 were chosen for further study. Annexin V is a member of a family of calcium-binding proteins and has been implicated as a regulator of several processes including cell adhesion and apoptosis. One of the earliest events in apoptosis is the externalization of phosphatidyserine (PS) which is translocated from the cytoplasmic side of the plasma membrane to the cell surface soon after the induction of apoptosis. The Annexin V protein has been shown to have a strong, specific affinity for PS. B16 melanoma cells showed a marked decrease in Annexin V expression whereas MC3T3 cells showed a substantial increase in expression. Glypican 6 is a glycosphingolipidinositol anchored heparin sulfate proteoglycan involved in cell growth and division. It is a putative cell surface co-receptor for growth factors, extracellular matrix proteins and proteases. Like Annexin V, Glypican 6 was down-regulated in B16 cells and up-regulated in MC3T3 cells. These results suggest that Ang II has specific growth effects which are differentially regulated in cancerous and non-cancerous cells.

Kelly Carver ’11, M’12  
Faculty Mentor: Professor Ryan Snyder, Chemical Engineering  
Uniform Monodisperse Crystals Via the Evaporation of Small Droplets  

Producing solid particles of controlled size and morphology is an integral step in many industrial solids processes in the food, personal care, and pharmaceutical industries. The purity, size, internal structure (crystalline vs. amorphous), surface roughness and morphology of a particle are all important characteristics known to impact the effectiveness of a solid product. Current industrial crystal formation is a multi-step process that requires the use of a crystallizer often followed by subsequent drying and particle reduction steps. This combination of processes is very energy intensive and costly because of the need for extra process time to accomplish each of the steps. A method which condenses the crystallization process could potentially aid in the advancement of crystal production technology. Several studies have recently been conducted on the production of highly uniform particles by evaporating monodisperse (evenly-sized) droplets in a modified spray drying setup. These studies show that this novel spray drying technique is successful at producing uniform amorphous particles; however, the possibility of producing uniform crystalline particles by this method has yet to be investigated. This research focused on utilizing a vibrating orifice aerosol generator (VOAG) to investigate the production of uniform, monodisperse succinic acid crystals. Control of particle characteristics was achieved by varying key operating parameters such as air flow rate and solvent. Scanning electron microscopy, x-ray diffraction, and nanoindentation were used to analyze the particle morphology, surface roughness, and internal structure of the resulting particles. Uniform succinic acid crystals were successfully produced in this study suggesting that monodisperse droplet evaporation is a promising method of crystal production.

Marie Chardon ’12  
Faculty Mentor: Professor David Dean, Psychology  
Change in First-year College Women’s Body Dissatisfaction in Relation to Drive for Thinness and Social Body Comparison and Risk for Body Dissatisfaction  

Researchers have identified a strong correlation between drive for thinness and social body comparison and body dissatisfaction, a robust risk factor for eating disorders; however, there is little understanding of how drive for thinness and social body comparison relate to increases in body dissatisfaction over time. To explore this relationship, I investigated how high initial levels of drive for thinness and social body comparison were correlated with changes in body dissatisfaction and ideal body over women’s first semester in college, a time period that is strongly correlated with an increased prevalence of eating disorders and body dissatisfaction. Body dissatisfaction is defined as dysfunctional, negative feelings and cognition about one’s weight and shape and ideal body is the body a subject identifies that they would like to be. Participants were 110 female, first-year women who completed baseline and follow-up questionnaires. High levels of drive for thinness at baseline were not significantly correlated with either changes in body dissatisfaction or ideal body. However, women with high initial levels of drive for thinness had significantly higher levels body dissatisfaction than women with low initial levels of drive for thinness. High levels of social body comparison at baseline were not significantly correlated with change in body dissatisfaction; however, they were almost significantly correlated with change in ideal body. Based on post hoc-tests, only individuals with low social body comparison seemed to change their preference and began choosing larger bodies (i.e. not those with high social body comparison). In addition, women with high initial levels of social body comparison chose significantly thinner ideal bodies than women with low social body comparison. Lastly, change in body dissatisfaction was significantly negatively correlated with change in ideal body. If replicated, I would hope these findings will help contribute to a better understanding of how women’s perception of their bodies changes over the course of their first semester in college and could inform interventions to address this potential risk factor for disordered eating.

Brian Charland ’13  
Faculty Mentor: Professor Jessica Newlin, Civil and Environmental Engineering  
Sediment Deposition Near Bridges in Pennsylvania  

Gravel bed streams across central Pennsylvania often have problems related to large quantities of transported bed material. The natural movement of sediment can be disturbed when bridge structures are placed across a stream channel or a channel is modified due to an infrastructure project. Observations of stream characteristics and qualities provide information that help find out why sedimentation problems are occurring. Many sites have large gravel bars and other deposits in their channels. The reason that bridge ways often have sediment deposits
under them is because the channel often is widened during construction to meet flood flow requirements. When the channel widens the water velocity decreases and sediments either stop moving or fall out of suspension because of the decreased shear stress in the widened channel. In the summer of 2011, the Pennsylvania Department of Transportation (PennDOT) district offices were contacted, to collect information regarding bridges with sedimentation problems that had been mitigated with stream restoration structures. From the information that was received from PennDOT, several sites were identified for further investigation. Field observations were gathered to describe the current condition of these sites. Based on field observations, the stream restoration projects were either successes or failures, depending on their ability to mitigate the stream sedimentation problems. Often, it was found that the restoration structure was buried by the sediment that it was designed to mitigate. Although some of the restoration structures did work by either focusing or redirecting flow, or stabilizing the banks. Based on this information we can better understand what kind of structures work in certain conditions and recognize trends that will help us improve the application of restoration structures to mitigate deposition problems at bridges in the region.

Catharine Cipolla ’14, Vincent Fasanello ’14, Taylor Haas ’14, Brooke Kania ’14, Maja Ostojic ’14
Faculty Mentors: Professor Marie Pizzorno, Biology; Professor Emily Stowe-Evans, Biology

Isolation and Characterization of 14 New Mycobacteriophages from Unique Soil Environments

This study is based on the work that was done by this year’s Phage Hunters class at Bucknell University through the HHMI SEA Program. Soil was extracted from a variety of environments, ranging from the Lewisburg PA graveyard to the remnants of a toxic waste field in Greenwich, CT. Mycobacteriophages, viruses that infect the bacterial host Mycobacterium smegmatis, were isolated via enrichment from these soil samples. After many rounds of plaque purifications, plaques of various morphologies were obtained, and with this, each student isolated a unique strain of a mycobacteriophage. The different phages were evaluated through restriction enzyme digestion and PCR analysis of genomic DNA, and transmission electron microscopy imaging of the bacteriophage particle. Each student extracted and purified DNA from their bacteriophage, and one phage was selected to have its entire genome sequenced. The class is currently annotating the genome sequence this semester. DNA of the bacteriophage selected, Breezona, was analyzed using bioinformatics and computer assessment in order to identify protein coding and tRNA sequences. All the information obtained has allowed the Phage Hunter’s class to characterize Breezona as a new bacteriophage in the L cluster, as well as determine specific genes in its genome that are closely related to other known genomes in the phage genome database.

Molly Clark ’12
Faculty Mentor: Professor Matthew McTammany, Biology and Environmental Studies

Effects of Thermal Stratification and Spring and Autumn Mixing on Vertical Profile of Water Quality in the McWilliams Reservoir at the Roaring Creek Tract of Weiser State Forest

We observed seasonal water quality changes in a reservoir located at the Roaring Creek Tract of Weiser State Forest. The reservoir is surrounded by mature second growth mixed deciduous forest and is used to provide drinking water for AquaAmerica customers in the towns of Mount Carmel and Shamokin. In addition, many people use the lake for recreational boating and fishing. This study was a yearlong observation of the effects of mixing and thermal stratification on the water quality and water chemistry within the lake. Measurements were taken and samples were collected fifteen times between 10 October 2010 and 5 October 2011 at the deepest part of the lake, which is located near the dam approximately halfway between the two shores. The depth at this location was generally around 14 m. We measured vertical profiles of temperature, dissolved oxygen, pH and photosynthetically active radiation by lowering calibrated electronic probes into the water column and taking readings every meter of depth throughout the water column. We also collected water samples and analyzed them for dissolved nutrients and ions, alkalinity, and chlorophyll biomass.

The lake showed strong seasonal patterns in water quality. During the year of our measurements, the water column of the lake turned over during October 2010 and continued mixing until the lake became covered in ice in early December 2010. Ice remained on the lake and caused inverse thermal stratification until mid-March 2011 when the lake turned over again and remained mixed until the onset of summer thermal stratification in May 2011. The water column remained stratified until mid-October 2011. Water quality varied according to vertical position in the water column when the lake was stratified but did not demonstrate much vertical pattern during periods of mixing. Oxygen concentration was highest near the surface of the lake and declined with depth in the water column, particularly below the thermocline. Light penetrated into the deep hypolimnion for most of the study period but eventually was extinguished at shallower depths near the end of the summer, after which the hypolimnion became anoxic. Minimal hypolimnmonic anoxia and intermediate concentrations of algae in the lake suggest that this reservoir is mesotrophic. Nutrient concentrations and alkalinity in the lake were generally low, reflecting minimal human impacts on the watershed and relatively inert sandstone underlying the basin. However, nutrient concentrations increased with depth during periods of thermal stratification, most likely from mineralization of nutrients from sinking plankton and organic matter accumulated on the lake bottom. Anoxic water in the hypolimnion of the lake caused ammonium to accumulate because oxygen was not available for bacteria to oxidize ammonium to nitrate (nitrification). While the lake was not overly productive, steps should be taken by DCNR and AquaAmerica to maintain ecological integrity of this lake to
preserve its value as a water source and recreational destination for users of Weiser State Forest.

Alexandra Clayton ’12
Faculty Mentor: Professor Matthew Travis, Biology
Variation in Posterior Neuromast Number in Three-Spined Stickleback

The lateral line system fulfills an extremely important function in both the lives of fishes and amphibians: the ability to detect stimuli in the water. Often described as a “touch at a distance system,” the lateral line system is comprised of hundreds of neuromasts that are distributed both cranially and throughout the length of the body that are similar in function and morphology to those in the auditory and vestibular system of vertebrates. Lateral line systems are well suited for studying how sensory systems have been shaped in the course of evolution to match the fishes’ sensory needs. We examined whether adaptive divergence in posterior lateral line morphology has occurred among several populations of threespine stickleback. We first characterized posterior lateral line phenotypes by counting the number of neuromasts on the left side of the fish. We measured fifty adult fish from eleven different populations living in various ecological conditions. We found extensive variation among populations in total neuromast number in the posterior lateral line. Variation among populations in neuromast number was related to the number of lateral plates on the stickleback. However, variation in neuromast number within populations was not explained by plate number. This indicates that posterior neuromast variation is influenced by the presence or absence of armor plates, but is unlikely to be the entire story. This research can help provide more insight into the processes that shape evolution in stickleback, and provide implications into how selection works on certain stickleback populations living in different environments.

Tricia Clyde ’13
Faculty Mentor: Professor Karen Castle, Chemistry
Vibrational Energy Transfer Between O Atoms and N₂O

The localized cooling caused by vibrational energy transfer processes involving O atoms can be related to changing atmospheric densities in Earth’s upper atmosphere. The determination of the rate coefficients for the N₂O-O interactions is also useful for studies of climate change and comparisons to rate coefficients of similar gases. In order to experimentally obtain these values, gas mixtures containing the subject gas, an O atom source, and bath gases are run through a 1m cell. A Nd:YAG laser beam simultaneously creates O atoms by photolysis of the O-atom source and excites the N₂O molecules into the bend excited state through a temperature-jump. Transient Diode Laser Absorption Spectroscopy is used to monitor the changing populations of molecules in the vibrationally excited states. The graphical representations of the vibrational relaxation under different quencher concentrations, taken from a LeCroy Wavesurfer 200MHz oscilloscope, were fit with SigmaPlot for quality control and then fed into a Global fit using a Levenburg-Marquardt least squares algorithm. The dependence of the relaxation rate versus the O atom concentration gives the value of the temperature-dependent rate coefficient. Updated progress on this experiment will be presented.

Christina Cody ’12
Faculty Mentor: Professor Gary Grant, Theatre and Dance
The Double Take Project: Using Applied Theatre for Campus Climate Change

Despite research gathered in the Campus Climate Report, I believe that it underrepresented the student experience of the social scene. The document primarily served as an identification tool for four major problems on campus: binge drinking, sexual assault, diversity, and disengagement in the classroom. Double Take Project also identifies similar issues, however this project uses theatrical techniques to gather the anecdotal reality of the student perspective. Double Take Project expands beyond the Campus Climate Report to inspire dialogue in a variety of student-to-student interactions and most importantly the project seeks action and solution plans.

The social scene dominates our culture and its many issues result in concern for the safety, self-identity, and development of Bucknell students into thriving adults. Double Take Project is rooted in the belief that theatre is a palpable tool for social change. Over the course of many events, Double Take Project has utilized facets of theatre to provide opportunities to voice discontent, widen perception of normalcy on campus, and inspire confidence to act on personal beliefs.

The Double Take Project used many Applied Theatre methods to impact the social scene. For example, I conducted 35 student interviews and transformed the stories into a one-woman show, Rage Behind Curtains, which I performed at multiple venues across campus. I also used interviews to create a radio show airing one story per day. I conducted ten workshops with student groups, Fraternities and Sororities, and in the classroom utilizing Augusto Boal’s Theatre of the Oppressed techniques. I also created a “social scene confessional” where I stood outside the Elaine Langone Center with a sign that read, “Tell me a story about the social scene” from a wide variety of Bucknell students. Finally, I have assembled a Forum Theatre Company based on Augusto Boal’s method of the spect-actor, utilizing participants as both actors and spectators in the theatre piece.

While planning events and conducting various theatrical experiences, I learned that there are a series of internal and external issues contributing to our social environment. Internally, students are conflicted with personal beliefs while battling outward social pressure. Whether they are on the outskirts or center of the social scene determines their response to this conflict. For example, I have discovered students on the borders of the social scene respond with criticism because they are already excluded, whereas the students centrally involved critique the culture in private and while their persona appears to not want change. Externally, there are many structural issues that contribute to the current social climate such as without Fraternity meal plans, Cafeteria space is not sufficient to feed all students, exclusive party culture, and gendered housing.
Through meetings with Deans and staff, I have learned there are also problems between administration and students, which result in resentment and blame. Although addressing structural issues would instigate immediate change, in my opinion, internal student conflicts are the primary cause for the current negative social atmosphere. I believe that pressure to conform is rooted in lack of personal identity. Because students simply do not know themselves, they form strong social groups that become the definition of themselves. Without confident self-awareness, large and powerful groups coerce students to accept social norms resulting in the individual’s outward distaste for change, yet internal discomfort.

Lucy Dean ’13
Faculty Mentor: Professor Elizabeth Durden, Sociology and Anthropology
Health Insurance Coverage Among Hispanic Adults: The Impact of Immigration

This research examines the disparities between Hispanic subgroups and health insurance coverage. Using data from the 2008 and 2009 National Health Interview, multinomial logistic regressions are performed to explore the main relationship between the independent variable “race/ethnicity” and the dependent variable “health insurance coverage”. Immigration is also considered a key component of this relationship. Demographic and socioeconomic variables are controlled. The results of the research illustrate that Mexican Americans and Other Hispanics in comparison to non-Hispanic whites are significantly more likely to have public health insurance or no health insurance at all than private health insurance. Cubans are not significantly different than non-Hispanic whites to have public health insurance coverage than private insurance.

Chelsea Dieck ’13
Faculty Mentor: Professor Ken Field, Biology
The Effects of Farnesyltransferase Inhibitor ABT-100 on T<sub>H1</sub> and T<sub>H2</sub> Differentiation and Cytokine Secretion in BALB/C Mice

Farnesyltransferase Inhibitors (FTIs) are a class of drugs known to prevent the farnesylation and subsequent membrane attachment of many intracellular proteins. In various studies, the administration of FTIs has been found to reduce inflammation as well as interfere with the activation and proliferation of B and T cells. This study focuses on the effect of the FTI, ABT-100 on the differentiation and cytokine secretion of Th1 and Th2 helper T-cells in BALB/C mice. This study is being done in efforts to try and understand how FTIs are acting as immunomodulators as well as which immune responses FTIs are specifically targeting.

Splenocytes were isolated from BALB/C mice, skewed towards either Th1 cells with the addition of IFN-γ, or towards Th2 cells with the addition of IL-4, and treated with various concentrations of ABT-100. Splenocytes were also isolated and immediately cultured in the presence of ABT-100 to observe differentiation trends of helper T-cells. Cytokine production was measured using flow cytometry analysis and ELISA assays. Preliminary results show that Th1 and Th2 cells have been seen to decrease IFN-γ and IL-4 production respectively when treated with ABT-100. In addition, although research is still being conducted on helper T-cell differentiation due to ABT-100 treatment, initial results suggest that FTIs promote Th2 cell proliferation over Th1 cell proliferation potentially suggesting that FTIs favor Th2 immune responses over others.

Erin Donaghy ’12
Faculty Mentor: Professor Jeffrey Trop, Geology

Upper Paleocene-Eocene sedimentary and volcanic strata of the Arkose Ridge Formation exposed in the southern Talkeetna Mountains record fluvial-lacustrine deposition in a forearc basin modified by Paleogene spreading ridge subduction beneath southern Alaska. This is the first detailed study of the westernmost portion of the outcrop belt, which extends along the western flank of the Talkeetna Mountains and includes thick, well-exposed outcrops along Willow Creek in the eastern Susitna basin. New sedimentologic, compositional, and geochronologic data were obtained from stratigraphic sections within Arkose Ridge Formation strata at Willow Creek. This data combined with new geologic mapping and geochronologic data from Willow Bench and Kashwitna River Bluff (north of Willow Creek), and from the Government Peak area (east of Willow Creek), help constrain depositional processes and source terranes that provided detritus to the westernmost Arkose Ridge Formation strata.

Westernmost Arkose Ridge Formation strata unconformably overlie a granitoid pluton that yields Late Cretaceous U-Pb zircon ages (79-69 Ma; 74 total grains from three samples). Four lithofacies associations characterize the 467 meter thick Arkose Ridge Formation outcrop at Willow Creek: poorly sorted, boulder-pebble conglomerate with minor channelized sandstone (FA1); poorly to moderately sorted, cobble-pebble conglomerate with imbricated conglomerate and channelized sandstone (FA2); channelized sandstone with scours, cross-stratification, and carbonaceous debris (FA3); and basaltic-andesitic lava flows with massive bases and vesicular tops (FA4). Conglomerate detrital modes are dominated by volcanic clasts (60 percent of all clasts) and plutonic clasts (31 percent) with three granitoid clasts from FA1 yielding U-Pb zircon ages of Latest Cretaceous (81-69 Ma), early Late Cretaceous (89-82 Ma), and Early Jurassic to Latest Triassic (215-190 Ma). U-Pb ages of 189 detrital zircon grains in two sandstone samples reveal three main populations: Latest Cretaceous to Early Paleocene (85-60 Ma; 63 percent of all grains); early Late Cretaceous (100-85 Ma; 30 percent) and Early Cretaceous to Jurassic (200-100 Ma; 5 percent). Sparse Late Paleocene (59-58 Ma; 2 percent) detrital zircon ages represent the maximum depositional age of the Willow Creek strata. U-Pb ages of 160 detrital zircon grains from two Arkose Ridge Formation sandstone samples from the Government Peak...
area reveal a single Late Cretaceous (97–69 Ma; 100 percent) age distribution that overlaps Late Cretaceous U-Pb zircon ages (86-79 Ma; 24 total grains from one sample) obtained from an underlying granitoid pluton. New geologic mapping at Kashwitna River Bluff and Willow Bench documents Paleogene basaltic-andesitic lava flows that unconformably overlie the Cretaceous granitoid pluton and may be correlative with lavas exposed in the Arkose Ridge Formation along Willow Creek. Collectively, these new compositional and geochronologic data from Willow Creek suggest: (1) Sediment was deposited by debris flow, hyperconcentrated flow, and streamflow on high-gradient braided streams influenced by episodic volcanic eruptions. (2) Local Cretaceous plutons and Paleogene volcanic centers presently exposed in the southwestern Talkeetna Mountains were important sediment sources. (3) Deposition took place after ca. 59-58 Ma, consistent with 60-56 Ma isotopic ages reported from volcanic interbeds in other parts of the Arkose Ridge Formation outcrop belt. (4) Exhumation of Cretaceous granitoid underlying and exposed north of the Willow Creek section occurred by 59 Ma followed by subsidence coeval with erosion between 59-55 Ma.

The history of Paleogene uplift followed by subsidence documented in this study is consistent with the expected effects of spreading ridge subduction, a second order tectonic process that modified the region’s configuration and depositional processes from traditional forearc basin models. Paleogene subduction of young oceanic crust beneath the Cretaceous magmatic arc would prompt increased compressive stress, rock uplift, and unconformity development in the upper plate followed by forearc subsidence and sediment accumulation (Arkose Ridge Formation) during passage of a slab window and progressively older crust. Integration of geochronologic and compositional data from Willow Creek with previous studies in the southern Talkeetna Mountains provides insight on the complex lateral variations in provenance and depositional environments in a forearc basin during a well-documented episode of spreading ridge subduction.

**Laura Duffy ’13**  
**Faculty Mentor:** Professor Erin Jablonski, Chemical Engineering  
**Particle Encapsulation and Recovery in a Micro-Fluidic Device**  
The purpose of this project was to design and operate microfluidic devices capable of forming and recovering hydrophilic capsules from an organic phase. Microfluidic devices include channels that are of the order of 100 microns, and typical flow rates through these devices are of the order of μl/h to ml/h. Two microfluidic devices were used for this experiment and were arranged in series, the first being that which created the capsules while the second was used to passively recover them in an aqueous buffer. The configuration of two devices in series allows for continuous processing of the capsules. Capsules were formed in a device that used a flow-focusing geometry to form droplets of a hydrogel precursor in a continuous organic phase (sunflower oil). The capsule material was made up of a biocompatible hydrogels that required ionic crosslinking conditions for gelation. For these studies, capsules formed were on the micron-scale and were made of calcium-alginate and sodium carbonate that cured upon interacting with acetic acid. The flow rates of the oil, acid, and hydrogel were controlled to create the desired size capsule by increasing or decreasing specific flow rates. After formed, capsules were recovered into a biologically relevant aqueous buffer using a previously developed technique that allows for co-laminar flow of immiscible liquids and passive separation of the capsules. These devices require a specific geometry that was determined through prior investigation. Capsule formation of a variety of sizes was achieved, but separation proved difficult. There are many factors that contribute to successful separation that were unforeseen like orientation of inlet and outlet streams and pressure within the system. Further investigation is needed to achieve the goal and allow for the project to move forward towards encapsulation of an object (glass bead or cell) with in the capsules.

**Danielle Edwards ’12, Alex Kiefer ’12, Elizabeth Allen ’13, Alexa Hays ’12, Kara Pine ’12, Cameron Potratz ’14, Lauren Stentz ’12, Kailey Tindle ’15**  
**Faculty Mentor:** Professor David Dean, Psychology  
**Determinants of Health Behavior in College Students**  
**Background:** A topic of particular interest to many in the field of health psychology is the phenomenon of risk behavior in adolescence, and the factors that contribute to this behavior. For instance, the short and long term consequences of alcohol abuse, particularly binge drinking for college students make it an issue of grave public health and educational concern. Alcohol abuse is highly correlated with other health risk behaviors, particularly non-condom use for anal and vaginal intercourse. This research seeks to investigate the psychological and social factors related to party drinking and condom use. Researchers utilized the theory of planned behavior as a backdrop for the questions surrounding binge drinking and condom use in an attempt to determine how beliefs, attitudes and norms contribute to the use of condoms, and the occurrence of binge drinking.

**Sample:** The sample included a random sample of 165 students from Bucknell University. All participants were over the age of 18, and included students in their second, third, and fourth year at Bucknell University.

**Methods:** Participants were recruited through a randomized email contact list from the Registrar’s office. The survey was completed online. Participants received a recruitment email that contained a link to the web-based survey. The survey included information relating to current and prior behavior, demographics, background factors, attitudes, norms, self-efficacy, alcohol and condom use beliefs, and social desirability.

**Preliminary Analysis / Future Directions:** This is an ongoing study. Therefore, although we are in the analysis phase of the project, the analyses are not complete. We will seek to
determine whether certain factors measured by constructs such as the big five inventory, Social Desirability scale, Rosenberg Self Esteem Scale, Sensation Seeking Scale, and questions pertaining to beliefs about party drinking and condom use relate to risk behavior. In addition, we will determine whether demographic information, background factors such as mental health and individual differences, and current and prior behavior predict condom use and party drinking behavior and beliefs. We expect that this information will lead to improvements in the University’s efforts at keeping its students safe, and in the scientific understanding of decision making about health behaviors.

April Elling '13
Faculty Mentor: Professor Emily Stowe-Evans, Biology
Expression of Nostoc punctiforme Light Dependent Protochlorophyllide Oxidoreductase (LPOR) and Dark Operative Protochlorophyllide Oxidoreductase (DPOR) Subunits in Red and Green Light

Cyanobacteria are photosynthetic bacteria which rely on light harvesting antennae called the phycobilisome (PBS) to harvest energy for photosynthesis. The protein composition of the PBS can include red light harvesting proteins called phycocyanin (PC) or green light harvesting proteins called phycoerythrin (PE). Some species which contain both of these proteins are able to alter the ratio of PE to PC to best absorb the most abundant wavelength of light in a process called complementary chromatic adaptation (CCA). Nostoc punctiforme is a nitrogen fixing, type II chromatic adapter, meaning it can alter its PE to PC ratio in green light (GL) but cannot alter PC. All cyanobacteria, including those that use CCA to gather light, require Chl a to change the light to stored chemical energy. The penultimate enzyme in Chl biosynthesis, protochlorophyllide (Pchlide) oxidoreductase has two alternative forms, Dark-operative protochlorophyllide oxidoreductase (DPOR) and light dependent protochlorophyllide oxidoreductase (LPOR). LPOR, composed of one peptide encoded by por, requires light and NADPH while DPOR, composed of three subunits encoded by the chlL, chlN and chlB genes, does not require light. These two Pchlide reduction systems allow the cyanobacteria to synthesize the right amount of Chl in light altered conditions. It was my goal to assess the affect of light color, Red Light (RL) vs GL, on the expression of the chlorophyll synthesis genes por, chlL, chlN, and chlB in N. punctiforme. I hypothesized greater expression of the DPOR subunits encoded by chlL, chlN, and chlB in GL than RL and greater expression of the LPOR peptide encoded by por in RL than GL. Cultures were grown in either red or green light until they reached an optical density (A₅₀₀) of 0.7-1.5. RNA was isolated and semi-quantitative reverse-transcriptase polymerase chain reaction was performed for each subunit. mRNA levels were normalized with ribosomal RNA levels. chlLN and chlLB were not upregulated in GL over RL. Por expression was greater in RL than GL, but not at a statistically significant level. This indicates N. punctiforme does not regulate chlorophyll synthesis genes through the CCA system. Possibly N. punctiforme does not grow in locations that require regulation of its synthesis through CCA. Future experiments could include cloning a reporter gene into N. punctiforme in order to get slightly more sensitive readings on the chlorophyll synthesis genes’ expression.

Tyler Erhard '14
Faculty Mentor: Professor Christine Buffinton, Mechanical Engineering
Development of Sham Atherosclerotic Arteries for Verification of Computational Models

Atherosclerotic material is not homogeneous: main constituents include fibrous tissue, fatty deposits, and thrombus. Calcifications, regions of mineralized tissue similar to bone, often occur in more advanced lesions. Recent finite element modeling of coronary arteries with macro calcifications showed large stress concentrations that are sensitive to the calcification geometry and elastic modulus. Stress concentrations increased with increasing distance from the lumen of arc-shaped calcifications and with increasing calcification stiffness. Interestingly, stresses were much lower for circular calcifications. Verification of these modeling results is important as they may have implications for plaque rupture.

The study goal was to develop an artery sham mimicking fibrous and calcified plaque tissue for comparison with computational models. Numerous silicones were evaluated to match reported arterial material properties. The most promising, Ecoflex and Dragonskin (Smooth-On), and 10:1 and 20:1 preparations of Sylgard 184 (Dow Corning), were molded into dogbone shapes and tested in uniaxial tension. Results for low-strain tangent elastic modulus were 66 ± 18 kPa (Ecoflex), 2278 ± 3 kPa (Dragonskin), 475 ± 56 kPa (Sylgard 184 at 20:1), and 2580 ± 65 kPa (Sylgard 184 at 10:1). Polycarboxylate dental cement (Prime-Dent), with reported modulus values of 15-17 GPa, was selected to model the calcified regions. The molds for the calcifications and artery cross-section were created in Pro/ENGINEER and laser-cut from Delrin. When creating sham arteries, bonding between the two materials was optimized by first molding the dental cement into the desired shape and then pouring the silicone around the dental cement insert and allowing it to set following the manufacturer recommendation. The artery surface was covered with ink splatter and imaged while the lumen was loaded by balloon pressurization. Digital image correlation with a MATLAB program was used to track local deformations and create a surface strain map.

Due to the difficulty in obtaining human or animal atherosclerotic tissue with a range of components, very few modeling studies include experimental validation. This preliminary study presents a method for creation of realistic shams of atherosclerotic arteries to aid in model validation. Future work should incorporate additional materials, such as lipid, and evaluate the effects of anisotropic material properties. The bond between calcified and non-calcified regions of plaque is also important: experimental studies on real arterial tissue should be performed to determine the nature of the interface which can then be incorporated into the sham.
Elizabeth Fanning ’12  
**Faculty Mentor:** Professor Steve Jordan, Biology  
**Population Genetics of an Endangered Alpine Stonefly, Lednia Tumana**

Glacier National Park, located in Montana, has seen significant glacial loss over the past 100 years due to climate change. With the loss in glaciers comes a loss in habitats for many alpine insects, including the stonefly *Lednia tumana*, which relies on the glacial melt-water to survive. This stonefly was listed as a candidate species for the Endangered Species Act in 2011 (Muhlfeld et al., 2011). This is of importance for two reasons: stoneflies are key to the health of their communities, and they are significant of an entire ecosystem that depends on the cold and permanent water.

The aim of this work is to analyze the genetic diversity within the *Lednia tumana* species for two different mitochondrial genes: COI and Cytb. We have run PCR on 241 samples for both the COI gene and the Cytb gene. Of these, we were able to sequence 109 samples for the Cytb gene, and 77 samples for the COI gene. These two genes have been concatenated and the result shows very little genetic diversity. There are 16 haplotypes, all differing in just a single nucleotide from the dominant haplotype. There is one haplotype common in individuals from 1997 to 2005 that seems to have disappeared. Our data indicate a genetic bottleneck which has most likely been induced by climate change.


Joanna Freeman ’12  
**Faculty Mentor:** Professor Matthew McTammany, Biology and Environmental Studies  
**Biogeochemical Influences on Carbon Flow through Roaring Creek Watershed**

Biogeochemical processes acting at multiple spatial scales create dynamic temporal and spatial patterns of a variety of chemicals in stream networks — from atmospheric gases and particles to interactions between water, geology, and terrestrial ecosystems. For example, carbon can be dissolved in water as it percolates through organic material in soils. This dissolved organic carbon (DOC) is a combination of carbohydrates, amino acids, lipids, and even nucleic acids. The composition of DOC changes along hydrologic flow paths because bacteria preferentially metabolize simple sugars and utilize nutrient-containing molecules. As a result, DOC changes from labile to recalcitrant forms as water moves down a river network. DOC is a major energy source for bacteria in groundwater and hyporheic environments, which links DOC metabolism to processing of a number of other elements (e.g., N, P, S).

We determined patterns of DOC concentration and quality along a stream network that is influenced by reservoirs, groundwater and tributary inflows, and in-stream processing along the Roaring Creek Watershed. South Branch Roaring Creek flows through the Roaring Creek Tract of Weiser State Forest, 9000 acres of deciduous and pine/hemlock forest in Columbia and Northumberland Counties. Roaring Creek flows from east to west, and several small tributaries flow from the southern side of the watershed. The watershed contains 3 reservoirs, which from a biogeochemical perspective, presents a unique opportunity to study the influence of these major aquatic ecosystems on water chemistry patterns across the landscape. 20 sampling locations were chosen based on proximity to the two reservoirs and the stream. Nine of these sampling locations were shallow groundwater wells that were on average 4-7 feet deep. Water samples were collected during periods of base flow and storm flow from June 2011-February 2012 and filtered through glass fiber and membrane filters and analyzed for DOC and DON concentrations. Total DOC concentrations were compared with absorbance of DOC at 254 nm to calculate SUVA, specific UV absorbance, which measures aromatic content of DOC. At the same time water samples were collected, we measured temperature, pH, and conductivity to associate DOC with potential biogeochemical processes.

DOC concentrations showed distinct spatial patterns across the study sites, but these patterns varied seasonally. DOC concentrations decreased from the summer to the fall and winter seasons, while DOC quality increased from summer to fall. During summer, DOC concentrations were higher as a result of less water in the stream and potentially more groundwater input. The dry summer might also have prevented production of high quality DOC by leaching from organic matter in soils. As a result, the only DOC remaining in Roaring Creek during summer was lower quality. Rain in late summer and early fall combined with fresh leaf litter following leaf fall produced leachate with high DOC concentrations and large amounts of sugars. DOC concentration was higher below reservoirs but decreased from the top to the bottom of the watershed. Phytoplankton might be exuding sugars following photosynthesis, which would contribute highly labile DOC to sites downstream of reservoirs in Roaring Creek. The broader decline in DOC concentrations and increase of recalcitrant DOC along Roaring Creek likely resulted from microbial consumption of labile DOC forms and minimal contributions from groundwater to replace consumed DOC. Well transects showed a distinct variability in DOC concentrations from colluvium to stream water flow within yards of each other, providing an interesting look at shallow groundwater movement through the subsurface with regards to stream flow and labile groundwater low. DOC concentrations in colluvium wells were similar to each other. DOC concentrations in Roaring Creek were similar to wells in the middle of each transect, which suggests there is a lateral subsurface flow path of stream water through the riparian zone and back to the stream below the lower transect.
Lauren Geisel '14, Jean Rieuthavorn '14, Lindsay Robinson '14, Alyshia Scholl '14, Christine Sharp '14, Breeze Victor '14
Faculty Mentors: Professor Marie Pizzorno, Biology; Professor Emily Stowe-Evans, Biology

Isolation and Characterization of Mycobacteriophage Breezona

The Bucknell University Phage Hunters program worked this year to identify and characterize 14 unique, novel mycobacteriophage phage. Breezona was isolated from a soil sample in Brockton, Massachusetts using enrichment and direct plating. After direct plating, a pure high titer lysate of Breezona particles was produced and DNA was extracted for genome analysis. Other characteristics of Breezona include a bulls-eye plaque morphology, and TEM imaging revealed a long non-contractile tail and an icosahedral head. Breezona was sequenced by Virginia Commonwealth University through the 454 Pyrophosphate Sequencing methodology, and it was determined that Breezona was a member of the L2 cluster. Breezona’s genome has a high degree of homology with the genome of another mycobacteriophage Faith1. DNA Master, Apollo, and GeneMark TB were programs used to annotate the genome and identify nucleotide sequences that code for potential proteins and tRNAs. Breezona’s genome contains 132 protein coding genes and 12 tRNA genes. Each gene was annotated separately by multiple class members and confirmed by a group consensus. Additional features of Breezona’s genome will be presented.

Adriana Golding ’12
Faculty Mentor: Professor Matthew Heintzelman, Biology

Identification of Myosins Involved in the Actin-myosin Motility System of the Marine Diatom Phaeodactylum tricornutum

Diatoms employ a unique form of cell locomotion known as gliding. A current model suggests that the cytoskeletal proteins actin and myosin mediate this form of motility. This model suggests that a complex of membrane-associated proteins forms an indirect connection between myosin and the adhesive mucilage that connects to the substrate. Myosin then mediates the rearward translocation of this protein complex by traveling along actin filaments localized near the cell cortex. A traction force is thus generated by myosin that propels the diatom forward over its substrate. In order to support or redefine this proposed mechanism, the normal expression of several diatom myosins will be impaired using RNA interference. Diatoms will be transfected with anti-sense myosin constructs, screened by phleomycin selection, subcloned, and assessed for knockdown efficiency by molecular analysis (PCR) and quantitative protein expression (western blot). Work is ongoing to produce anti-sense constructs and inverse repeat sequences against other myosins that may be employed in the actin-myosin motor system.

Alexa Hays ’12, Elizabeth Allen ’13, Danielle Edwards ’12, Alex Kiefer ’12, Kara Pine ’12, Cameron Potratz ’14, Lauren Stentz ’12, Kailey Tindle ’15
Faculty Mentor: Professor David Dean, Psychology

Determinants of Health Behavior in College Students

Researchers: Risk behavior on college campuses is ubiquitous—and, unfortunately, not inconsequential. For instance short- and long-term consequences of alcohol abuse, particularly binge drinking, for college students make it an issue of grave public health and education concern. The inability to effectively reduce behaviors like problem drinking and increase behaviors like condom use in college students suggests that we have not yet adequately addressed how students make the decision to drink to excess. With this study, we hope to identify the beliefs that contribute to the reasoned, yet not necessarily rational, approach to behaviors like binge drinking. We administered a pilot questionnaire to undergraduate students to elicit their salient beliefs, particularly regarding behavioral outcomes, normative referents, and control factors, on party drinking and condom use. At Time 1, participants (N = 165; mean age = 20.3 years; n = 113, 68.5 percent female) completed an electronic questionnaire on measures of psychological and behavioral constructs. The questionnaire data consisted of quantitative demographic information and open-ended responses to questions on alcohol use (referred to as “party drinking”) and condom use. The responses were coded using standard qualitative coding procedures. The researchers coded all of the qualitative data individually before coming together in pairs and re-coding with agreed-upon codes. All of the coded responses were reviewed for a third time by eight researchers who compared the two previous coding sets, noted any discrepancies and corrected them, and a finalized list of codes was developed for each construct.

Since this study is ongoing, all of our data has not been analyzed yet; however, we have an analysis plan. The qualitative data will be analyzed to determine the most frequent beliefs associated with attitudes, norms, and perceived behavioral control regarding alcohol use and condom use. Some of our preliminary analyses have yielded interesting results. Many of our participants responded that pregnancy prevention (88.5 percent) and the prevention of sexually transmitted infections (78.2 percent) are two major advantages of using condoms, while “reduced pleasure” was the most frequently cited disadvantage of condom use (37.6 percent). When the participants were asked who they thought would approve of condom use, the most frequent responses were “family” (42.4 percent), “friends” (31.5 percent), and “everyone” (30.3 percent). In addition, we will look to see if beliefs differ based on specific demographic variables, such as gender, class year, Greek participation, athletics and race/ethnicity. For example, we found that an overwhelming majority of female participants said pregnancy prevention was the primary advantage of condom use (90.3 percent). Participants also responded that “significant others/partners” would approve of condom use, but the frequency of this response declined as a function of increased age (Sophomores = 16.4 percent, Juniors = 8.3 percent, Seniors = 5.4 percent). We are currently
In order for the substrate to reach the active site two alpha helices must be separated. Site-directed mutagenesis was used to obtain the T259C S545C mutant. Experiments have been done with oxidizing agents to induce a disulfide linkage between the two cysteine residues, but it appears that this reaction is unfavorable. In order to simulate the formation of a disulfide linkage, the mutant enzyme was incubated with a linking molecule, 2,3-Dibromomaleimide (DBM). A control reaction was conducted using N-ethylmaleimide (NEM) to determine if the presence of a molecule similar to DBM would affect the rate. NEM did not decrease the rate of reaction for the mutant or wild type enzyme. Incubation with DBM decreased the rate of reaction for the mutant enzyme by approximately half, but had no impact on the rate of the wild type enzyme. In order to determine if DBM was reacting with one of the thiols, linking both thiols or reacting with each thiol individually. Determining the effect of linking the two alpha helices in front of the active site and preventing the separation of these strands is important for understanding the mechanism through which soybean lipoxygenase binds substrate.
Currently, two modal analysis methods are available for obtaining estimates of the modal parameters of an as-built structure: Experimental Modal Analysis (EMA) and Operational Modal Analysis (OMA). Experimental modal analysis requires the measurement of both the input excitation and output response during a controlled test. The algorithms applied to this data in EMA are relatively straightforward and the results typically have a high level of accuracy. However, the applicability is occasionally limited because controlled excitations on large structures are hard to achieve. Operation Modal Analysis requires only the output response to be measured, assuming an ambient excitation. It can be applied to a wide range of large structures and the testing setup is easier than for EMA. However, because the method is based on some assumptions, the accuracy of the results is less reliable. In addition, although the algorithms of OMA are well documented, the software to apply the algorithms is complicated because it usually integrates several algorithms. An understanding of the algorithm utilized in the software is important in achieving confidence in the OMA results.

One of the most common algorithms employed for OMA is Frequency Domain Decomposition (FDD). This algorithm was studied and subsequently applied through a Matlab script in this research project. The algorithm transforms the time domain data into a power spectrum and decomposes into singular values so that natural frequencies can be identified from peaks in the frequency domain. To verify the accuracy of the programmed algorithm, OMA was applied to raw data collected from a cantilevered laboratory test structure. The obtained modal parameters were compared with the modal parameters determined from EMA. The comparison verified the relative accuracy of the OMA algorithm and enables its future application to other structures where the modal parameters are unknown. The continuation of this research involves applying the OMA algorithm to data from an occupied structure and analyzing how the modal parameters of the structure are impacted by human occupancy.

Ariel Hughes ’13
Faculty Mentor: Professor Christopher Mordaunt,
Mechanical Engineering
Liquid Fuels as an Alternative for Standard Combustion Fuels

Alternative fuel combustion is a widely researched topic in the field of engineering. This past summer I participated in a study where we experimented with an emulation fuel consisting of methane (CH₄) and varying concentrations of carbon dioxide (CO₂) to simulate a gaseous bio-mass fuel. Additionally, we finalized the design of a new liquid fuel injector for the atmospheric combustor in the Combustion Research Lab (CRL). Three-dimensional SolidWorks models were developed, and the injector system was constructed and tested. Several support systems had to be designed, specified, and installed to ready the apparatus for liquid fuel experiments. Specifically, an emergency shutoff valve, and atomization air supply system were installed and tested. Several pressure transducers and thermocouples are set up in various locations and measurements are collected using LabVIEW data acquisition software. An emissions sampling unit is set up to collect and read harmful pollutant emissions such as CO (carbon monoxide), NOₓ (nitrogen oxides), and SO₂ (sulfur dioxide). Future work includes further testing of various aviation fuels such as JP-8 and JP-900 to better understand our data so that we may build predictive trends to compare to a known standard. Also, it is our hope to test these models further in a similar high-pressure, high-temperature model gas turbine system at the Propulsion Engineering Research Center at The Pennsylvania State University.

Ken Inoue ’14, Judy Anne Romero ’14
Faculty Mentors: Professor Marie Pizzorno, Biology; Professor Emily Stowe-Evans, Biology
Isolation and Purification of Avant-garde Mycobacteriophages and Further Analytical Investigation of “Breezeza”

Bacteriophages are viruses that infect bacteria. Ranging from medical to industrial uses, bacteriophages are a part of a new scientific field with a plethora of potential applications. The 14 novel bacteriophages were individually isolated from enrichment and direct plating methods using the host, Mycobacterium smegmatis. Using plaque purification techniques, each member of the class was able to purify a novel bacteriophage and harvest high titer lysates, which were used to discover phage plaque morphology and characteristics. Utilizing Transmission Electron Microscopy (TEM) and restriction enzyme analysis of genomic DNA, each bacteriophage was characterized further. In particular, the genome from the bacteriophage, “Breezeza” was sequenced and is currently being annotated using computer analysis and comparison with other DNA sequences available in the online resource Genbank.

Stefan Ivanovski ’12
Faculty Mentor: Professor Geoffrey Schneider, Economics
Exploring Worker Cooperative Models for Sustainable Local Economic Development in the U.S.

The economic and financial crisis of 2008 has severely affected both economically developed and developing regions of the world. Some of the consequences of the economic and financial crisis of 2008 for the U.S. and much of the rest of the world have been: slower economic growth, increasing unemployment, rising inequality and growing poverty (ILO 2011). The purpose of this research paper is to probe the theoretical and practical possibilities of using the worker cooperatives, as local socioeconomic actors, to revert the negative effects of the economic and social crisis on a community level that is currently affecting many regions in the U.S. In other words, the aim is to research how the worker cooperatives can contribute to sustainable local economic development. For the purposes of this research, sustainability will refer to economic “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Robertson 1999, 1).

The term “sustainable” economic development applies to the potential of the community to preserve and create jobs on a continual basis, even in times of socio-economic depression, lack of capital and investments. The research will focus
more specifically on the United States; however there will be comparisons with study cases from Argentina and Spain. The study case from Argentina will include an analysis of the worker’s take-over of enterprises and factories after the social, economic and political crisis that affected Argentina in 2001. The study case from Spain will focus on the experiences of the Mondragon Cooperative Corporation (MCC) in the current economic crisis and how both of these models can be applied to the U.S. to promote local economic development with a focus on responsibility to social and community needs.

Leonard Joseph ’13
Faculty Mentor: Professor John T. Ptacek, Psychology

Perceived Stress and Multidimensional Burnout in College Students

Psychological burnout drains a person of their psychological and physiological resources as a result of prolonged stress (Maslach & Schaufeli 1993; Schaufeli, Leiter, & Maslach 2008). This relationship has been demonstrated in a variety of contexts (Neumann, Finaly-Neumann, & Reichel 1990; Raedeke, Lunney, & Venables 2002; Simoni & Paterson 1997). Dispositional variables such as types perfectionism and coping as well as inadequate motivation have been shown to influence the stress-burnout relationship (Brummellhuis, Hoeven, Bakker, & Peper 2011; Wallace, Lee, & Lee 2010; Zhang, Gan, & Cham 2007). The present study attempts to enhance the literature on stress and burnout in academics using a prospective design to test for contributions of these variables in predicting multidimensional burnout directly, as well as to detect the influence of these variables on the stress-burnout association. Data from 39 undergraduate students enrolled in a summer college course were collected using self-report measures at three different times throughout the summer. Results showed that dimensions of burnout were independently associated with adaptive perfectionism, avoidant coping, amotivation, and perceived stress. Regression analysis found strong effects for the influence of both forms of perfectionism and avoidant coping on the predictive strength of stress on two dimensions of burnout. This study demonstrates that the stress-burnout construct is complex and should be investigated with the inclusion of multiple predictors. Furthermore, the construct may be variable across differing contexts.

David Kashan ’13
Faculty Mentors: Professor Warren Abrahamson, Biology; Professor Mizuki Takahashi, Biology

Age of Saw Palmettos, a Foundation Clonal Plant, in Archbold Biological Station, Florida

Conservation planning tends to be focused on endangered species with little regard to more prevalent foundation species. Saw palmetto, Serenoa repens, is a foundation clonal plant of prime importance to a myriad of organisms in many Southeastern US ecosystems. Although development of an appropriate management plan for Serenoa is critical, we lack some of the fundamental life-history information including longevity of Serenoa genets. A recent study from our laboratory estimated the genet age to be approximately 1227–5215 years. However, the small study plot size (20 x 20 m) may have led to an underestimation of the genet’s age. The current study expanded the plot size to 80 x 80 m, allowing for a more accurate age assessment. We are utilizing Amplified Fragment Length Polymorphism (AFLP) fingerprints to reveal the clonal structure and genet ages of saw palmettos obtained from Archbold Biological Station (27°10’59”N, 81°21’24”W), south of Lake Placid, Florida. Based on the results from the previous study, we predict that some genets are more than 10,000 yrs old. Land clearing for agriculture, construction of golf courses, housing development, and numerous other human disturbances are causing a rapid decline in populations of saw palmettos on Florida’s Lake Wales Ridge. The findings of the present study will reveal the longevity of the genets, thereby exposing potential consequences of continued human encroachment on saw palmetto and the plethora of species whose survival depends on it.

Hallie Kennan ’12
Faculty Mentor: Professor Peter Wilshusen, Environmental Studies

Composition of Bucknell’s Waste Stream and It’s Contributing Factors

This presentation will discuss my results and conclusions about Bucknell’s waste stream and recycling behaviors. My research intends to answer three questions: The first asks, what Bucknell’s waste stream looks like? During my summer internship with the Environmental Center, I designed a campus-wide waste audit procedure, which sampled eleven campus dumpsters to better understand Bucknell’s waste composition. The audit was implemented during the Fall semester of this school year. The waste from each dumpster was sorted into several recyclable and nonrecyclable categories and then weighted individually. I will present my results from the waste audit at the symposium. My second question asks what influences Bucknell’s waste stream to be what it is? To answer this question, I created a survey to be sent out to a randomly selected group of campus members, which asks questions about their waste and recycling behavior, attitudes toward recycling, and potential motivators for their behaviors and attitudes. I used statistical analysis to evaluate survey responses, which helped determine what causes the waste stream’s components to be what they are. I will present my survey results at the symposium, explaining what significances and correlations between variables exist. My third question asks what Bucknell can do, given results from the waste audit and survey, to make the waste stream as efficient as possible? While I will not be able to actually implement any programs this semester, I intend to make suggestions for projects that future students may take on for summer or thesis research.
**Brennen Kim ’12**  
**Faculty Mentor:** Professor Amy Wolaver, Economics  
**The Impact of Weekend Admissions on Patient Outcomes by Race**

Using 2009 inpatient discharge data from Pennsylvania collected by the Pennsylvania Health Care Cost Containment Council (PHC4), I compare the magnitude of the weekend admission effect (weekends versus weekdays) on patient outcomes by race. The literature shows that outcomes are worse for weekend admissions than for weekday admissions; I test whether this effect differs between White non-Hispanics versus Hispanic patients for three particular patient diagnosis groupings (cardiovascular, respiratory, cancer). Measurements of patient outcomes focused on in-hospital mortality, total charges excluding professional fees, and length of hospital stay.

I found disparities in average total charges between racial groups ($44,065 Whites; $49,913 Hispanics), and a larger drop in average total charges from weekdays to weekends for White patients ($8,552 Whites; $5955 Hispanics). Analysis of total charges was in line with most other related healthcare research. Additionally I observed that both racial groups had longer lengths of stay for weekday admissions, while Hispanics averaged shorter stays for all admissions. Regression analysis also showed higher mortality rates for Whites in general, and on weekends, which is not commonly found in healthcare research. My analysis of mortality rates was most contrary to related studies, as I found that Hispanic patients had lower mortality rates than White patients, and those rates actually decreased on weekends.

**Jaclyn Kirna ’12**  
**Faculty Mentor:** Professor Lori Smolleck, Education  
**The Investigation of the Ways in Which Gender Stereotypes are Perpetuated Through Questioning and Assessment Strategies in Inquiry-Based Science Classrooms**

The purpose of this study was to investigate the questioning strategies of preservice teachers when teaching science as inquiry. This research analyzed the questions that preservice teachers asked in relation to the classification levels of Blooms Taxonomy. The goal was to determine if male and female students are being provided with equal opportunities to use higher order thinking skills in science classrooms. The concern for making sure that preservice teachers at the elementary level are incorporating higher-order thinking skills within their inquiry-based teaching strategies becomes critical when considering ways that teachers can help to close the gender gap in elementary science education. The guiding questions for this research were: In what ways do the questioning strategies of preservice teachers differ for male and female elementary students when teaching science as inquiry and how is Bloom’s Taxonomy evident within the questioning strategies of preservice teachers?

Data was collected from 8 preservice elementary teachers (7 female, 1 male) during their senior year student teaching experience at a university in central Pennsylvania. Of these student teachers, one taught at the kindergarten level, five taught at the second grade level, and two taught at the fifth grade level. We viewed numerous videotapes of preservice teachers teaching science as inquiry within elementary science classrooms. These tapes were the basis of our research as we analyzed the types of questions each participant asked, to determine how often the questions were asked to male versus female students, what type of question each would classify as according to Bloom’s Taxonomy and whether the questions differed in content and complexity. In total, forty-two lessons were analyzed. Furthermore, data was also analyzed in relation to grade level in an attempt to determine if differences in questioning strategies existed among grade levels. Examination of the data indicated that participants asked a total of 4,158 questions to their elementary aged students. Of these questions, 974 (23 percent) were asked to boys, and 991 (24 percent) were asked to girls. The remaining questions (53 percent) were asked to the class as a whole, therefore no gender could be assigned to these questions. In relation to Bloom’s Taxonomy, 74 percent of the questions were basic knowledge, 15 percent were secondary comprehension, 2 percent were application, 4 percent were analysis, 1 percent were synthesis, and 3 percent were evaluation.

Data analysis from this study revealed patterns in the overall data, as well as according to grade level. Conducting these two separate analyses made it possible to investigate the overall findings, as well as the impact grade level may have had on the types of questions the participants asked according to the classifications of Bloom’s Taxonomy. Overall, the findings of this research reveal approaches to teaching science that were implemented by the participants. This research may assist researchers, teacher educators, administrators, in-service teachers, and preservice teachers in better comprehending effective approaches teachers can and should be using to help close the gender achievement gap in science education. This data, paired with research on gender disparities in science education will provide insight as to the progress preservice science teachers are making towards a more reform-based approach of teaching science as inquiry, which simultaneously addresses the strengths of both male and female students as well as their prior experiences with science.

**John Kyle Kissock ’13**  
**Faculty Mentor:** Professor Jeffrey Trop, Geology  
**Sedimentary Record of Late Paleocene-early Eocene Exhumation Along the Inboard Margin of the Chugach Accretionary Prism: Stratigraphic and Geochronologic Evidence from the Chickaloon Formation, Northern Chugach Mountains, South-Central Alaska**

The geology of southern Alaska is defined by a complex assemblage of magmatic belts, sedimentary basins, and accretionary prism strata that record construction of juvenile continental crust for the past 200 million years. Paleocene-Eocene sedimentary strata exposed in the northern Chugach Mountains record deposition in a remnant forearc basin between a remnant magmatic arc and an exhumed accretionary prism. Previous studies centered on the northern, arcward
margin basin fill, whereas southern strata exposed adjacent to the accretionary prism are largely unexplored. New geologic mapping, sedimentological data, and geochronological data provide improved constraints on the depositional environments, provenance, and depositional age of southernmost outcrops of the Chickaloon Formation.

Measured bed-by-bed stratigraphic sections spanning the Chickaloon Formation at Nelchina Glacier and Glacier Creek document conglomerate, sandstone, mudstone, and sparse tuff. Lenticular beds of fine to very coarse grained sandstone and poorly to moderately sorted pebble-granular conglomerate record subaqueous deposition in shallow, low-sinuosity channels and bars by streamflow, hyperconcentrated flow, and debris flow. Subordinate carbonate mudstone with plant fossils records suspension fallout and pedogenesis. In the Glacier Creek area, lithofacies fine northward from exclusively alluvial conglomerate and sandstone along the Border Range fault to interbedded conglomerate, sandstone, mudstone, and tuff within a few kilometers north of the fault. Newly discovered bentonites at Nelchina Glacier and Glacier Creek yield U-Pb zircon ages of 54.2±1.4 Ma (10 spot analyses) and 53.9±1.9 Ma (7 spot analyses), respectively. Integrated detrital zircon geochronologic and compositional data provide insight on sediment provenance. The sampled strata contain abundant metasedimentary detritus, chiefly black argillite, mudstone, and chert, and subordinate mafic-intermediate volcanic and felsic plutonic clasts. U-Pb geochronologic analyses of >800 detrital zircons from eight sandstone samples of the Chickaloon Formation, older segments of the accretionary prism (McHugh Complex), and younger segments of the accretionary prism (Valdez Group) reveal two distinct age populations. Samples of the Chickaloon Formation and older segments of the McHugh Complex exhibit a narrow range of Early Jurassic to Early Cretaceous ages, whereas the Valdez Group yields a wider distribution of detrital ages, including chiefly Early Jurassic to Late Cretaceous grains and subordinate Paleozoic and Precambrian grains. The detrital age spectra, together with northward lithofacies transitions and compositional data, indicate that detritus was eroded from the McHugh Complex and to a lesser extent, adjacent Jurassic volcanic-plutonic rocks of the accreted Talkeetna arc. Targeted geologic mapping confirms an unconformable contact between the Chickaloon Formation and metasedimentary rocks of the accretionary prism in the Nelchina Glacier area, consistent with subaerial exposure of the prism prior to deposition of the Chickaloon Formation. Prism strata were deposited, underplated, metamorphosed, and subaerially exposed between 75 and 54 Ma based on the youngest cluster of detrital zircons in the prism strata and the age of tuff within the overlying Chickaloon Formation.

Integration of these new geochronologic, sedimentological, and mapping datasets provides robust evidence for subaerial uplift and erosion of the accretionary prism onto northward-dipping alluvial environments by 54 Ma. Regional uplift and associated synogenic sedimentation during early Eocene time is consistent with tectonic models that predict transpressive shortening in response to subduction of a spreading center beneath southern Alaska from ca. 59-50 Ma.

Joshua Kurtz ’12
Faculty Mentor: Professor Indranil Brahma, Mechanical Engineering
Particulate Analysis of Transient Diesel Emissions

The Environmental Protection Agency (EPA) is responsible for placing restrictions on emissions from diesel vehicles. At present, it governs the level of NOx and SOx emissions and the total mass of particulate emission. Diesel vehicles conform to these regulations by producing relatively low amounts of particulate emissions during steady state operating conditions. Under transient operating conditions, periods of heavy acceleration under load, however, certain diesel engines demonstrate a large increase in particle exhaust matter far in excess of either steady state boundary condition. [2] This is of concern because exposure to particulate emissions, particularly those below a diameter of 2.5 μm, is directly correlated to a high occurrence of cardiovascular morbidity. [1] The objective of this research project was to prove by elimination that spikes in transient particulate emissions from diesel engines are created by the use of variable geometry turbochargers. Using an opacity meter, a device which measures emissions based on the amount of light absorbed, the percentage of particulate matter in the exhaust of a non-turbocharged engine was identified. It was found that transient particulate emission was not significantly higher than particulate emission at the steady state boundaries, confirming by process of elimination that the variable geometry turbocharger is largely responsible for spikes in particulate pollution. Cited Sources: [1] Brook, J., Pope, A. Rajagopalan, S., Brook, R., Leupker, R., Hong, Y., Holguin, F.,Diez-Roux, A. Bhatnager, L., Smith, Sidney., Siscovick, D., Peters, A. Mittleman, M., 2010, “Particulate Matter Air Pollution and Cardiovascular Disease,” Journal of the American Heart Association, pp. 2331-2378. [2] Filipi, Z., Hagenia, J., Fathy, H., 2008, “Investigation the Impact of In-Vehicle Transients on Diesel Soot Emissions,” Thermal Science, Vol. 12(1), pp. 53-72.

Carmen Lamancusa ’12
Faculty Mentor: Professor Tim Raymond, Chemical Engineering
Ambient Aerosol Sampling: A Novel System for the Collection Aerosols for Cloud Condensation Nuclei Activity Analysis

As the need for more accurate climate models increases it becomes increasingly important to have a better understanding of how aerosols influence cloud formation, as clouds play a significant role in the predictions made by these models. In our research we set out to acquire a better understanding of how ambient aerosols influence cloud formation. Considering the nigh limitless combinations of shapes and compositions, we decided to take samples directly from the ambient air. In order to maximize the number of sample locations we constructed two mobile carts that would house all of the equipment required for sampling and an external power source. Our sampling procedure utilized a Condensation Particle Counter and Differential Mobility Analyzer in conjunction with a Cloud
Condensation Nuclei Counter. This allowed us to calculate the fraction of the particles that were acting as condensation nuclei within a given size range. Then based on the results of this data we were able to begin drawing correlations between locations and their relative impact on the formation of clouds in the region.

Noel Lampazzi ’13
Faculty Mentor: Professor Mizuki Takahashi, Biology

Promoting Amphibian Conservation Through College Classroom: Detection of Batrachochytrium dendrobatidis Among Local Amphibians

Animal taxa are in world-wide decline and the most disturbing negative trends are being found in amphibian populations. The fungal pathogen Batrachochytrium dendrobatidis (Bd) has been implicated by numerous recent studies as one of the major factors driving amphibian declines. Although the scientific community has gathered wide-ranging data on the global distribution of Bd, there remains a need for higher resolution data, especially in largely unsampled areas such as the Northeastern United States. For this study a group of mostly undergraduates in a Bucknell University upper level Amphibian Biology course collected samples from terrestrial, stream, and pond species in Central Pennsylvania in order to assess the prevalence of Bd among six local amphibians in each habitat. We ran PCR assays on extracted DNA from our samples to detect Bd and found infections in a small percentage (5.6 percent) of the sampled N. viridescens populations, with no infections in any of the other five species, suggesting low Bd prevalence among studied species in Central Pennsylvania. Yet, it is vital that the presence and prevalence of Bd continue to be monitored at a regional level as Bd prevalence can change spatially over time. We encourage other institutions to take advantage of undergraduate workers in this pursuit: while contributing to the expansion of Bd distribution data, undergraduates can use this opportunity to learn more about key environmental and conservation issues, especially in the realm of amphibian declines.

Alex Liggett ’13 and Nguyen Vo ’14
Faculty Mentor: Professor Michael Gross, Chemical Engineering

The Effect of Vanadium Deficiency on the Catalytic Degradation of Solid Oxide Fuel Cell Electrodes

The electrochemical performance of strontium-doped lanthanum vanadate (La$_x$Sr$_{1-x}$V$_2$O$_6$ for x=0.90, 0.95, and 1.00) electrodes for use in Solid Oxide Fuel Cells (SOFC) was investigated. The effect of vanadium stoichiometry on the catalytic degradation of palladium (Pd), platinum (Pt), palladium-cesia (Pd-CeO$_2$), platinum-cesia (Pt-CeO$_2$), and copper-cesia (Cu-CeO$_2$) catalysts was determined under SOFC operating conditions. Catalytic poisoning was most severe when the electrodes were exposed to air at fuel cell temperatures (~700°C). Poisoning of the catalyst significantly decreased with both an increase in vanadium deficiency and the addition of cesia. The highest performing electrode included a Pt-CeO$_2$ catalyst and the lowest performing electrode contained a Cu-CeO$_2$ catalyst. The poor catalytic activity of Cu-CeO$_2$ appears to be related to the morphological restructuring of Cu during exposure to cycles of oxidation and reduction.

Yang Lu ’14, Evan Shemonsky ’13
Faculty Mentor: Professor Katsuyuki Wakabayashi, Chemical Engineering

Biodegradability Measurement in Polymers and Polymer Nanocomposites

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 [1]. Pure forms of bio-based polymers often exhibit undesirable physical properties, and thus incorporating small amounts of nanoscale fillers, such as layered silicates (clay), into the biodegradable polymer matrix is considered as an alternative. [1] W. Amass, A. Amass, B. Tighe, Polymer International, 47, 89 (1998).

There is a scientific and industrial interest in properly and systematically characterizing the rate of bio-degradation in these polymer-based materials, so as to establish a standard measurement technique to compare the “biodegradability” of different materials.

We have recently built and in-house instrumentation to measure the biodegradability of polymeric samples based on ISO standard 14855-2 [2]; the test models aerobic biodegradation of plastic materials in a composting soil environment. The instrumentation involves a warm composting environment at 60°C, a constant moist air flow, and measurement of the carbon dioxide concentration from the degraded plastics. [2] International Organization for Standardization, 14855-2 (2005).

This poster presents the underlying theories behind aerobic digestion via composting, the evolution of the instrumentation setup, and preliminary results from a study involving polylactic acid, a typical biodegradable natural polymer.

Alexander Lunde ’12
Faculty Mentor: Professor Mary Beth Gray, Geology

Progressive Deformation at the Allegheny Front: A Study of Structural Geometry, Associations, and Kinematics, Lycoming County, Pennsylvania

This study defines the structural associations observed in three separate outcrops adjacent to PA Route 44 and the Pine Creek Rail Trail, Lycoming County, PA. Cross-cutting relationships between structures and the relative orientations of similar structures in separate outcrops are used to define stages of progressive deformation and inform their kinematic interpretations. The Upper Devonian Lock Haven and Catskill Formations contain orthogonal joints, wedge faults, regional and hand-sample sized folds, moderately dipping thrust faults, and conjugate wrench faults. These structures indicate a sequence of progressive deformation comprising three stages. Stage I
deformation includes layer-parallel shortening of rocks and development of orthogonal joints and contractional wedge faults. Stage II consists of rotation of Stage I structures on the limbs of regional folds and the formation of small parasitic folds. Stage III is characterized by fold modification by late breaking thrust faults and conjugate wrench faults. Conflicting shear sense from slickenfibers on wrench faults of similar orientation and multiple generations of slickenlines on some faults may be explained by reactivation of favorably oriented contractional, Andersonian faults formed after Stage II folding.

Similar to the findings of Spiker (1997) 25 km to the east of this study area, maximum shortening directions (MSDs) for each stage of progressive deformation indicate no significant rotation through time. This contrasts with counterclockwise rotation of MSDs in the western Pennsylvania Salient of the Appalachians (Nickelsen, 1988; 1996) and clockwise rotation in the eastern portion of the Pennsylvania Salient (Nickelsen, 1979; Gray and Mitra, 1993).

Jeff Madrak ’13
Faculty Mentor: Professor Michael Thompson, Electrical Engineering

Cloud Computing: I.T. for the Future

The primary focus of Cloud Computing is to take the next big step in the information technology sector, changing the way we think about computing, data, and data storage.

There are several different types of cloud computing creating this new shift. The most general model is Software as a Service (SaaS), providing software on demand for anyone with a computer and Internet connection. The next cloud-computing blockbuster is Infrastructure as a Service (IaaS), sending computing power and offering virtual networks and data storage directly through the Internet. Lastly, Platform as a Service (PaaS) offers a platform for developers to deliver web based applications.

This particular project involved assembling our own private Ubuntu Enterprise Cloud. The Ubuntu Enterprise Cloud is Ubuntu’s build of an IaaS (Infrastructure as a Service) offering. Throughout the setup process it became evident that there were several key parts of a cloud. The cloud was built on two main computers which acted as servers to cloud users on the local network. The heart of our cloud was the Node Controller, where virtual machine instances were instantiated, ran, and processed. The other server, which acted as the brain of the cloud, contained the rest of the main components such as the data storage component, the Cluster Controller, which allocated notes for virtual machine instantiation, and the Cloud Controller, providing an interface for cloud users, and managed running virtual machine instances. With both servers working together, a user on the same network of the cloud could start a virtual machine instance, connect to it, and use the clouds power and resources to accomplish almost any modern day computing task. The idea of outsourcing computing became a reality with our model.

The goal of this project was to learn more about the mysteries of Cloud Computing. Proven to be a thing of the future, Cloud Computing is already everywhere. Everyone with an Internet connection has been exposed to a cloud in some way, shape or form. To be able to apply cloud practices to University or classroom use with relative ease was the ultimate goal of this project.

Andrea Massa ’12, Nikki Shea ’12, Marie Chardon ’12, Aly Lebowitz ’12, Libby Munson ’12, Jenni Whalen ’12, Jessica Yingst ’12, Kristen Born ’13, Tricia Collins ’13, Tom Latosek ’14
Faculty Mentor: Professor William Flack, Psychology

Acquaintance Hook Ups, Alcohol, and Male Peer Support for Woman Abuse Are Related to Perpetration of Sexual Assault by Men

Previous research has demonstrated a significant association between sexual assault perpetration and alcohol consumption, rape myth acceptance, and hooking up (Flack & Daubman, 2007; Burt, 1980). In the present study, we tested these relationships more directly by asking male students to indicate levels of male peer support for woman abuse (MPS), acceptance of rape myths (RMA), alcohol consumption, and history of hooking up and sexual assault perpetration during their undergraduate experience. Participants in this study were 200 male Bucknell students (sophomores - seniors) who completed an online survey concerning these issues. The overall prevalence rate for any type of sexual assault perpetration was 10.5 percent. Specific prevalence rates for non-invasive contact, completed rape, and attempted rape were 5.5 percent, 2.0 percent, and 5.0 percent, respectively. Sexual assault perpetration was positively correlated with MPS and alcohol consumption but not with RMA. Acquaintance hook ups were the type of intimacy context used most frequently across all types of sexual assault. These findings demonstrate direct, significant relationships between sexual assault perpetration, alcohol abuse, and different types of hooking up, and an association between perpetration and MPS that requires further elaboration.

*Cameron McConnell ’13, Anthony Carter ’12
Faculty Mentor: Professor Robert Stockland, Chemistry

Establishing the Limits of Phosphorous Arylation via Palladium Catalysis

This project attempts to combine aryl halides with phosphine oxides via a palladium catalyzed cross coupling reaction. Several scientific articles have been published describing this type of reaction, where a new carbon-phosphorous bond is formed; however, the steric limits of these particular reagents have not been established. Both dimesitylphosphate oxide and diphenylphosphine oxide were investigated as sources of the phosphorous-hydrogen bond to be cleaved and replaced by a phosphorous-carbon bond, and the groups to be added were bromo-toluene and bromo-mesitylene. Reactions were microwave assisted, carried out at a determined optimal temperature of 120 degrees C at 175 W. After screening several bases, including
triethylamine, potassium phosphate, potassium carbonate, and calcium carbonate, cesium carbonate was determined to be the best base to cleave the phosphorous-hydrogen bond. Palladium acetate, along with various phosphorous supporting ligands, assisted the formation of new carbon-phosphorous bonds.

Justin McKnight, Graduate Student
Faculty Mentor: Professor Joseph Murray, Education
Thoughtful Interventions: Men and Student Conduct Cases

Through interviews and the collection of quantitative data I have found that men are overrepresented in student conduct proceedings. It is my contention that educative conduct infraction sanctions and their proper execution are more effective than traditional punitive measures in prompting an overall reduction in this trend. Thoughtful interventions with men, including restorative justice options, therapeutic counseling, mentor relationships, and community engagement opportunities, are developmentally appropriate alternatives to traditional conduct infraction sanctions.

An important aspect of my research is the way in which college men perform and reinforce notions of hetero-normative masculinity as demonstrated by their social behavior. Research by a number of scholars, especially Keith Edwards (2007) and Frank Harris III (2008), informs my understanding of college male masculinity. Their research portrays learned patterns of masculinity that place clearly defined limits on socially acceptable male behaviors, with deleterious effects to those that challenge normative behavior.

Proper engagement with males is an important first step to individual and, eventually, group changes in attitudes and outlook. Research regarding the internalization of the shame response by men and an understanding of male gender role conflict (Jim O’Neil, 2004) provide the necessary framework for the reconceptualization of student conduct practice. Interviews and comparative data between universities with different approaches to student conduct practice offer a glimpse into the successes and failures of student conduct sanctioning. My examination of current practices with sound theoretical models makes a strong case in the call for reform.

Jim McMichael ’13
Faculty Mentor: Professor Ken Field, Biology
Expansion of Myeloid Derived Suppressor Cells Upon Treatment with Farnesyltransferase Inhibitors

Myeloid Derived Suppressor Cells (MDSC) are a heterogeneous population of cells that originate in the bone marrow along with immature myeloid cells (IMCs). Under pathological conditions, MDSCs expand and are thought to contribute to the negative regulation of immune responses during cancer and other diseases. MDSCs are characterized by the co-expression of the cell surface markers GR1 and CD11b and can be positively identified with flow cytometric analysis. Farnesyltransferase inhibitors (FTI) are a therapeutic class of anti-cancer drugs that have recently been shown to selectively inhibit the immune system function by preventing the secretion of cytokines during an immune system response in mouse models. Since FTIs have been shown to prevent the secretion of cytokines, we tested the hypothesis that FTIs would block the expansion of MDSCs during an immune response in mouse models. Mice were started on FTIs two days prior to intraperitoneal injection with anti-CD3 on day 0, and the bone marrow extracted on day 10. The cells were stained, and the CD11b+ and GR1+ cell expansion measured via flow cytometry. MDSCs showed significant expansion upon stimulation with anti-CD3 compared to Phosphate Buffered Saline (PBS) control; however, the FTIs had no significant effect on MDSC expansion in a duplicate analysis. This study only represents a specific T-cell mediated immune response. Given the important role that MDSCs have in immune system regulation and the potent effect of FTIs, more studies under various pathological conditions are needed to fully understand FTI’s effect on MDSC expansion.

Oudam Meas ’12
Faculty Mentor: Professor Ronald Ziemian, Civil and Environmental Engineering
Modeling Yield Surfaces of Various Structural Shapes

This study was to investigate the possibility of custom fitting a widely accepted yield surface equation to the theoretical yield surfaces of different structural shapes including wide-flange, solid and hollow rectangular, and solid and hollow circular shapes. To achieve this goal, a theoretically “exact” but overly complex representation of cross section’s yield surface was initially obtained by using theories of solid mechanics. Then with this data, a weighted factor was developed to help with the distribution of the yield surface data. Finally the weighted “exact” yield surface data is then used within a regression analysis to obtain the coefficients of terms in the widely accepted yield surface equation, thus obtain the “best” yield surface equation of the given cross section. In theory, the theoretical exact yield surface shall have zero percentage of concavity. Therefore, in evaluating the results coefficient of determination R^2 and percentage of concavity of customized yield surface were compared to those of the widely accepted yield surface. This also required the development of a concavity test, which was done based on the MATLAB function “surfnorm.”

The results show that compared with the current widely accepted yield surface equation the customized yield surface equation of each cross section fits better to the theoretical yield surface in term of coefficient of determination R^2. By using concavity test developed in this study, the theoretical exact yield surface has a certain percent of concavity. The reason is that convexity test is highly sensitive to rounding off errors. This reason was proven by observing that the points on the yield surface that were tested concave had negligible differences from being convex. Therefore, the percentage of concavity of the exact yield surface was then used as an offset for testing both widely accepted yield surface equation and customized yield surface equation. With the offset by this percentage of concavity, both widely accepted yield surface and customized yield surface were tested as being completely convex.
Adam Meier ’13, Aravinda Seneviratne M’12, Derek Schilt M’07, Diana Scheerbaum ’05
Faculty Mentor: Professor Timothy Strein, Chemistry

Toward Understanding Transient Isotacophoresis of an In-line Product Using EMMA

Electrophoretically Mediated Microanalysis (EMMA) has proven to be a useful technique for carrying out enzymatic reactions. However, without the advantage of enzyme turnover, EMMA assays involving small molecules suffer from have limited sensitivity, particularly when UV absorption is the mode of detection employed. We explore here the use of electrophoretic stacking to improve the sensitivity of an in-line assay for creatinine, an important biological molecule formed during muscle contraction and excreted in the urine. One of the accepted clinical techniques used to quantify creatinine in body fluids is called the Jaffe reaction, a reaction between alkaline picrate (yellow) with creatinine (colorless) and measuring the change in color as a red Jaffe product is formed. EMMA is an attractive method for the Jaffe chemistry as is both faster than the traditional methodology and it generates less waste. Under certain reaction conditions, often aided by the presence of highly mobile hydroxide ions, the doubly anionic Jaffe product formed with the in-line reaction will undergo a transient isotacophoretic stacking as it leaves the reaction zone. If the assay can be performed such that the timing of detection corresponds with this stacking, the method sensitivity can be significantly increased. Characterization of what governs this particular phenomenon with both experiment and computer simulation using Simul 5.0 will be presented. For this application, we have found that hydroxide ions greatly influence the timing of the observed stacking behavior, and can be used to engineer the sensitivity of the assay in capillaries of differing length.

David Moffat ’12
Faculty Mentor: Professor Alf Siewers, English

The Wonderful Structure of the World: Joseph Priestley and the Developing American View of Nature

I pursued a research project on the English chemist, political thinker, philosopher, and theologian Joseph Priestley (1733-1804) as part of the McKenna Internship program. I worked with the idea that Priestley’s political millennialism and scientific outlook were responsible for his own utilitarian view of nature and by extension an expansion of the similar outlooks in the American tradition. Priestley came to the United States in the last ten years of his life after his progressive ideology earned him many enemies in the England. In 1794, he settled in Northumberland, Pennsylvania. Though unpopular in his home country, he was feted by the American elite. His sermons were widely discussed in America and he is credited with inspiring the religious beliefs of Thomas Jefferson. Priestley also made friends within the burgeoning scientific community, corresponding with Benjamin Franklin, Benjamin Rush, and Charles Wilson Peale. His 1767 work, The History and Present State of Electricity, provided the now archetypal story of Benjamin Franklin’s kite experiment, which has shaped the popular American conception of science.

Priestley is best known today as a chemist for his discovery of Oxygen in 1774. His scientific method could be called amateurish, even in relation to his day, but his dedicated empiricism and natural curiosity produced occasional though significant breakthroughs. His scientific doctrine was a mixture of enlightenment rationalism, Newtonian materialism, and Baconian empiricism. It was through this composite scientific philosophy that modern science emerged, with Priestley as an important vanguard. Priestley valued understanding as the key mode of relating to nature and relied on a method of chemistry which involved the manipulation of natural objects to obtain such knowledge. For Priestley, the purpose of nature was to advance humanity.

The shared Puritanical background which wedded the contemporary American beliefs to Priestley’s Unitarianism drew largely on a view of nature as providence and bounty—a model which made nature directly subject to the uses of mankind. The uncultivated wilderness was seen as an area apart from humanity, unavoidable separate from the needs of men. Inherent in this brand of political postmillennialism is a teleological line of thinking, which provides the world with a clear and definite end point that reduces all life and matter to its service. In the scheme of Priestley’s millennialism, the perfectibility of man is a means to such an end, and nature a way to accomplish mankind’s end.

As a natural philosopher, Priestley saw nature as an object of study; as a theologian he saw it as an object of salvation. In spite of the apparent beneficence towards nature which such motives inspire, the underlying utilization of nature reduces its value to the furtherance of human civilization. In a new American paradigm supported by both emerging scientific and religious beliefs, nature was subjugated to use without regard for its own unique character.

Allison Mongan ’12
Faculty Mentor: Professor Lori Smolleck, Education

Changes in Preservice Teachers’ Self-Efficacy: From Science Methods to Student Teaching

The purpose of this research was to assess preservice teachers self-efficacy at different stages of their educational career in an attempt to determine the extent to which self-efficacy beliefs may change over time. In addition, the critical incidents, which may contribute to changes in self-efficacy, were also investigated. The instrument used in the study was the Teaching Science as Inquiry (TSI) Instrument. The TSI Instrument was administered to 38 preservice elementary teachers to measure the self-efficacy beliefs of the teacher participants in regard to the teaching of science as inquiry. Based on the results and the associated data analysis, mean and median values demonstrate positive change for self-efficacy and outcome expectancy throughout the data collection period.
Dick Muyambi ’12
Faculty Mentor: Professor Jeffrey Evans, Civil and Environmental Engineering
Design of Geotechnical Equipment and Methods to Determine Properties of Cohesionless Soils Subsequent to Liquefaction and Resedimentation

The Network for Earthquake Engineering Simulation Research has coordinated with the National Science Foundation to award Stanford University, Arizona State University, and Bucknell University a project focused to determine the properties of cohesionless soils subsequent to liquefaction and resedimentation. Specifically, the Bucknell research team is concentrating efforts to create reproducible liquefied sand samples for the necessary testing. The desired end result of this experimental research project is to obtain reproducible results of Consolidated Isotropically Sheared Undrained (CIU) soil tests of pre and post liquefied sand samples. Also, particular testing has been completed to verify a specimen’s void ratio, as well as reproducibility of the experiment. To achieve this goal, multiple pieces of geotechnical equipment and effective laboratory methods of soil preparation and sampling were designed throughout the course of this project. A small scale laminar box was designed and has been employed on a shake table to create uniform shear forces in prepared F55 and 20/30 Ottawa sand samples through seismic simulations. Additionally, a soil pluviator has been designed and implemented to rain sand into the laminar box with a uniform distribution. For void ratio verification, overflow cylinders were constructed to measure accurate volumes of specimens. Complete methods were developed to utilize the experimental assembly in a manner to create statistically identical sand samples. Multiple test parameters were varied to gain insight toward the properties of sands subsequent to liquefaction. These variations include, homogeneous and heterogeneous soil layers, loose and dense soil samples, pre and post liquefied samples, and three different consolidation pressures during the CIU testing. Results describe the differences and similarities of these variations with respect to strength, void ratio, and soil structure.

Aleem Naqvi ’12
Faculty Mentor: Professor Charles Clapp, Chemistry
Synthesizing Halogenated Lipoxygenase Inhibitors

The goal of the research was to synthesize a halogenated unsaturated fatty acid which will act as an inhibitor for soybean lipoxygenase. This inhibitor is going to be used in crystallographic studies of the enzyme lipoxygenase to better understand the mechanism by which it is inhibited. The research explored a synthetic route which involved the halogenation of a p-aminobenzoic acid derivative and then attached the halogenated p-aminobenzoic acid derivative to oleic acid or its derivative.

Nicholas Noss, Graduate Student
Faculty Mentor: Professor Kelly Salyards, Civil and Environmental Engineering
Development of a Laboratory Test Program to Examine Human-Structure Interaction

Vibration serviceability is a widely recognized design criterion for assembly-type structures, such as stadiums, that are likely subjected to rhythmic human-induced excitation. Human-induced excitation of a structure occurs from the movement of the occupants such as walking, running, jumping, or dancing. Vibration serviceability is based on the level of comfort that people have with the vibrations of a structure. Current design guidance uses the natural frequency of the structure to assess vibration serviceability. However, a phenomenon known as human-structure interaction suggests that there is a dynamic interaction between the structure and passive occupants, altering the natural frequency of the system. Human-structure interaction is dependent on many factors, including the dynamic properties of the structure, posture of the occupants, and relative size of the crowd. It is unknown if the shift in natural frequency due to human-structure interaction is significant enough to warrant consideration in the design process. This study explores the interface of both structural and crowd characteristics through experimental testing to determine if human-structure interaction should be considered because of its potential impact on serviceability assessment. An experimental test structure that represents the dynamic properties of a cantilevered stadium structure was designed and constructed. Experimental modal analysis was implemented to determine the dynamic properties of the empty test structure and when occupied with up to nine people arranged in different locations and postures. Comparisons of the dynamic properties were made between the empty and occupied testing configurations. Data trends lead to the development of a dynamic crowd model. This dynamic model can be used in conjunction with a finite element model of the test structure to estimate the dynamic influence due to human-structure interaction. In the future, the crowd model will further be refined and hopefully can aid in assessing vibration serviceability of a structure during the design phase.

Brenna O’Neill ’12
Faculty Mentor: Professor Amy Wolaver, Economics
Ambulatory Care Sensitive Conditions in Pennsylvania—Oral Presentation

Using Pennsylvania Health Care Cost Containment Council (PHC4) data from 2009, which collects inpatient discharge records and ambulatory/outpatient records from Pennsylvania hospitals and surgery centers; I am researching the occurrence of ambulatory care sensitive conditions in the different counties throughout Pennsylvania. Ambulatory care sensitive conditions are “medical conditions for which physicians broadly concur that a substantial proportion of cases should not advance to the point were hospitalization is needed if they are treated in a timely fashion with adequate primary care and managed properly on an outpatient basis.” (https://www.cms.gov/) Some examples of these conditions are diabetes, asthma, and hypertension. The presence of these conditions is a sign of a lack of adequate primary care and should serve as an indicator of the need for improvements in primary care systems in each county throughout Pennsylvania. Examples of common ambulatory care sensitive conditions include diabetes, asthma, dehydration, and obesity. These conditions put a great burden on the healthcare system in Pennsylvania, leading to increased healthcare costs and decreased quality of life for patients.
care, as most people should not need to be hospitalized for these conditions. I will use this data to calculate the rate at which these hospitalizations are occurring in each county to discover areas where citizens are not receiving satisfactory outpatient care. I also wish to know whether socioeconomic status, measured by such factors such as family income and race, affect the rates of ambulatory care sensitive conditions in different counties. I hypothesize that a high occurrence of ambulatory care sensitive conditions will be related to a lower socioeconomic status.

Mark Paleafico ’13
Faculty Mentor: Professor Ryan Snyder, Chemical Engineering
Isolation of Glycine Polymorphs by Crystallizing Monodisperse Droplets

The morphology (shape) and polymorph (internal structure) of crystals play a vital role in the effectiveness and potential uses of a compound. Different morphologies and polymorphs of the same molecule are often seen as a result of changes in processing conditions such as solvent choice. Shape may affect process downstream of the particle formation, while different polymorphs of the same compound may have vastly different bioavailability due to differences in dissolution rate.

The evaporation of uniform small droplets is a potentially advantageous way to investigate particle formation and the resulting crystal properties.

Glycine was chosen as the compound of interest because it is a model compound. Glycine has both a carboxylic acid group and an amine group and can be used to predict the crystallization of many pharmaceuticals because of this. Glycine solutions of different solvent composition were tested with the goal of isolating α and β-glycine separately. Glycine is insoluble in alcohols and when an anti-solvent is present in the solution, β-glycine is formed. The monodisperse droplets were created by the Vibrating Orifice Aerosol Generator (VOAG) which also offered different air flow rates to influence solution evaporation and crystallization. The crystals were studied using both SEM imaging and X-ray diffraction techniques. It was found that using pure water solvents, α-glycine was isolated. Using a 50/50 water/ethanol solvent, a mixture of α and β-glycine were created.

Stefan Petrovic ’14
Faculty Mentor: Professor Thomas Selby, Chemistry
Mechanistic Characterization of the Streptomyces Antibioticus Phosphatidylinositol-specific Phospholipase C (PI-PLC) Enzyme

Streptomyces antibioticus phosphatidylinositol-specific phospholipase C (SaPLC) is a 38 KDa prokaryotic enzyme that catalyzes the hydrolysis of phosphatidylinositol (PI) into a hydrophilic inositol phosphate and a hydrophobic diglycerol (DAG) part. Phospholipases are a ubiquitous family of enzymes in both eukaryotic and prokaryotic systems. In eukaryotes, phospholipase C (PLC) plays a key role in calcium-dependent cellular signal transduction pathways. Previous work in this laboratory determined the calcium dependence for activity in SaPLC, which makes it a candidate for a model of the much larger eukaryotic phospholipases. Moreover, SaPLC may represent an evolutionary link between the eukaryotic and prokaryotic calcium-independent phospholipases. Prokaryotic PI-PLCs have been described as virulence factors in pathogenic bacteria such as Listeria monocytogenes[1], Mycobacterium tuberculosis[2], Clostridium perfringens, Corynebacterium pseudotuberculosis, Pseudomonas aeruginosa, Staphylococcus aureus[3]. Understanding the active site mechanism would be key to the design of mechanism-based inhibitors (i.e. antibiotics).

Wild-type SaPLC was crystallized in the absence of ligands. In order to identify the actsives site, we resorted to the availability of inositol-binding enzymes in the Protein Database (PDB). Structures of our enzyme and homologues from the database were computationally superimposed, which allowed for the identification of the amino acids in the presumed acid-base catalytic region. Site-directed mutagenesis reactions were set up to modify a cloned plasmid vector such that the candidate amino acids would be substituted by a neutral alanine, or the closest analogous amino acid of opposite charge (e.g. glutamate to lysine). The His-tagged mutant enzymes were expressed in competent cells E. coli cells. Purification by affinity and gel filtration chromatography was optimized for these enzymes. A kinetic assay based on a tritium-labeled PI substrate was optimized for determining changes in enzyme activity relative to the wild-type.

Freeze-drying with liquid nitrogen and storage at -80°C was successfully accomplished, as indicated by activity measurements in the resuspended wild-type SaPLC, a property of great practical importance. The activity of mutant H236A (histidine to alanine) was observed to be lower than that of the wild type. Present and future work includes the design, purification and assay of more mutants (currently more than 20). Further work will include an attempt to obtain crystal structures of mutant versions of SaPLC, providing information on conformational changes related to shifts in activity. Also, a phosphorus (31P) NMR kinetic assay is being developed, with the purpose of collecting data that is more time-sensitive and might illustrate discrete steps in the catalytic mechanism. Eventually, we aim to elucidate the mechanism of hydrolysis by which PI is cleaved with the information collected from structural and kinetic studies. [1] Mengaud, J., Braun-Breton, C. and Cossart, P. (1991), Identification of phosphatidylinositol-specific phospholipase C activity in Listeria monocytogenes: a novel type of virulence factor?. Molecular Microbiology, 5: 367–372. [2] Raynaud, C., Guilhot, C., Rauzier, J., Bordat, Y., Pelicic, V., Manganelli, R., Smith, I., Gicquel, B. and Jackson, M. (2002), Phospholipases C are involved in the virulence of Mycobacterium tuberculosis. Molecular Microbiology, 45: 203–217. [3] McNamara, P.J., Bradley, G.A., and Songer, J.G. (1994) Targeted mutagenesis of the phospholipase D gene results in decreased virulence of Corynebacterium pseudotuberculosis. Mol Microbiol 12: 921–930.
Monazite and Detrital Zircon Geochronology in the Picuris Mountains

The Marquenas Formation experienced the same metamorphism and deformation as the Vadito Group, so metamorphic monazite ages from the Vadito Group in this study record the timing of metamorphism and deformation in the Marquenas Formation. Mesoproteozoic regional metamorphism in north-central New Mexico is likely associated with an intracratonic, syn-tectonic, orogenic event.

Evidence for Mesoproterozoic Deposition, Regional Metamorphism and Deformation in North-Central New Mexico: Metamorphic Monazite and Detrital Zircon Geochronology in the Picuris Mountains

Lily Pfeifer '12

Faculty Mentor: Professor Christopher Daniel, Geology

Metamorphic monazite ages (1.63-1.40 Ga) from the underlying Vadito Group records two generations of monazite growth and requires regional deformation and metamorphism between 1.48-1.40 Ga, possibly associated with a poorly understood, Mesoproteozoic, intracratonic, orogenic event in the southwestern United States.

Quartzite from the Marquenas Formation in the Picuris Mountains, north-central New Mexico contains 1.48-1.45 Ga (billion year old) detrital zircon which confirms evidence of Mesoproteozoic sedimentation in the southwest United States. Metamorphic monazite ages (1.63-1.40 Ga) from the underlying Vadito Group records two generations of monazite growth and requires regional deformation and metamorphism between 1.48-1.40 Ga, possibly associated with a poorly understood, Mesoproteozoic, intracratonic, orogenic event in the southwestern United States.

Chris Porter '13

Faculty Mentor: Professor Ryan Snyder, Chemical Engineering

Systematic Method to Determining Slow Growing Edges and Faces of Organic Molecular Crystals

Crystallization is an important process in many industries, including in the pharmaceutical industry. The crystallization process controls the resulting morphology of a solid. This morphology can then have consequences for the physical properties of the solid, such as hydrophobicity and reactivity.

Since different morphologies can lead to different properties, it is useful to predict the final morphology of a crystal beforehand. This would allow processes downstream of crystallization (filtration, washing, drying, etc.) to be tailored more specifically to the crystal, resulting in a cheaper, more efficient overall process.

At low super saturations, the crystallization process goes through a spiral growth mechanism. In this process, a screw dislocation to the crystal, resulting in a cheaper, more efficient overall process. This process controls the resulting morphology of a solid. This process is useful to predict the final morphology of a crystal beforehand.

To find these edges and faces, it is necessary to look at the intermolecular interactions within the molecule. Finding the flat edges of a face involves looking at the directions in which no intermolecular interactions are present. Since different morphologies can lead to different properties, it is useful to predict the final morphology of a crystal beforehand. This would allow processes downstream of crystallization (filtration, washing, drying, etc.) to be tailored more specifically to the crystal, resulting in a cheaper, more efficient overall process.
Scott Radzinski, Graduate Student  
**Faculty Mentor:** Professor Eric Tillman, Chemistry  
**Selective Formation of Diblock Copolymers by Atom Transfer Coupling Reactions**

Polymers synthesized by atom transfer radical polymerization (ATRP) will posses a halogenated chain end that can undergo further transformation. A popular subsequent reaction is atom transfer radical coupling (ATRC), where the chain end polymer radicals are formed in high amounts and will undergo coupling to produce larger polymers. When ATRC is performed in the presence of a nitroso group, which will act as a radical trap, the coupled product will possess an alkoxyamine functionality at mid-chain. This process has been shown to work in our lab using brominated polystyrene in a redox active solution at 80 °C. More recently, efforts in our lab show that two compositionally different polymers, polystyrene (PSt) and poly methyl acrylate (PMMA), will preferentially make diblock copolymers when activated in the presence of a nitroso group. The ATRC phase of the reaction can be done in the same pot because of the different reactivities of the polymer’s chain ends. The PMA will be activated and react with the nitroso first, then the PSt will be activated and react with the nitroxide end-capped PMA resulting in the diblock copolymer with alkoxyamine functionality separating the segments.

Ian Rafter ’12  
**Faculty Mentor:** Professor Indranil Brahma, Mechanical Engineering  
**Diesel Smoke Characterization**

In conventional engine studies in the past, fine filters have been used to collect pollutants from engine emission. Used filters were weighed to determine exactly how much, in terms of mass of particles, was released during the time of collection. Although this method is quite accurate for detecting mass flow rates of carbon particles, it gives no information on the size and distribution of such particles. Using the filter collection method there is also a chance of losing an important segment of data because of particles which were too small to be captured by the filter. And it is these sized particles that have been thought to affect the health of humans and the quality of the air we breath. Fine particles, which occur both through nature and human activity, have been linked to the cause of both heart and lung disease which kill thousands of people every year. The data obtained through this project could have serious implications on environmental legislation and health regulation.

It is the goal of this project to, through new characterization methods, analyze diesel exhaust during both transience and steady state to determine exactly what size and quantity of particles are released at different loads on a diesel engine. Most importantly, we are concerned with the emission that takes place during a time of transient -- when the engine’s speed or load is changing. Transients are important because most particulate matter or ‘diesel smoke’ occurs when the engine conditions change suddenly and there is not sufficient air to burn the fuel.

In this project, it is our goal to determine the size distribution of particles that are being released during transient operation. Although this project was met with several equipmental stumbling blocks, the research initiative proved to determine many interesting results.

Lauren Rambo ’12  
**Faculty Mentor:** Professor Ruth Tincoff, Psychology  
**Infant Understanding of Words Referring to Physical Objects and Familiar Events**

In this study, we test for infants’ comprehension about words that refer to common objects and events in the lives of very young infants. Infants in two conditions watched split screen videos showing these objects or events while hearing a word that matched one video. If infants understand the word, then they should look longer at the matching video. The study takes a socially relevant event, and tests the infant’s comprehension of the physical parts of the event.

From Tincoff & Jusczyk (2011), we know that infants are able to comprehend socially relevant objects, but we are now testing for infants’ comprehension of physical objects within a socially relevant context. Eating and drinking are multi-sensory and socially directed events, which might facilitate the links of words with the objects (Bahrick et al., 2002).

We are currently about a quarter of the way through the testing stage, which will continue throughout the year. We will present data from the experimental test and from parent data surveys which provided more information about the infant’s exposure to the events and objects we are testing. This study is important, because the study is looking at a much younger age and we might find that we learn aspects of language sooner than previously evidenced.

Billy Raska ’12  
**Faculty Mentor:** Professor Kundan Nepal, Electrical Engineering  
**Design of an Open-Source Hardware/Software Embedded Platform**

The goal of this project was to complete the design of a printed circuit board that will house a processor and associated circuitry, develop a complete programming library for the processor board, and provide public access to the PCB board design, parts list, and programming library. Previously I designed a processor board for mobile robotics that had a raw cost of approximately $50, which is significantly less than the price of many other processor boards on the market. When designing this board, the main goal was to create a board that was both cheap and versatile. Both of these things were accomplished, but when it came time for the Mobile and Autonomous Robotics Club (MARC) at Bucknell to decide what processor boards to use, this one was not chosen for a few reasons. These deficiencies included no external display beyond a row of LEDs, limited motor ports, and no serial data ports. A new prototype had been started before the summer began, but it did not perform as expected and I was forced to spend more time than anticipated.
creating a new design. However, this paid off in the end because I was able to improve the design and bring the cost back down to rival that of the original board. The deficiencies were solved by adding an interface for an LCD display, adding more motor ports, and including both a USB and I2C interface. Significant progress was made in developing a programming library for the board and efforts in this area have continued throughout the school year as the board has been used in the design of a robot through MARC. Providing public access to the design and programming library is only a matter of time.

Lindsay Regruto ’12
Faculty Mentor: Professor Julie Gates, Biology
Roles of the SKIP Protein During Egg Development in Drosophila melanogaster

Developmental biologists seek to understand the process by which a complex multicellular organism, such as humans, frogs, and fruit flies, grow and develop from a single cell, the fertilized egg. Development requires the cells of an organism to divide, specialize, and move. During development, cell movement occurs that gives the organism its specific shape; it controls the organization and distribution of specialized cells that eventually form the tissues and organs of an organism. The formation of a multicellular organism requires the coordinated behavior of multiple different cell types in order to form the egg, which will later be fertilized and develop into the adult. The developmental processes occurring during the formation of the egg provides the opportunity to study how cells and structures within a developing organism interact with and influence each other. The correct positioning, interaction, and behavior of a variety of cells is essential to the proper organization and formation of the developing egg and eventual embryo. Actin, a protein found in all cells of a developing organism, forms a network of filaments called the cytoskeleton that provides the force required for cell movement and subsequent organization. Ena is a protein that belongs to a family of proteins that regulate the actin cytoskeleton and cellular movement during development. SKIP is a newly discovered protein demonstrated to directly interact or associate with Ena. Ena and SKIP have homologous, or similar, protein forms in both humans and Drosophila melanogaster, commonly known as the fruit fly. The fruit fly is a typical model organism – a species that allows biologists to study the various biological processes and structures in a species other than a human. Physically, humans and fruit flies may not look alike, but at the molecular level, the mechanisms controlling their crucial developmental processes are very similar. About 73 percent of the genes that when mutated cause disease in humans have a very close relative in the fly. So, what we learn in flies can be extended to the study of human development and disease. In order to better understand the mechanisms by which Ena and its associated proteins affect the regulation of actin and eventual development of an egg, my work aimed to determine if the SKIP protein also affects actin regulation during development through its interaction with Ena using the fruit fly. To accomplish this, developing egg chambers were generated with decreased levels of SKIP protein in comparison to levels naturally found in a developing fruit fly egg. I found that reducing the levels of SKIP protein may impact the organization of the actin cytoskeleton in specific cells during development of a mature, fertilizable egg.

Jordan Rivera ’13
Faculty Mentor: Professor Charles Kim, Mechanical Engineering
Robotic Safe Joints

Robots are used heavily in the industrial setting of production lines. While many are small and relatively safe, some are large and powerful machines with the potential to injure a human standing near them. Because of this inherent danger humans are often unable to work alongside these robots. By creating a system which would allow human workers to complete tasks alongside robots production times could be reduced and problems could be solved more quickly. A robotic safe joint is one proposed solution to this problem. A safe joint is a purely mechanical device designed to allow normal, precise functioning of a robot while ensuring that if the robot were to exceed a peak amount of torque that it would stop moving before injuring a human.

The original design for the safe joint to be built at Bucknell was based on dimension parameters associated with the Bucknell humanoid robot. Specifically for this project, the elbow joint of the arm was most significant. Dimensions for the spring bearing design of the safe joint were based on the largest dimensions in the elbow of the humanoid robot.

Following the design, construction, and testing of the spring link safe joint mechanism the project moved to designing and building a compliant version of the joint which accomplished the same task. A compliant mechanism uses flexible members within the structure to give a spring like reaction when force is applied.

The final result was the production of two distinct and effective joint designs which were explored in order to further understand the effective use of these mechanisms in industrial settings where human interaction was a concern. References [1] “Safe Joint Mechanism using Inclined Link with Springs for Collision Safety and Positioning Accuracy of a Robot Arm” By Jung-Jun Park and Jae-Bok Song.

Kirstin Rudd ’12, Danielle Alaimo ’12, Ginna Freehling ’15, Chuqiao Ren ’15, Anthony Cillo ’10,
Faculty Mentor: Professor Elizabeth Marin, Biology
Antp and Ubx Regulate Segment-Specific Survival and Morphology in the Postembryonic Ventral Nervous System of Drosophila melanogaster

In the insect ventral nervous system, secondary neurons born during larval life have been observed to exhibit segment-specific survival and morphology. The Hox genes are excellent candidates to regulate these differences since they known to mediate many aspects of anteroposterior patterning in Drosophila. There are two main clusters of hox genes: the Bithorax (BX-C) genes Ubx,
*abda* and *AbdB*, which control the identities of segments in the posterior thorax and abdomen, and the Antennapedia (*Antp*) genes *lab*, *pb*, *Dfd*, *Scr*, and *Antp*, which are involved in the determination of head and anterior thoracic structures.

Our preliminary experiments demonstrate that *Ubx* is expressed primarily in the last thoracic and first abdominal segments of the developing ventral nervous system and that loss of *Ubx* function causes anterior transformation of neurons in the wild type domain of *Ubx* expression, while gain of *Ubx* function causes posterior transformation of neurons anterior to that domain. Previous research has suggested that the *Antp* expression expands toward the posterior and is needed for the duplication of the mesothorax in *bithorax* mutants and that *Ubx* and *Antp* play adversarial roles in embryonic-born neuron survival. These findings suggest that homeotic transformations resulting from experimentally induced loss of *Ubx* function may be due to ectopic expression and function of *Antp*. Our experiments will help determine the role that *Antp* plays in segment-specific lineage formation and whether *Antp* activity is repressed by *Ubx* or *Antp* expression is being repressed by *Ubx*.

To lay the foundation for this project, we have characterized the wild type *Antp* expression pattern in the thorax and upper abdomen. We find that *Antp* is expressed at high levels primarily in the second thoracic segment, but in a lineage-, sibling-, and age-specific manner. It is also expressed at lower levels in at least some lineages in the posterior thorax. We have verified that there is no overlap in the endogenous expression patterns of *Antp* and *Ubx* in the lineages of interest.

Our preliminary results show ectopic *Antp* expression in at least some posterior *Ubx* MARCM clones, strongly suggesting a role for *Antp* in promoting their anterior transformation. We are also examining neuron morphology in gain-of-*Antp* MARCM clones in order to distinguish between the aforementioned models for posterior dominance. If *Ubx* represses *Antp* activity in these cells, no changes in clone morphology should be seen in posterior segments. On the other hand, if *Ubx* only represses *Antp* expression, anterior transformation of *UAS-Antp* clones is expected in the posterior domains.

**Diane Schrom ’12**  
**Faculty Mentor:** Professor Marie Pizzorno, Biology  
**Determining of Protein-Protein Interactions between two Drosophila Proteins, Skip and Ena**  
Embryonic development is a complex system involving coordinated movements of individual cells that, on a large scale, ultimately determine the organism’s body-plan. In past studies, the Ena protein, a member of the Enabled/VASP protein family, has been found to be a necessary component for various morphogenic processes. In *Drosophila* embryos, removal of maternal and zygotic Ena disrupted or altered a number of events in embryonic morphogenesis. Like all proteins, Ena is believed to form protein-protein interactions in order to carry out these functions. In a large-scale yeast-two hybrid assay the protein Skip was found to interact with the Ena. Our study aims to better understand the biochemical basis of this protein-protein interaction between Skip and Ena. Our hypothesis is that the proline-rich region of Ena binds the SH3-domain found in Skip. We are in the process of cloning various regions of the Ena cDNA into a GST expression plasmid and the SKIP cDNA into a 6xHis tag plasmid using recombinant DNA techniques. Problems have occurred throughout the process, such as point mutations occurring during PCR that resulted in the formation of a stop codon and a shortening of the Ena fragment. We believe the DNA deletion may be the result of the repetitive sequences in the proline-rich domain. Once these plasmids have been constructed, it will then be possible to express and purify these two different fusion proteins from bacterial cells. To confirm the interaction between Ena and Skip, GST pull-down experiments will be conducted using the Ena and Skip fusion proteins. If our hypothesis is correct the purified protein complexes will contain both Ena and Skip because of their interaction with each other.

**Brian Schultz, Graduate Student**  
**Faculty Mentor:** Professor Jessica Newlin, Civil and Environmental Engineering  
**Monitoring and Mathematical Modeling of the Sediment Processes at In-Stream Restoration Structures in the Vicinity of a Bridge Crossing**  
Aggradation, or sediment deposition, is a common problem at many bridges crossing small streams in the Susquehanna River watershed. Modifications to the channel near a bridge crossing can lead to the extensive deposition of sediment in the bridge waterway. This partial blockage of the bridge waterway poses serious safety problems to the overall bridge structure. The most common solution for aggradation in Pennsylvania is to dredge the stream channel frequently. While this mitigation procedure is successful in clearing some of the sediment that is blocking the waterway, it also creates conditions that promote further sediment deposition at the bridge. Sediment transport and bridge hydraulics need to be investigated to determine a more sustainable solution to aggradation at bridge crossings. The bridge crossing of Old Route 15 over White Deer Creek in White Deer, PA has had many sediment related problems in the past. A stream restoration project was conducted on the stream to help control the sediment deposition problems occurring at the bridge crossing. The main goal of the presented research was to monitor White Deer Creek and create 1D and 2D models for hydraulic and sediment transport analyses of the bridge crossing and stream restoration structures. The results of these analyses along with the collection of topographic, hydraulic, and sediment data will help inform bridge design guidelines and stream restoration design guidelines that account for the transport of sediment as well as the hydraulics of the waterway.
Matthew Segar ’12  
Faculty Mentor: Professor Brian King, Computer Science  
De Novo Assembly of Second Generation Genome Sequencers

With the advent of cheaper and faster DNA sequencing technologies, assembly methods have greatly changed. Instead of outputting fragments that are thousands of base pairs long, new sequencers parallelize the task producing read lengths between 35 and 400 base pairs. Reconstructing an organism’s genome from these millions of reads is a computationally expensive task. Our algorithm solves this problem by organizing and indexing the fragments using n-grams, which are short, fixed-length DNA sequences of length n. These n-grams are used to efficiently locate putative fragment joins, thereby eliminating the need to perform an exhaustive search over all possible fragment pairs. Our goal is to develop a novel n-gram method for the assembly of genomes from next-generation sequencers. Specifically, a probabilistic, iterative approach will be utilized to determine the most likely fragments to join through development of a new metric that models the probability of any two arbitrary fragments being joined together. Tests were run using simulated short read data based on randomly created genomes ranging in lengths from 20 to 100,000 nucleotides with 4 to 20x coverage. We have been able to successfully re-assemble entire genomes up to 100,000 nucleotides in length as well as output 72 percent coverage in a real-life genome of Staphylococcus aureus.

Darshan Shah ’12  
Faculty Mentor: Professor Kathleen Page, Biology  
Alteration in 5HT1A Receptor Activity from a Prenatal Exposure to Dexamethasone in a Stressed and Non-Stressed Adult Male Rat

Synthetic glucocorticoids (GC) are used as a clinical therapeutic to stimulate lung development in fetuses that present the risk of preterm delivery. Previous studies have shown that prenatal exposure to Dexamethasone (Dex) causes a disturbance of normal GC mediation of neuritic outgrowth, cell signaling, and serotonergic systems. Our hypothesis is that prenatal exposure to Dex during the third trimester of pregnancy alters 5HT1A receptor function. Pregnant dams were injected daily with 150ug/ml/kg of Dex (sc) from gestation day 14 through 19. Control (Con) dams were treated with saline. Behavior testing was conducted on male rats an hour prior to being sacrificed which constitutes a stress challenge (CH). Another group was tested and allowed to return to baseline before sacrifice, non-challenged (NC). Hippocampi were analyzed using a radioligand-receptor binding assay and GTPγS incorporation (3H-MPPP antagonist and 8-OH-DPAT agonist, respectively). A significant increase in Bmax and Kd was found in Dex-exposed animals for both NC and CH groups (Bmax: Con: 23.57±0.79 vs Dex: 26.78±0.92 fmoles/mg/CH: Con: 21.90±0.86 vs Dex: 24.46±0.80 fmoles/mg, Kd: Con: 0.58±0.04 vs Dex: 0.70±0.02 nM/CH: Con: 0.50±0.01 vs Dex: 0.56±0.02 nM). In addition, the challenged Dex group showed a significant increase in Emax (Con: 9.8±0.5 vs Dex: 11.2±0.3 fmoles/mg) while the non-challenged Dex group showed a significant increase in EC50 (Con: 5.32E-7± 0.4E-7 vs Dex: 6.67E-7± 0.4E-7 M). When comparing the control CH to control NC or the Dex CH to Dex NC groups, a significant decrease in Kd and Emax was observed when animals were challenged. These results suggest that prenatal dexamethasone exposure and subsequent alteration in serotonergic signaling and GC mediation is causing significant alteration to 5HT1A receptor function.

Nikki Shea ’12, Andrea Massa ’12, Marie Chardon ’12, Aly Lebowitz ’12, Libby Munson ’12, Jenni Whalen ’12, Jessica Yingst ’12, Kristen Born ’13, Tricia Collins ’13, Tom Latosek ’14  
Faculty Mentor: Professor William Flack, Psychology  
Disclosing Sexual Assault Victimization to Others

Previous research has demonstrated that victims of sexual assault disclose their assaults most frequently to members of their intimate social circle. Victims confide more often in friends than in family members or health professionals (Golding, Siegal, Sorenson, Burnam & Stein, 1989). Unfortunately, some friends and family members give support in ways that are perceived as unhelpful, such as blaming the victim or treating her differently post-disclosure (Campbell, Ahrens, Seft, Wasco & Barnes, 2001). The present study was designed to examine in further detail the relationship between sexual assault victimization and disclosure. Participants in this study were 345 female Bucknell students (sophomores - seniors) who completed an online survey about sexual assault, hooking up, disclosure, and social reactions to disclosure. The overall prevalence rate for any type of sexual assault was 41.4 percent (rates for unwanted touching, attempted rape, and completed rape were 34.5 percent, 22.0 percent, and 19.2 percent, respectively). Among victims who disclosed their assaults to anyone (13.3 percent did not disclose to anyone), 39.8 percent disclosed to a friend, 3.1 percent disclosed to a family member, and 2.3 percent disclosed to a health professional (no one reported disclosing to the campus or local police). Positive support in response to disclosure was perceived to occur more often by non-victims than actual support reported by victims. Victims and non-victims also differed significantly in actual versus perceived levels of helping the victim get information and aid, believing that the assault occurred, and providing emotional support. Victims reported experiencing blame from disclosure recipients for their assault significantly more often than the rates at which non-victims perceived they would be blamed. These results indicate that significant efforts are needed to change the campus culture by increasing support for sexual assault victims.

Rebecca Shopiro ’12  
Faculty Mentors: Professor Richard Crago, Civil and Environmental Engineering; Professor Kevin Gilmore, Civil and Environmental Engineering  
Runoff Water Quality and Pollutant Mass Loads from Extensive Green Roofs

The ability of green roofs to mitigate volume and peak flow-rate of stormwater runoff has been studied extensively. However, because green roof fertilization is common, this study compares
green roof runoff quality with precipitation and runoff from a bare shingle roof. The runoff from a demonstration-scale extensive green roof was analyzed during summer of 2011 for its effect on runoff volume and analyzed during seven storm events in the fall for concentrations of nitrogen species, total nitrogen, total organic carbon, sulfate, orthophosphate along other monovalent and divalent ions, as well as copper, cadmium, zinc, and lead. The green roof reduced the overall volume of runoff and was a sink for some pollutants, such as NO3- and NH4+. However, it was also a source for pollutants, such as PO43-, SO42-, TOC, cations, and total nitrogen. Metals such as zinc and lead showed trends of higher concentrations in the runoff from the bare roof than in precipitation and in the green roof runoff, although results were not statistically significant at the 95 percent level (P = .06 respectively). Copper and cadmium concentrations showed no trends among the roof types. Since completion of the mockup roof in November, one rainfall event showed lower overall mass loads from the green roof while a second rainfall event showed higher overall mass loads. Results suggest that it cannot be universally stated that pollutant mass loads from a green roof will be lower than those from a bare roof, despite volume reduction and nitrogen retention by the green roof.

Loren Sri-Jayantha ’12
Faculty Mentors: Professor Warren Abrahamson, Biology; Dr. Catherine Blair, Biology; Professor Mizuki Takahashi, 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 southernmost 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.

Lauren Stenz ’12, Kara Pine ’12
Faculty Mentor: Professor David Dean, Psychology
Investigating Rural Youth Health Behavior and Decision Making
Adolescence is often marked by risk behaviors that negatively affect health and well-being. The purpose of this study is to describe adolescent health risk and protective behaviors, identify predictive factors for risk and protective behaviors, and determine factors to target in behavior change interventions. Using the Centers for Disease Control and Prevention (CDC) Youth Risk Behavior Surveillance (YRBS) system and several additional measures regarding individual psychological and social factors, we will survey 1,306 high school students and 905 middle school students in the Central Susquehanna Valley area in order to gauge the prevalence of specified risk behaviors. Questions taken from the CDC’s YRBS pertain to unintentional injuries and violence, tobacco use, alcohol and other drug use, sexual behaviors, dietary behaviors, physical activity, obesity, and asthma. The additional survey questions we developed will examine students’ psychological factors and personal beliefs about health risks and protective behaviors, social factors including connections to school, family, and community, and behavioral skills relating to risk behavior refusal and risk reduction negotiation. This longitudinal study will rely on passive consent (unless a school specifies otherwise) to survey students at Time 0 and Time 1, three months later.

Alexandra Stough ’14, Kate Wilsterman ’14
Faculty Mentor: Professor Jennie Stevenson, Psychology
Characterization of Estrogen Regulation of Oxytocin Neurons and Release in Female Prairie Voles
Oxytocin (OT) is a neuropeptide hormone, secreted by the posterior pituitary, that has implications in social bonding, mating, parenting behaviors, the stress-response, and birthing and lactation within the female members of mammalian species. Estrogen is known to modulate the OT system, and it is widely assumed that estrogen (due to regulation of gene expression) upregulates the OT system. The purpose of this study is to investigate how estrogen affects the synthesis and release of OT, particularly the release of OT in response to stress. Understanding the manner in which estrogen regulates the synthesis and release of OT will help us understand social-
and stress-related diseases which show sexual dimorphism or hormone-related effects, including autism and schizophrenia. Understanding the manner in which estrogen regulates OT will also help us better treat women who need hormone replacement therapy. The use of estrogen as hormone replacement therapy is currently controversial, but it is possible that some of the positive behavioral and physiological effects of estrogen may be due to estrogen’s influence on endogenous release of OT. The current study examines the effects of chronic estrogen (estradiol bezoate, EB) on OT peptide expression in the hypothalamus, levels of OT in plasma under basal conditions, and temporal OT release in plasma following a stressor. The subjects chosen for the study, female prairie voles (m. ochrogaster), were housed in same-sex sibling pairs and underwent ovariectomies to remove endogenous sources of estrogen. They were then assigned to either estradiol bezoate (EB) or control treatment groups. According to treatment group, the animals received a subcutaneous (S.C.) capsule containing either EB or vehicle treatment. After 14 days of treatment, the animals were assigned to either stress or no stress groups. Stress animals underwent a resident intruder (R-I) test lasting five minutes. They were then sacrificed 0, 10, 30, or 60 minutes following the R-I stressor, and brains and trunk blood were collected for immunohistochemistry and enzyme immunoassay analysis respectively. Immunohistochemistry will allow us to analyze how much OT is being made in the brain. Enzyme immunoassay will allow us to measure OT content in the bloodstream.

David Sulon ’12
Faculty Mentor: Professor Nathan Ryan, Mathematics

Verifying Harder’s Conjecture

We verify a number of cases of Harder’s conjecture about congruences between classical modular forms and Siegel modular forms. Our approach is based on Satoh’s description of the module of vector-valued Siegel modular forms of weight \((k, 2)\), an explicit description of the Hecke action on Fourier expansions, and the extensive algebraic number theory capabilities present in Sage.

Kaitlyn Sweeney ’12, Colleen Garrehy ’12, Kimberly Fisher ’14
Faculty Mentor: Professor Morgan Benowitz-Fredericks, Biology

Effects of Yolk Testosterone Levels and Post-hatch Food Availability on Wound Healing in Male Domestic Chicks (Gallus gallus)

Avian phenotypes are affected by both physiological maternal effects and post-hatch environmental conditions. We investigated the interactions between yolk testosterone levels, a maternal effect, and post-hatch food availability in young male domestic chickens (Gallus gallus). We hypothesize that maternal testosterone is more likely to promote fitness when environmental conditions, specifically food availability, are favorable. However when post-hatch environmental conditions are suboptimal, chicks exposed to elevated yolk testosterone may suffer reduced fitness compared to those from low yolk testosterone eggs. We investigated immune function as a phenotypic measure important to fitness. To assess the effects of both yolk testosterone levels and post-hatch food availability on immune function, we used a wound healing assay, which was previously validated in non-avian systems. We injected unincubated chicken eggs with 5 ng of testosterone dissolved in 50 μL of sesame oil (“T”) or with 50 μL of sesame oil (“C”). On day 7 post-hatch, 30 T males and 20 C males were evenly distributed into diet cohorts. “Ad libitum” chicks had unlimited access to undiluted Poultry Starter Mix while “restricted” chicks had unlimited access to the same food diluted with 30% oat hull filler. Wound healing measures the effectiveness of an integrated innate immune response to a cutaneous wound by measuring the healing rate of a small biopsy. A 5 mm diameter biopsy punch was taken from the wing web of each animal. Standardized photographs of the biopsy sites were taken at days 20, 23, and 26, and the area of the biopsy site that remained open was measured digitally. Wound healing was slower in chicks exposed to elevated yolk testosterone but was not affected by food restriction. We also propose that the wound healing technique maybe an effective indicator of immune function in birds.

Mike Synodis ’13
Faculty Mentor: Professor Michael Gross, Chemical Engineering

Using Computer Modeling to Assess the Performance of Infiltrated Solid Oxide Fuel Cells

Fuel cells operate by releasing energy during an electrochemical reaction and converting that energy into usable electricity. Solid oxide fuel cells (SOFC’s) have three ceramic layers that are required for the electrochemical reaction to occur: the anode, the cathode, and the electrolyte membrane. In the SOFC, oxygen ions from the cathode reaction transport across the electrolyte membrane from the cathode to the anode, where they react with the fuel. Energy generated by the reaction is harnessed and transported as electrical energy through an external circuit.

This research project utilized computer modeling in MATLAB to simulate the laboratory process of creating the anode of a SOFC. Initially, a slurry of polymer pore formers, binder material, and the anode structure material (yttrium stabilized zirconia, or YSZ) is created, the pore formers and binder material are burned off, and the remaining YSZ powder sinters together at extremely high temperatures. The YSZ powder retains its shape after the pore formers are burned off, so even after sintering the pores created by the polymer are evident. The conductor material is then infiltrated into the anode through the porous YSZ structure. This infiltration process allows smaller amounts of conductor (loading percentages) to be used to achieve the same conductivity as a bulk mixing of the YSZ and conductor.

The computer program mimics the underlying physics of the complete process by creating and analyzing a 3-D array of a simulated anode, where each of the processing steps in the procedure is simulated as part of the program. When the program is run, a plot of the cell array is generated after each step in
the gut, presumably by pre-absorptive receptors. This supports the idea that glucose ingestion stimulates intake. Consumption is then inhibited by the post-ingestive negative feedback effects arising in the gut, which contribute to satiety. Recent research has suggested the existence of a pre-absorptive “gut taste” transduction mechanism that utilizes glucose receptors, like those in the mouth, to convey positive feedback information early in the meal. To test this proposed system, two experiments were performed to assess the unconditioned response of rats to the detection of sugar infused intragastrically (IG). In the first experiment, subjects acclimated to the testing procedure were presented daily with a novel flavor of .05 percent saccharin solution accompanied by IG water infusion for a series of three baseline trials. In the subsequent test trial, novel flavored saccharin was coupled with a 16 percent (w/w) glucose infusion. Rats consumed significantly more in this test compared to the baseline trials. To rule out the possible effect of thirst caused by the intragastric introduction of hypertonic glucose, a second within-subjects experiment was conducted using other carbohydrates with similar osmotic effects but that may not have the same rewarding effect. On each of the test days, rats received a novel flavor of saccharin solution paired with an IG infusion of either water (baseline) or a 16 percent (w/w) glucose, fructose or maltodextrin solution. Rats drank more when infused with glucose than they did on trials featuring either of the other equi-osmotic sugar solutions, which were similar to baseline. Additionally, rats’ licking rates in the IG glucose tests accelerated relative to water infusion baseline tests at approximately the 6th minute of the session, suggesting that increased intake is linked to a rapid detection of glucose in the gut, presumably by pre-absorptive receptors.

Emily Richards ’13, Marisa Taddeo ’13
Faculty Mentor: Professor Kevin Myers, Psychology

Rapid Detection of Intragastric Glucose Enhances Intake

It is generally understood that the palatable taste of sugar stimulates intake. Consumption is then inhibited by the post-ingestive negative feedback effects arising in the gut, which contribute to satiety. Recent research has suggested the existence of a pre-absorptive “gut taste” transduction mechanism that utilizes glucose receptors, like those in the mouth, to convey positive feedback information early in the meal. To test this proposed system, two experiments were performed to assess the unconditioned response of rats to the detection of sugar infused intragastrically (IG). In the first experiment, subjects acclimated to the testing procedure were presented daily with a novel flavor of .05 percent saccharin solution accompanied by IG water infusion for a series of three baseline trials. In the subsequent test trial, novel flavored saccharin was coupled with a 16 percent (w/w) glucose infusion. Rats consumed significantly more in this test compared to the baseline trials. To rule out the possible effect of thirst caused by the intragastric introduction of hypertonic glucose, a second within-subjects experiment was conducted using other carbohydrates with similar osmotic effects but that may not have the same rewarding effect. On each of the test days, rats received a novel flavor of saccharin solution paired with an IG infusion of either water (baseline) or a 16 percent (w/w) glucose, fructose or maltodextrin solution. Rats drank more when infused with glucose than they did on trials featuring either of the other equi-osmotic sugar solutions, which were similar to baseline. Additionally, rats’ licking rates in the IG glucose tests accelerated relative to water infusion baseline tests at approximately the 6th minute of the session, suggesting that increased intake is linked to a rapid detection of glucose in the gut, presumably by pre-absorptive receptors.
modern large-assembly structures that are increasingly flexible and susceptible to vibration levels which may be discomfting to the occupants of the structure. This research aimed to estimate the crowd-induced dynamic loading on an actual structure during an event utilizing the recently proposed Load Estimation Method (LEM). This method is unique in that it does not require direct load measurements. Instead, the LEM utilizes in-service acceleration data in conjunction with properties of the crowd and the structure.

The dynamic properties of the structure, including modal stiffness and the natural frequency, were obtained by analyzing a computer analysis model. The damping ratio was estimated through previous experimental testing on the structure. The properties associated with the crowd loading were estimated from a variety of sources. The frequency of the rhythmic loading was deduced from the acceleration data and from the beat of inciting music at the event. The contact duration of the jumping load was estimated from values suggested by the developers of the LEM method.

The LEM was initially confirmed for a small group occupying a small structure with previously obtained experimental data. The method was then applied using Matlab to in-service acceleration data from a larger crowd occupying a larger structure. The results for the magnitude of the dynamic loading were unreasonable. It was determined that the LEM method is particularly sensitive to the structural properties, particularly the structural stiffness. An investigation into static and modal stiffness for a variety of structures was developed and is ongoing.

**Christian Treat ’13**

**Faculty Mentor:** Professor Peter Judge, Animal Behavior

**Personality Assessment in Captive Hamadryas Baboons (Papio hamadryas)**

Personality is the result of consistent, yet individualized behavior toward environmental stimuli and conspecifics. Factor models describe the structure of personality by extracting suites of related behaviors that represent a particular trait. Some traits are evident across different species, such as similarities between the Five Factor Model of personality in humans and corresponding dimensions in nonhuman primates. Personality is typically assessed through subjective ratings, experimentation, or direct observation of behavior. However, subjective ratings are vulnerable to observer bias and experimentation is often limited to a single personality trait. Direct observation avoids these limitations through nonbiased sampling methods to measure behavior. To assess personality in a nonhuman primate using direction observation, focal observations were conducted on the nine individuals in a captive group of hamadryas baboons and behavior was coded based on a 75-item ethogram. Principal Component Analysis was used to group similar behavior categories and five stable and interpretable factors were extracted. These personality dimensions included three social traits that were labeled, ‘sociability,’ ‘social embedment,’ and ‘subordination,’ and two nonsocial traits labeled, ‘anxiety’ and ‘activity.’ The five traits accounted for 84.7 percent of the total variance in behavior. The extracted traits reflected how the tightly interwoven social structure of hamadryas baboons influenced the manifestation of personality in this species. Furthermore, these dimensions were consistent with findings of previous studies of personality in nonhuman primates. Due to the similarity of the traits in the Five Factor Model and those extracted in this nonhuman primate study, the project provides support for an evolutionary basis for personality.

**Anna Uehara ’12**

**Faculty Mentor:** Professor Kathleen Page, Biology

**The Effects of Altered Melatonin Levels and Hippocampal Gene Expression in the Male Rat**

The stability of the circadian rhythm for mammals lies greatly in the levels of serotonin and melatonin, neurohormones that signal for lightness and darkness, respectively. Disruption in the stability of neurohormones has been seen to be a critical factor in psychopathological disorders in humans. Altering levels of melatonin in utero through administration of melatonin or the melatonin receptor antagonist, luzindole, has been seen to cause changes in developmental growth and adult behavior in the male rat. Behavior testing has indicated that varying melatonin levels may lead to changes in plasticity through learning and memory of the male rat. Differences in the degree of plasticity may be due to alteration in levels of receptors and neuronal proteins. Levels of postsynaptic receptor for gamma-aminobutyric acid, GABAA or GABAB and subunits of receptor NMDA, key players in memory and learning, have been found to be altered in schizophrenic patients with right/left hemisphere differences. Growth association protein, GAP-43, a protein that is necessary for neuronal growth cones as well as long term learning has been found to be critical for axon and presynaptic terminal formation and retention. It is possible that altered levels of receptors or essential proteins will lead to differences in neuronal growth and plasticity. To further understand the consequences of altering melatonin levels, qRT-PCR was used to investigate gene expression in the right and left whole hippocampus of adult rats.

**Tony Veloz ’14**

**Faculty Mentor:** Professor Eric Tillman, Chemistry

**Synthesis of Telechelic Polymers via Atom Transfer Radical Coupling**

High amounts of α,ω fluorene end-labeled polystyrene were produced by use of an Atom Transfer Radical Polymerization (ATRP) (Scheme 1) and then a subsequent Atom Transfer Radical Coupling (ATRC) reaction (Scheme 2). The polymer was synthesized by allowing 9-bromofluorene to become a free radical in the presence of a metal-ligand catalyst complex and allowing it to react with styrene monomer (Scheme 3). Furthermore, the resulting polymer was then coupled using a copper-ligand catalyst complex (Scheme 4). The polymers were analyzed by Gel Permeation Chromatography (GPC), Nuclear Magnetic Resonance (NMR), and UV-Visible Spectroscopy (UV-Vis Spec). By thorough analysis of data, it was found that high degrees of coupling were achieved along with high amounts of fluorene labeling on the resulting polymer.
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 thirty individuals have been collected from 26 sites across the sympatric distribution range of *M. convicta* host races (eastern and mid-western United States). After the extraction of the beetles from the gall, DNA was extracted from the beetles using DNeasy Tissue kit (QIAGEN). Ten 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.

**Katherine Wiley ’14**
*Faculty Mentor: Professor Erin Jablonski, Chemical Engineering*

**Liquid-liquid Extraction of a Model Small Molecule Pharmaceutical Agent in a Milli-fluidic Device**

Milli-fluidic devices are used for the extraction of naproxen from octanol into pH 7.4 aqueous solution. Co-current laminar flow of the organic phase and aqueous phase is stabilized in the milli-fluidic devices by a hydrogel layer lining one side of the channel. The hydrophilic hydrogel interacts with the aqueous phase, and effectively creates a stable interface between the aqueous and organic phases. Naproxen, a small molecule pharmaceutical, diffuses across this interface from the organic phase to the aqueous phase. Based on controlled flow rates, duration, inlet concentrations, and measured outlet concentrations, a mass transfer coefficient was calculated. The mass transfer coefficient calculated by experimental data can be verified by theoretical estimates determined using the Wilke-Chang equation and penetration theory.

*Spring 2012 Semester Abroad*