



STUDENT SHOWCASE OF
EXCELLENCE

PLYMOUTH STATE UNIVERSITY

April 25, 2014
2 – 7 p.m.

Hartman Union Building

Plymouth State University
Plymouth, N.H.

Plymouth State University Student Showcase of Excellence

2:00 – 2:15	Welcome and Reception	Julie Bernier <i>Provost</i> Fireplace Lounge
2:30 – 6:00	Student Presentations Room 109 (2:30 and 4:30) Room 119 (Student Senate Room) Room 123	Page 31 Page 33 Page 36
3:00 – 4:30	Student-Designed Games and Interactive Presentations Room 109	Page 32
3:00 – 4:00	Poster Session A - Court Room	Page 2
3:00 – 7:00	Student Presentations and Interactive Demonstrations Tower Room	Page 38
4:00 – 5:00	Poster Session B - Court Room	Page 10
5:00 – 5:15	Remarks	Sara Jayne Steen <i>President</i> Fireplace Lounge
6:00 – 7:00	Poster Session C - Court Room	Page 20
6:50 – 7:00	Concluding Remarks	Thaddeus Guldbrandsen <i>Vice Provost</i> Court Room

Refreshments are available at 2 p.m. and 5 p.m. in the Fireplace Lounge

All student research posters will be displayed from 2 - 7 p.m. in the Hartman Union Building Court Room. Times listed refer to when students are scheduled to be present to discuss their research with visitors.

Abstract and project descriptions include names of student researchers (and academic major), other on-campus and off-campus collaborators, and the faculty sponsor. Students marked with an asterisk (*) study in one of Plymouth State University's graduate programs.

Abstracts and project descriptions reflect writing styles and conventions established by the individual discipline.

Some projects are supported by Plymouth State University's participation in the National Institutes of Health's IDeA Network of Biomedical Research Excellence (INBRE), the National Science Foundation, the Provost's Research fund, and other external funders.

Poster Session A

1. Effects of Anxiety within Unknown Time restrictions

Student Researchers: Kimberly Brooks, Jana Nieman (Psychology)

Faculty Sponsor: Angela Kilb

This is important because we want to see if time management has an impact on students when they experience different levels of anxiety. We are measuring the levels of anxiety in individuals after participating in a reading comprehension and questions while being restricted to time without knowing. We are measuring anxiety by a clinical anxiety scale that is taken after doing the reading comprehension and questions. The part of this experiment that is being manipulated is time. We have two measures of time (3 minutes and 5 minutes), the participants don't know that they are being timed or for how long. We will evenly distribute the length of time within different groups of participants. Our predictions that the participants who have 5 minutes to complete the task will have a lesser level of anxiety compared to those who have only 3 minutes to complete the task. Preliminary results will be presented.

2. Characteristics of Middle School Male Students Who Are At Risk For Alternative Learning Settings in Rural Areas

Student Researcher: Brittany Snow* (Special Education)

Faculty Sponsor: Ann B. Berry

This study identifies five protective and risk factors that place urban male adolescents at-risk for being placed in an alternative learning setting (ALS). These characteristics are socio-economic status (SES), family/neighborhood dynamics, history of academics, codings or present disabilities, and involvement with behavioral interventions. Data on these factors will be collected from a rural school district within New Hampshire and analyzed to determine if the factors present in urban male adolescents are also present in rural male adolescents.

3. The Effect of Personality and Appearance on Attractiveness

Student Researchers: Brittany Sleeper, Kelley Kirby (Psychology)

Faculty Sponsor: Angela Kilb

This project is important because it determines the effect appearance and personality has on level of attraction. We are measuring peoples attraction to certain individuals based on personality and appearance with a presentation of pictures and personality descriptions. The personalities are being manipulated by presenting interchanging positive, negative, and neutral personality traits. We predict that females will be more attracted to personality while males will be more attracted to physical appearance. Preliminary results will be presented.

4. Aggressive Tendencies at PSU

Student Researchers: Lindsay Hale, Alexandra Cardi, Colin Zhang, Kathleen Winchell (Psychology)

Faculty Sponsor: Angela Kilb

This project is important because this will show whether aggression is still present after being exerted for a period of time. We are measuring the amount of aggression towards others. We are measuring this by the number of unpleasant photographs the participant

chooses for a future research experiment. We are increasing aggression by having each participant play "Flappy Birds" for 5 rounds and then having half of the participants punching a punching bag to release aggression. We predict that the participants who punch the punching bag will choose more of the pleasant photographs, and the participants who do not get to punch the punching bag will choose more unpleasant photographs. Preliminary results will be presented.

5. New Hampshire Paleoindian Fluted Point Inventory

Student Researcher: Thor Johnson (Anthropology/Sociology)

Faculty Sponsor: Katherine Donahue

This project consisted of taking measurements of all Paleoindian (approx. 11,000 to 8,000 BP) fluted projectile points found in New Hampshire. These measurements and their attendant descriptions were entered on data sheets and placed in an Excel document. This data will go to the Paleoindian Data Base of the Americas (PIDBA), a site hosted by the University of Tennessee. A report describing my findings from every site in which a point was discovered will include all the photographs, raw data sheets, and also the final Excel document. This report includes discussion of the significance of the findings and compares the different styles of the points from each site.

6. From the Caribbean to your couch: the real pirates that invaded our imagination! An exploration of historical inaccuracies within contemporary print, film and media

Student Researcher: John O'Grady (Humanities)

Faculty Sponsor: Elaine Allard

The pirates of the early 18th century were often referred to as the general enemies of Mankind; yet in the 20th and 21st century they are viewed as misunderstood seaman with Robin Hood-esque goals. How did the men that terrified the seas evolve into the theme for children's birthday parties? This research is to reveal the historical truths and fallacies within the modern portrayals of pirates. My research has focused on The Flying Gang, a sub-society of pirates, whose adventures inspired countless movies, books, and video games.

7. Paleoecology of a kettle bog within an active fluvial system

Student Researchers: James Coll, Kim Bourgouin (Environmental Science and Policy)

Faculty Sponsor: Lisa Doner

After retrieving nearly 10 meters of sediment from the bottom of what was believed to be a kettle bog, a remnant of the last glacial retreat up the Baker Valley in New Hampshire, a high resolution organic content record has been established, going back more than 6000 years, with three radiocarbon dates constraining this interval. All ages are presented as calibrated years before present. Preliminary analyses of the core reveal several unexpected, high magnitude features in the organic content time series. Since the mid-Holocene, the bog has experienced a general downward trend in organic content from roughly 35% LOI at 6000 yr. BP to 20% by 1000 yr. BP. During this period, the record of organic content oscillates sinusoidally by $\pm 7.5\%$ LOI from the trend line. Organic content increases abruptly to 45-50% LOI after 1000 yr. BP, and stays at that level until ca. 400 ± 35 yr. BP, and the increase to 45% LOI is represented by multiple samples. After 400 yr. BP, LOI values plunge to below 3% in the span of 2

centimeters, and remain low for another 30 cm. The texture of low LOI interval is very fine sand and is a distinctly lighter color, most likely representative of a flood event that mobilized Baker River alluvium and deposited it into the relatively deeper water of the bog pond. Although the Bog elevation is mapped at just above the 100-year flood limits on FEMA maps, the Baker River experienced many very high magnitude floods during the later 1800's and early 1900's. While it's uncertain if these large floods pre-date deforestation by logging, we anticipate that information as an outcome of our research. Research is ongoing, and we are continuing to add new data series and date analyses to this unique and unstudied portion of the Baker River Valley.

8. The Effects of Social Anxiety Levels on the Perception of Awkward Situations

Student Researcher: Lynne Dumas (Psychology)

Faculty Sponsor: Angela Kilb

As humans are inherently social creatures, the ability for those who are socially anxious to successfully obtain everyday resources can be negatively impacted by their fear and avoidance of the social world. In this experiment, 20 undergraduate subjects were administered the Social Avoidance and Distress Scale, followed by an Appraisal of Awkward Situations test consisting of five scenarios. Half the participants were closely monitored during testing, and were given the illusion that the researcher was taking notes about their responses and behavior, creating an amplified atmosphere of awkwardness and scrutiny for the participant. It was predicted that the more closely monitored participants would have higher scores on both the Social Avoidance and Distress scale, as well as the Appraisal of Awkward Situations test.

9. Route 3 Retrotour Research

Student Researchers: Michael Toof, Geena Powers, Sean McGlynn (Tourism Management and Policy)

Faculty Sponsor: Mark Okrant

The Retrotour is a collaborative marketing organization designed to help revive 1950s-1960s themed businesses on and around New Hampshire's Route 3. In an effort to help market the Retrotour, research was conducted on the 1950s and 60s to determine what was iconic during these times and what it really means to be retro. Interviews and surveys were conducted to reveal that many millennials were interested in the 1950s and 60s, road trips, and overall exploring of New Hampshire's Route 3. Our team worked hands-on with the Pemi Valley Chamber of Commerce to reach out to businesses that fit our criteria we established for the Retrotour. We worked to create image generation with a combination of website and logo design. We were asked to design an idea for a homepage for the Retrotour website and to give some insight on the navigation of each page and the layout of what they would consist of. A marketing plan and timeline were created to help the Retrotour move forward.

10. Deep Growth: Benefits of integrating a school garden project into a 1st grade curriculum

Student Researchers: Jill Tarkleson* (Counselor Education); Julie Bisson (non-degree)

Faculty Sponsor: Stephen Flynn

The study explored how 1st grade children benefit from participating in a school-based garden project. Creating a curriculum that could be used by other school counselors and teachers to implement nature based activities that foster wellness in children was the intention of the study. A narrative approach was used to interview the children and their teachers. The findings of the study showed that children gained critical thinking skills, increase in empathy, and an increase in engagement in all academic classes. The participants also demonstrated knowledge in how to grow vegetables, and an increased depth of knowledge related to the American School Counseling Association standards and the Common Core standards.

11. Applying Fieldwork Skills to Field Trips

Student Researcher: Brittany Angelo (Environmental Science and Policy)

Faculty Sponsor: Bryon Middlekauff

In the Geosciences, from the students' perspective, fieldwork skills are essential. Field trips are critical in learning the necessary skills, such as organization, interpersonal, and intellectual activities, time management and presentation skills. Other transferable skills, such as teamwork, communication, autonomous learning, computer literacy, and independent and small group interaction are also critical and can be reinforced and leveraged in internships and job training. Even though planning and executing of a field trip is very difficult, time consuming, and stressful, a professor can give a student so much more than a classroom lecture with real-life experiences. Additionally, through field trips, a student can discover more about themselves and complete career planning tasks. The student also can get a better understanding of real world problem solving skills and learn how to better utilize skills. This poster illustrates examples of the execution of these skills in a field setting.

12. Does Situational Context Influence The Use Of Direct And Indirect Aggression?

Student Researcher: Theresa Pallotta (Psychology)

Faculty Sponsor: Angela Kilb

The importance of this study is to determine when direct and indirect aggression is used and how the situational context may influence the use of either direct aggression or indirect aggression. The variable being measured is aggression but more specifically the likelihood of using direct and indirect aggression through an adapted version of the Richardson Conflict Response Questionnaire. The manipulation in the study is the source and information revealed in two scenarios. The source in one scenario is an enemy spreading false rumors and the source in the other scenario is your roommate which you confided in about a personal matter. The predicted results are to see an increase in the likelihood of using direct aggression toward the person the participant confided in and an increase in the likelihood of using indirect aggression toward the person who spread false rumors about the participant. Preliminary results will be presented.

13. Changing Cultures Along the Silk Road

Student Researcher: Bethany Cook (Anthropology/Sociology)

Faculty Sponsor: Katherine Donahue

The Silk Road was and still is a series of routes that stretch across Asia west into Europe. Intricate roadways through deserts and over mountain passes created connections between eastern and western societies, some long disappeared. It is commonly thought that the Silk Road merchants such as Marco Polo normally travelled long distances from west to east and back again with their goods. On the contrary, the norm was for merchants to exchange goods such as silk, gemstones, and horses at market towns and cities such as Samarkand or Xian. Merchants from other cities then carried those goods farther east or west, thereby spreading goods and ideas.

In fact, the most important trade on the Silk Road was not material goods, but culture itself. The Silk Road routes enabled religions such as Buddhism, art, music, language, and technology to spread. This cultural exchange is still visible in the art and architecture of Eurasia, from the caves of Dunhuang in China to seventeenth century delftware in the Netherlands. However, because similar cultural exchanges happen to this day, it is even more important to be able to unravel and understand the mechanisms of exchange of ideas behind the more obvious material goods.

14. MAPS (Marketing Association of Plymouth State)

Faculty Sponsor: Brad Allen

15. Invisible Barriers to Student Success in Higher Education

Student Researchers: Karen Deighan* (Learning, Leadership, and Community)

Faculty Sponsor: Cheryl Baker

This presentation will attempt to answer the following questions: How is student success in higher education defined? What are the invisible barriers, which may impact student success? How can students prevail in higher education? The gap is closing and a more diverse population, including students with disabilities, is going to college. Students often have an unrealistic view of their ability to overcome their challenges to learning and this can have an adverse effect on their education. Additionally, this presentation will explore the importance of self-advocacy for students and what can be done to assist them, both at the classroom level and the institutional level.

16. Social Justice in the Bateyes of the Dominican Republic (Title IV-E partnership with NH's Division of Children, Youth, & Families)

Student Researcher: Samantha Nolin (Social Work)

Faculty Sponsor: Kristina Lind

The concept of social justice embraces the concept that every human deserves to be able to meet his or her basic needs. Each human has the right to access food, water, shelter, basic health care, and primary education. A four-hour plane ride away, on an island which supports the two different nations of Haiti and the Dominican Republic, many people struggle to meet the basic needs of themselves and their children. For Haitians who live in the Dominican Republic, their struggles are compounded by intense racism in many areas of the country. From the 1930s-1960s, many Haitians were trafficked into the Dominican Republic, used for cheap labor cutting sugar cane, stripped of their

legal identification documents, and sometimes gruesomely massacred for the sheer fact of being Haitian. Today, most of the sugar plantations are gone, but a large population of undocumented Haitian workers and their native born children, are living in a country that does not count them as one of their own, and ignores them as they starve or die from preventable diseases. As engaged, global citizens, especially as Americans, we have huge potential to create profound change and access to resources for communities such as the Bateyes within the Dominican Republic.

17. Eastern Brook Trout as a Species of Concern

Student Researchers: Matt Marchand, Jacob Brendle, Zach Lebreux (Environmental Science and Policy)

Faculty Sponsor: Mary Anne McGarry

The goal of this project is to raise awareness of Eastern Brook Trout (EBT) as a species of concern and the conservation efforts directed towards them in New Hampshire. EBT are important to the local economy as a popular game fish and their presence is indicator of good overall ecosystem health. Within this project three main objectives are fulfilled the trout are raised in the classroom from fry, a suitable release site is assessed, and limits of temperature change, which could threaten the species are researched. This project cumulates in the release of the EBT at an area determined by the results of the river reach assessments. All observations and information are shared with cooperating partners Trout Unlimited and N.H. Fish and Game, and with the general public in an effort to continue education on the importance of conservation of native species. This project involves three Environmental Science and Policy students pursuing independent research in different aspects of the project.

18. Is CRYPTOCHROME a core circadian protein in the eye of the American Lobster, *Homarus Americanus*?

Student Researchers: Alexandria M. Santry (Biotechnology); Carissa N. Mosbey, Thomas H. Duval II, Abigail M. Beringer (Biology)

Faculty Sponsor: Christopher Chabot

Circadian clocks are 24-hour endogenous timing systems that are regulated by oscillating protein expression. Two of the core clock proteins, PERIOD and CRYPTOCHROME (CRY), have been found to cycle in the central nervous system of crayfish. In another crustacean, the American lobster, PERIOD has also been found to cycle in the central nervous system. Based on these results, CRY is hypothesized to be localized in the eyes of lobster and to cycle by time of day. To test this hypothesis, protein was extracted at mid-light and mid-dark from lobster eye, brain, and ventral nerve cord tissue. Then, western blot procedures were performed using humanCRY1 antibodies to probe for lobsterCRY. While there was no hCRY immuno-positive staining in the ventral nerve cord or the brain, there was positive staining of the eye tissue. Although this positive staining appeared to have higher intensity in mid-dark versus mid-light, statistical significance was lacking ($P=0.08$). Thus, these results support previous studies that suggest that the circadian clock is in the eye of lobster and further suggest that CRY acts as a core circadian protein.

19. The Effects of Dopamine, Histamine and Octopamine on Efferent Neural Activity in *Limulus polyphemus*, The American Horseshoe Crab

Student Researchers: Bailey Carignan, Phi Pham, James Davis, John Rollins (Biology); Jonathan Rieder (Psychology)

Faculty Sponsor: Christopher Chabot

The neurotransmitters dopamine, octopamine, and histamine have been localized in specific areas of the brain in the American horseshoe crab, *Limulus polyphemus*. Although neurons of these brain loci have been suggested to play a role in efferent motor activity, there are few studies directly linking these neurons to efferent activity. In order to investigate the potential role of these neurotransmitters on efferent activity in *Limulus*, nerve impulses were recorded from isolated brains, *in vitro*. After establishing baseline activity, spontaneous bursts (1-20/hr) of nerve impulses were seen. Dopamine and octopamine were administered at 10-6M, and increased by ten-fold increments up to 10-1M at 30 minute intervals, while histamine was administered in 60 minute intervals. Application of octopamine and dopamine elicited immediate (<10 sec) bursts of higher amplitude nerve impulses. Histamine also caused higher amplitude bursts although with a longer latency (≥ 20 min). Overall, these neurotransmitters appear to modulate bursts of nerve impulses from the isolated brain of *Limulus*, suggesting that they normally modulate efferent output.

20. Showcase of Excellence Logo Design

Student Researcher: Brianna Casey (Bachelor of Fine Arts)

Faculty Sponsor: Pamela Anneser

21. The effects of a naturally occurring frhA point mutation in *Vibrio cholerae* pathogenesis using a copepod model

Student Researchers: Kyle Brumfield (Biotechnology), Ashley Maxner* (Biology)

Faculty Sponsor: Mike Son

Cholera is a re-emerging infectious disease of the small intestine, which if left untreated, will ultimately result in death by severe dehydration. This disease is caused by the aquatic Gram-negative bacterium *Vibrio cholerae*, which is commonly found in the environment attached to the chitinous exoskeleton of planktonic crustacean copepods. Attachment of *V. cholerae* on the surface of copepods has been observed to increase the survivability of the bacterium in the environment. The flagellin-related protein hemagglutinin, coded by frhA, mediates the attachment of *V. cholerae* to chitin and epithelial cells in conjunction with the chitin binding protein GbpA. Recently, mutations have been identified in clinical isolates of *V. cholerae*, and these mutations have been linked to an increased level of virulence than was previously observed. The goal of this research is to determine how a frhA point mutation, in conjunction with other implicated point mutations in regulatory genes (hns, hapR, luxO and vieA), affects attachment of *V. cholerae* using a copepod model. For each *V. cholerae* mutant, we will enumerate the number of cells attached to the chitinous surface of marine copepods. We hypothesize that strains containing the frhA point mutation will have an increased ability to attach, thus lending support to its role in the increased virulence of clinical isolates. A better understanding of the role of the point mutation in frhA and its effects on binding may shed light on how the intricate regulatory mechanisms are involved in virulence gene expression and *V. cholerae* pathogenesis.

22. Transcriptomic identification of putative circadian clock genes in the American lobster, *Homarus americanus*

Co-Authors: Christopher Gonzalez, Christopher Wilk* (Biology); Ethan Johnson (Biotechnology), Christopher C. Chabot

The circadian clocks of animals generally contain the core clock genes clock, cycle, timeless, period, and cryptochrome, as well as regulatory clock genes such as protein phosphatase and casein kinase. While clock genes have been well-studied in several animal taxa, little is known about these genes in crustacea. The goal of this study was to determine if the American lobster, *Homarus americanus*, has these clock genes and to predict their phylogenetic relationships. A further goal was to quantify light and dark clock gene expression using RNAseq. In this study, mRNA was extracted from brain and eye stalk tissue of lobsters approximately one hour after lights on (n=3) and one hour after lights off (n=3). The mRNA was then sequenced via Illumina HiSeq2000 to compile a reference lobster transcriptome, which was subsequently queried via tblastn with known clock homologs. Importantly, core and accessory putative clock genes were found and identified for the first time in lobster. Surprisingly, no significant changes in gene expression between the light and dark samples were found ($P > 0.05$). Overall, the results suggested that putative lobster clock genes are highly conserved among arthropods.

23. DNA Extraction and Sequencing for Discovery of Genetic Variation in the Connective Tissue Growth Factor Gene

Student Researchers: Ellen Rounds, Harlie Shaul, Kate-Lyn Skribiski (Biotechnology); Courtney Pearson (Psychology)

Faculty Sponsor: Heather Doherty

In America, heart disease has risen to be the most common cause of death. After there is damage to the heart, tissue dies and is replaced by scar tissue called fibrosis. Fibrosis constricts the heart causing it to not function properly. One of the main genes involved in healing and fibrosis is connective tissue growth factor (CTGF). CTGF signaling encourages the break down of damaged tissues and rebuilding extracellular matrix (ECM). Transforming Growth Factor-Beta (TGF- β) stimulates the CTGF signaling pathway, and acting together, they can cause fibrosis. Sequencing of the five CTGF exons will allow us to look for genetic variations in the human population. Primers were designed for sequencing and initial samples have been compared with the published human genome to look for sequence variations. For exon 3 and 4 few variations were found and for exon 5, at least five variations have been seen. As more samples are sequenced, it will allow for detection of additional variants. In the future, investigation of fibroblast cells in culture will allow for the determination of fibrosis-related phenotypes of these genetic variants. Knowing how CTGF is involved in regulation of healing and fibrosis can lead to new treatments for heart disease.

24. Evaluating the Effects of Clinically Relevant Point Mutations in Four Regulatory Genes on the Levels of TcpA and ToxT Production

Student Researchers: Keyandra Barchey-Robinson, William Armstrong, Kyle Brumfield (Biotechnology); Calli DeGrace, Stephanie van Loon, Ashley Maxner* (Biology)

Faculty Sponsor: Mike Son

Cholera is a globally important, re-emerging infectious disease of the lower intestine. There have been growing concerns with *V. cholerae* evolving to increased virulence, causing more severe cases of disease at a much faster rate than previously observed. The hallmark symptoms of the disease include vomiting and severe watery diarrhea, which if left untreated or treated improperly leads to severe dehydration and death. The primary research goal of this project is to evaluate the relative levels of virulence factor production in *V. cholerae* with clinically relevant point mutations through immunohistochemistry. Different combinations of clinically relevant point mutations in four regulatory genes (hapR, hns, luxO, vieA), previously identified through next generation deep sequencing, demonstrated increased cholera toxin production when introduced into a prototypical wild-type strain (N16961). We are currently investigating the effects of the four point mutations in different combinations on the expression levels of virulence factor TcpA, the pilin subunit essential for colonization, and the master regulator ToxT. Determining the effects of the different point mutations in different combinations will allow us to better identify which regulators are potentially involved in the increased virulence observed in cholera outbreaks. This identification of important virulence regulators will yield insight into the overall pathogenesis of *V. cholerae* and significantly enhance our understanding of cholera and other enteric diarrheal diseases.

Poster Session B

25. Conserving Grassland Bird Habitat on Private Land in the Upper Valley

Student Researcher: Jamie Sydoriak* (Environmental Science and Policy);

Other Collaborators: Rosalind Renfrew, Pamela Hunt, Shannon Rogers, Len Reitsma

Faculty Sponsor: Len Reitsma

Grassland songbirds have shown widespread, long-term population declines as a result of development, succession of grassland habitat to forest, and intensification of agricultural practices. Conservation strategies and incentive payment programs for managing grassland habitat exist, but most private landowners are not aware of the serious threats faced by grassland birds, much less the opportunities to address the problem. We initiated a targeted bird survey and subsequent outreach program to better manage existing habitat for grassland birds in the Upper Valley of the Connecticut River, an area where populations of these sensitive species have been disappearing. The mean relative abundance of grassland birds has significantly declined by 22.5% across a subset of sites surveyed in the 1990's (paired t-test, $p = 0.03$). In addition, the results of a targeted landowner questionnaire reveal that 38% of farmers are cutting their hayfields more often than they were 30 years ago (Cochran's $Q(2) = 9$, $p = 0.011$). To fill an information gap, outreach packets about bird-friendly grassland management

were distributed to over 100 landowners who requested it from their questionnaire, were non-respondents identified as owning high-priority grassland conservation areas, or were present at public workshops. By engaging private landowners and increasing habitat quality on lands already managed to maintain "openness," we can conserve viable populations of grassland birds in the Upper Valley. This goal is increasingly important as grassland birds continue to decline, even in the heart of their ranges. (This project received supported from Joe and Gail White Fellowship; Norcross Wildlife Foundation; Davis Conservation Foundation; Roby Charitable Trust; Stone House Farm Fund; Mascoma Bank; French Foundation).

26. Issues of Hand Hygiene Compliance and Sustainability in a Critical Access Hospital: Improving a Culture

Student Researcher: Stephanie Treadwell (Anthropology/Sociology)

Faculty Sponsor: Katherine Donahue

Unacceptable hand hygiene compliance rates are an issue faced by many hospitals. This study sought to gain an understanding of the culture found within Spear Memorial Hospital, a critical access hospital and integrate proper hand hygiene practices into the culture. Questionnaires dealing with issues of hand hygiene compliance and accountability were sent to all health care workers, observations of hand hygiene compliance were done, and a focus group was held to give the opportunity for health care staff to have an open forum to speak about hand hygiene compliance. Hand hygiene compliance rates were shown to need improvement and through data analysis, patients were found to be a unifying factor that could have the potential to hold health care workers and even departments accountable to one another for their hand hygiene. Educational forums about accountability and hand hygiene were found to be a potential solution.

27. Panthers Weather Forecasting

Student Researchers: Chaz Braxton Cole, Shawn Handler, TJ Palmer, Ethan Scannell (Meteorology)

Faculty Sponsor: Jason Cordeira

In collaboration with the PSU Athletic Department, the PSU Meteorology Department aids in providing current weather conditions and forecasts for upcoming athletic events on campus as well as off campus. Student forecasters consult with computer models and similar sources to make their own unique forecasts which are then displayed on the Panther's Forecast website at <http://vortex.plymouth.edu/panthers/>. Forecasts that are posted to the website can then be reviewed by the athletic directors in order to help them decide whether an event should proceed as planned, or if extra precautions should be taken due to severe or extreme weather (e.g., thunderstorms, heat, or cold). The purpose for our involvement with the Athletic Department is to keep them informed of impending weather situations in order to reduce the risk of on-the-field injuries, as well as transportation information, brought upon by weather-related circumstances. The forecasting job provides students with a unique opportunity to enhance their skillset in forecasting applications and to practice their communication skills required to inform the public with consistent weather updates. Our goal is to provide useful information to the public while also gaining experience in meteorological applications.

28. A Visual Approach to Generating Normative Standards of Quality for Two Squam Lake, New Hampshire Hiking Trails

Student Researcher: Micah Hall (Environmental Science and Policy)

Faculty Sponsor: Benoni Amsden

The data generated by this study will help inform management in generating standards of quality for the West Rattlesnake trail and Mount Morgan trail in Holderness, New Hampshire, both managed by the Squam Lakes Association (SLA). This study will also contribute to a growing body of literature on normative standards of quality. A visual survey was used to gather visitor input for the generation of normative standards for these trails. Indicators and standards of quality are integral components to define and measure recreational carrying capacity. Visual research methods have emerged as an effective way to define standards of quality at more heavily used front country sites. Two crowding indicators were studied, People at One Time (PAOT) on the summit and Persons per Viewscope (PPV) on the trail. The research questions examined are: 1. What normative standards will visitors identify for the selected indicator variables? 2. What will be the intensity and crystallization of the norms identified? 3. What differences will exist between normative standards for the two trails? Potential respondents were approached at the respective trailheads and asked to participate. 50 surveys were collected at each site. Respondents were shown a series of five photographs for each indicator variable that depicted a range of conditions- 0, 5, 10, 15, and 20 PAOT and 0, 2, 5, 8, and 10 PPV. They were asked to rate the acceptability of each photograph on a scale from -4 to +4. In addition, respondents were asked to identify the photograph that best represented the condition they prefer, the condition that would result in them no longer using the trail (displacement), the condition at which use of the trail should be restricted (management action), and the condition they saw on their visit (existing conditions). Respondents' acceptability ratings were aggregated and graphed into impact evaluation curves using the mean for each variable to determine the range of acceptable conditions. The West Rattlesnake PAOT curve never crossed in to unacceptability, while conditions remained acceptable at 8 PPV but not 10 PPV. At Mount Morgan, conditions remained acceptable at 15 PAOT but not 20 PAOT, and at 5 PPV but not 8 PPV. Crystallization was measured as standard deviations and was generally greater for the low PAOT and PPV photographs, with less agreement shown at higher use conditions. It is concluded that SLA should use caution when considering restrictions on these trails. It may be better to keep use concentrated at these popular trails, rather than trying to disperse use to other trails in the area whose users could get displaced. However, since crystallization was so low at higher PAOT and PPV levels, it is suggested that even though mean acceptability ratings were close to neutral, that may be misleading and the number of respondents rating those conditions as very unacceptable is significant. Those visitors may find the conditions unacceptable but continue to use the trails because of physical, financial, or temporal limitations, or because of attachment to these particular places and the lack of a suitable substitute.

29. Contaminants in Squam Lake

Student Researchers Andy Klempa (Chemistry)

Faculty Sponsor: Jeremiah Duncan

Toxic compounds, both organic and Inorganic, have had an effect on the depletion of loons on Squam lake. The Loon Preservation Committee, LPC have preserved loons

for the last thirty-five years. Since 2005 there has been a depletion of loons on the lake. There have been signs of toxic metals getting into the water and loon eggs. We have teamed up with the LPC to help find the cause of these metals and the depletion of loons on the lake. My project was to continue the 2012 Environmental Chemistry student projects, along with my own work of testing for metals in water samples. I tested 26 different water sample sites from around the lake and tested for ten different metals, Cd, Cu, Pb, Ba, Mg, Mn, Ni, Zn, Cr, and Sr. I used water samples collected by my group and Gregg Callanan's group from the spring of 2013 Environmental Chemistry class, along with Dr. Jeremiah Duncan to get extra samples. Working with Aaron Johnson and using the Graphite Atomic Absorption Spectrometer Furnace to test various water samples for the metals to see if there are contaminants in the water that is causing the decline of loons on Squam Lake.

30. Benthic macroinvertebrate community responses to stream flow variability

Student Researcher: Donovan King (Biology)

Other Collaborator: Mark Green

Faculty Sponsor: Kerry Yurewicz

Changing flow patterns pose challenges for most aquatic organisms, but not all species are affected equally. As local conditions change, so can competitive hierarchies, resulting in changes to the structure of stream communities. An initial examination of stream flow data from the Hubbard Brook Experimental Forest (HBEF) shows an increase in annual flow volume and variation at all watersheds over the last 50 years. In order to understand flow-induced community responses, biweekly benthic invertebrate samples will be collected from two consistent locations at HBEF for approximately one year. The use of a Surber sampler will ensure that the area of the stream bed examined remains consistent. Additional samples will be collected from sites analogous and contiguous (<2m distant) to the primary sites following any significant departure from seasonally typical stream flow. Any changes in invertebrate density, biomass, and diversity will be examined. These data will be combined with stream data provided by HBEF and all site-specific data collected during sampling. By examining how the benthic macroinvertebrate community responds to localized stream flow patterns, predictions can be offered to describe how future communities may be shaped by the changing frequency of different stream conditions.

31. The Effects of Threat Type on Mediating Right Wing Authoritarianism and Out-group Opposition

Student Researchers: Justin Demers, Chris Moore, Jeff Steiner (Psychology)

Faculty Sponsor: Angela Kilb

This research study is important because it investigates out-group opposition and how it is effected by different types of threats. This study measures Right Wing Authoritarianism using the Right-Wing-Authoritarianism scale and Out-Group opposition using the Generalized Group Attitude scale. The type of threat was manipulated in the study by presenting three different groups being actively recruited to come to Plymouth State University, each of which represented either an academic, social, or no threat. We predicted that higher levels of Right Wing Authoritarianism would correlate with higher opposition to a group posing an academic threat. Preliminary results will be presented.

32. The Effects of Job Interview Performance on Anxiety Level

Student Researchers: Haley Bassett, Kelsey Hooper, Kendra Makos (Psychology)

Faculty Sponsor: Angela Kilb

Understanding the effects of job interview performance on anxiety level is important because it can help better prepare individuals for real life job interviews. We are measuring the participants' anxiety levels when put in stressful situations (job interview) versus general anxiety. We will do this by using two questionnaires and counting the amount of filler words used by each participant in their responses. We are manipulating the participants' anxiety level using stressful job interview questions and scenarios. For the experimental manipulation, half of the participants will be told they are being watched from behind a two way mirror by potential employers. We predict that participants will experience increased levels of anxiety, especially those in the experimental group, during the job interview situation. Preliminary results will be posted.

33. Can Remember/Know Judgments Create a Shift in Memory Strategy?

Student Researchers: Amanda Goodwin, Evan Kowalski, Allison Jacques (Psychology)

Faculty Sponsor: Angela Kilb

Previous research has shown that older adults demonstrate a memory benefit when asked to provide remember/know (RK) judgments (Navah-Benjamin & Kilb, 2012). One explanation for the increase in performance is that providing RK judgments encourages participants to engage in new strategies at encoding and retrieval. We examined several manipulations to investigate possible strategy shifts that occur either at encoding or retrieval in younger and older adults, and results show some support for both explanations.

34. Recommendations for Future Growth of the Belknap Mill

Student Researchers: Geena Powers (Tourism Management and Policy); Christopher Burbank (Social Science)

Faculty Sponsor: Mark Okrant

The Belknap Mill is having trouble staying financially sustainable. This is due to a lack of consensus on a solid core mission and lack of Board of Trustee involvement. Best practices and case studies about financial sustainability, past mill projects, and other successful nonprofit organizations maneuvers were analyzed and researched. A SWOT analysis was also conducted. With this information, recommendations for the Belknap Mill were developed in the form of a number of questions. The board of trustees must ask themselves these questions. Stakeholders associated with the Mill should be present to give feedback about each question. Once these questions are analyzed and answered thoroughly, the Belknap Mill will be better positioned to engender future growth in the Lakes Region of New Hampshire.

35. Flood Insurance Rates and Mitigation ecosystem Services in the Upper Valley of the Connecticut River

Student Researcher: Jonathon Loos* (Environmental Science and Policy)

Faculty Sponsor: Shannon Rogers

Climate change predictions for increased precipitation and storm event uncertainty in the Northeast have produced a greater need for flood mitigation factors within the

region. These projections alongside planned changes to National Flood Insurance Program rates have created a situation for reevaluation of ecosystem services that bestow flood mitigation benefits. This is especially so in the Upper Valley region of the Connecticut River, which currently experiences a high degree of flooding. Working within the Upper Valley, this work will examine the ecological processes and infrastructure that together confer flood mitigation services to human communities. The social-ecological systems approach considers ecosystem services as part of a cycle of influence among human well-being outputs, and environmental management inputs (Reyers et al. 2013). Using this approach with survey based stakeholder input, this project will explore the ways perceptions of flood mitigation services in the Upper Valley shift as a result of changes to flood insurance policies. Results might suggest ways that policy can better reinforce the value of ecosystem services to prepare for future climate and flood scenarios. *This project is part of a statewide research and education project known as Experimental Program to Stimulate Competitive Research (EPSCoR).*

36. 50 Years of the Wilderness Act

Student Researchers: Ryan Curtin, Richard Russo, Christopher Orlando, Michael Garcia (Environmental Science and Policy)

Faculty Sponsor: Mary Ann McGarry

Starting in 1964 the Wilderness Act was established to ensure that expanding settlements would not overtake all areas of the United States. This act secured the everlasting resource of wilderness for our generation and will continue to do so in the future. Since being enacted the United States population has increased by over 100 million people. Fortunately during this same time period over 50 national parks along with over 750 wilderness areas have been established. These places are overseen by agencies such as the US Forest Service (1916), National Park Service (1905), and the US Fish and Wildlife Service (1940). When Aldo Leopold, Bob Marshall, and Howard Zahniser first crafted the idea of conserving land in the early 1900s they could have only dreamed that their efforts would be taken this far. New bills for designated areas of wilderness are proposed to congress every year and progress is always being made toward more land conservation. Proposals for the 113th Congress are looking to protect lands from Alaska all the way to Maine. We can only hope that the next 50 years of the Wilderness Act will be just as successful so that future generations will continue to have areas of wilderness for years to come.

37. The Effects of Cognitive Tasks on Heart Rate Variability

Student Researchers: Michael Akusis, Sean Madden (Psychology)

Faculty Sponsor: Brian Healy

Our research examined the effects that cognitive tasks had on measures of heart rate variability (HRV) and the galvanic skin response (GSR). Heart rate, respiration, and GSR were recorded from undergraduate students in the psychophysiology laboratory within the Department of Psychology. These physiological measures were recorded during an initial two minute baseline followed by a two minute subtraction task in which each participant was required to begin with a value of 400 and subtract either 5 or 7 from each successive value. This subtraction task was counterbalanced such that one participant would begin subtractions by the value of 5, followed by a 2 minute post-task baseline, followed by two minutes subtracting by a value of

7. Other participants began with subtractions by 7 followed by the value of 5. We hypothesized that subtractions by 7 would be considered more challenging to the participants compared to subtractions by 5 and be reflected in a more pronounced physiological response. Preliminary analyses (N = 15) demonstrated both a heart rate and GSR increase during the mental math exercise. The data suggest that task difficulty is related to an increase in physiological responsivity and may be related to enhanced performance.

38. Celebrating 50 Years of the Wilderness Act of 1964

Student Researchers: Ali Ponte, Amanda Hollenbeck, Lydia Morton, Jane Duggan (Environmental Science and Policy)

Faculty Sponsor: Mary Ann McGarry

Wilderness lands provide an abundance of important benefits and functions towards the environment and humankind. Conservation of these lands ensures a quality relationship between humans and the environment as well as the preservation of critical ecosystem functions and animal habitats. The Wilderness Act of 1964 was created in order to maintain our wilderness lands from population growth and expanding resource depletion. The inception of the Act is due largely in part to the contributions of three environmentalists: Aldo Leopold, Bob Marshall, and Howard Zahniser. To commemorate the 50th anniversary we analyzed the past and present impacts and successes of the Act. Even further, we assessed future potential issues that may present themselves as obstacles towards its progression.

39. Wilderness Act of 1964

Student Researchers: Field Martin, Peter Petkauskos, Sarah Ray, Jamie Wright (Environmental Science and Policy)

Faculty Sponsor: Mary Ann McGarry

This poster celebrates fifty years of the Wilderness Act, and the importance of wilderness and conservation in society. In this poster, the meaning of wilderness is explored and defined, as well as the relevance of wilderness at the time of the ratification of the Wilderness Act. This history of wilderness is also explored and events predating the Wilderness Act that lead to its creation, and the pinnacle people who represented the need for wilderness. This poster also goes into the importance of wilderness. Lastly, this poster examines the future of wilderness preservation in the United States.

40. PVSWD and PAREI Solar PV Project

Student Researcher: Richard Russo (Environmental Science and Policy)

Faculty Sponsor: Mary Ann McGarry

This poster will be about a new solar array to be installed at Plymouth Village District Sewage Treatment Plant in Plymouth, N.H. The project is a partnership between Plymouth Area Renewable Energy Initiative (PAREI) and the Plymouth Village Water and Sewer District. This project was a focus of my three-credit academic internship with PAREI. The poster is going to convey the details of this project and specifics about the energy and money that will be saved. I was involved in all phases of the project from design leading up to installation. I will be able to elaborate on the background of the project, explain the economics, identify partnerships and resources, and convey all information I learned through this process.

41. The Influence of Temperature and Lunar Phase on Hatch Intensity of *Hexagenia limbata*.

Student Researchers: Brandon Huckins (Biology)

Faculty Sponsor: Brigid O'Donnell

Mayflies are an important species for freshwater environments that can serve as bioindicators of pollutants. Mayfly nymphal growth is influenced by temperature, and mature nymphs will molt and form large mating swarms during the spring and summer months. *Hexagenia limbata* (Ephemeroidea) are a large-bodied species of burrowing mayflies found throughout freshwater systems across North America. In this study, we hypothesized that water temperature and lunar cycle would work synergistically to initiate large hatches of *H. limbata* and to influence swarm intensity throughout the hatching season. We observed nighttime hatches of *H. limbata* at Sky Pond (New Hampton, N.H.) during the summer of 2013 and measured hatch intensity, water temperature and percent lunar illumination each night, while also regularly sampling nymphs over the course of the season. We observed intense hatches occurring as soon as four days after a full moon and up to two days before a new moon, at water temperatures above 20°C. In addition, we found that nymphal body size did not decrease over the season. This data lays the foundation for future studies and lends support to our hypothesis that abiotic factors such as water temperature and lunar phase can influence *H. limbata* hatch intensity.

42. Heat shock protein expression in the mayfly *Hexagenia limbata* following osmotic shock

Student Researchers: Justin Provazza, Melissa Peplinski (Biotechnology)

Faculty Sponsor: Brigid O'Donnell

Studying organism-level responses to environmental conditions is useful to monitor anthropogenic disturbance in ecological systems. Mayflies are environmentally sensitive insects and their gills are a direct interface between organism and environment, therefore these structures should reflect changes in the quality of the environment. Heat shock proteins have been demonstrated to be highly sensitive and are upregulated in response to encountered stress. In this study, we measured the expression of a heat shock protein (Hsp70) in the mayfly *Hexagenia limbata* to ascertain if gills respond to osmotic stress. Live *H. limbata* nymphs were collected from Sky Pond (New Hampton, NH) and subjected to a 6, 12, or 24-hour exposure at 176.4 ppm, 667 ppm or 1137 ppm NaCl solutions, approximating realistic exposure levels. Exposed and control nymphs were dissected and proteins were extracted and purified. Protein extracts were used in immunoblotting protocols employing an Hsp70 primary antibody coupled to a fluorescently labeled secondary antibody. We found no bands of the appropriate size (70kDa), potentially due to loading insufficient amounts of protein or lack of antibody recognition. Future work entails determining and fixing errors in immunoblotting with the hope of optimizing this technique for novel approaches to biomonitoring. *This project is part of Plymouth State's participation in the National Institute for Health's IDeA Network of Biomedical Research Excellence (INBRE).*

43. Meat Production, Processing and Market Demand in New Hampshire

Student Researchers: Jessica Wilhelm*, Rachele Lyons (Environmental Science and Policy); Taylor Dillingham (Social Science)

Faculty Sponsor: Benoni Amsden

The Center for Rural Partnerships at Plymouth State University is conducting research regarding meat production and processing on behalf of the New Hampshire Department of Agriculture. The study aims to gauge meat production as it relates to processing facilities and the needs of producers. An effort was made to make the survey as inclusive as possible, and each producer and processor was mailed either a paper survey, or a link to a survey online. Three discrete surveys were administered for meat producers, processors, and purchasers in an effort to measure the feasibility of a state level meat certification process. Developing an understanding of each component is important for identifying gaps in production, processing, and market demand as they relate to one another. These distinct perspectives provide a holistic view about the obstacles and opportunities of the meat market. The study will provide empirical evidence to increased meat production and processing in New Hampshire and provide information about the market receptivity to a state-level meat processing certification.

44. The Clash between Idealism and Realism in The Ingenious Don Quixote de la Mancha and “The Matrix”

Student Researcher: Michael R. Farkas (Spanish)

Faculty Sponsor: Wilson A. Garcia

This presentation will examine the constant clash of idealism and realism in the novel *The Ingenious Don Quixote de la Mancha* (1605 and 1615) by Miguel de Cervantes Saavedra through a social and historic lens. The protagonist Alonso Quijana/Don Quixote de la Mancha appears in the first part of the novel as an idealistic being who attempts to live vicariously through literature. With Sancho Panza as his squire and realistic counterpart, Don Quixote encounters various seventeenth-century, ‘contemporary’ societal obstacles that inhibit him from fulfilling his expectations as a knight errant. Don Quixote must later unwillingly accept the reality in which he lives in by becoming a realistic being. The transformation of Don Quixote’s ideologies demonstrates the positive and negative influences that society has on a human being and how idealism may not be satisfied through physical, but in turn psychological, means. A comparison will be made to the film “The Matrix” (1999) and its protagonist Thomas A. Anderson/Neo.

45. The Effects of Dopamine on Locomotor Behavior in the American horseshoe crab, *Limulus polyphemus*

Student Researchers: Rachael Glazner, Doran Logsdon (Biology); Kelley Collins (Athletic Training)

Faculty Sponsor: Christopher Chabot

The American horseshoe crab, *Limulus polyphemus*, has robust circatidal rhythms of locomotion that synchronize breeding and feeding behaviors to the tides. These locomotor behaviors can be altered by neurotransmitters like dopamine in some animals such as *Drosophila melanogaster*. While in *Limulus*, dopamine has been shown to increase muscle contractions and influence motor functions in vitro, its effects on locomotor behavior is relatively unknown. The goal of this study was to determine the

effects of dopamine injections on locomotion in *Limulus*. To investigate these effects, juvenile horseshoe crabs (60-72g) from the Great Bay Estuary in New Hampshire were placed in a 14:10 light:dark cycle and were injected with saline as well as three concentrations of dopamine (10-6M, 10-5M and 10-4M) during both light and dark portions of the light:dark cycle. Locomotor activity was recorded 10 minutes pre-injection and post-injection, and both visual and digital analyses (EthoVision) were performed. Preliminary results showed dose dependent inhibitory effects, which were seen at concentrations above 10-6M with largest effects occurring at 10-4M. These results suggest dopamine has an effect on behavioral locomotion and may modulate circatidal rhythms of locomotion in *Limulus*.

46. The Effects of Power Posing on Overconfidence in the DRM Paradigm

Student Researcher: Allison Jacques (Psychology)

Faculty Sponsor: Angela Kilb

Power poses are postures that have been shown to provide long-lasting feelings of power and confidence after only two minutes. This study is testing the effects of high and low power poses on the confidence and response rates for critical lures in a memory task. Critical lures are words related to a study list that are not studied, but often recalled. High power poses are predicted to elicit higher rates of confidence overall and on the memory task, as well as increase the likelihood of recalling a critical lure. It is also predicted that the low power poses will cause participants to give lower confidence ratings than the high power poses and will be less likely to recall critical lures.

47. Local Food Security

Student Researcher: Sam Durfee (Environmental Science and Policy)

Faculty Sponsor: Brian Eisenhauer

Over the past few years at Plymouth State University, I have been working on two projects in particular with the goal of educating the student body about what food security is, why we need to care about it and ways we can achieve it. My showcase will highlight the work I have done with Sodexo and the work I have done with the Office of Environmental Sustainability (OES) as the Permaculture Design Intern. The presentation will present key findings from these experiences for improving food sourcing on campus. With Sodexo, I have helped create a living wall for the atrium which provides information on the types of plants on the wall and ways they can be used. I am also working on a project in conjunction with the Real Food Challenge to evaluate our purchasing practices as a university and the quality of the food that we buy. Through OES I am currently working on a design for a greenhouse addition to the South side of the existing EcoShed.

48. Biotechnological Production and Characterization of Eugenol Oxidase

Student Researchers: Justin Provazza, Adam Tangarone, Trevor Gordon, Katherine Fondo, Harlie Shaul (Biotechnology); Rachel Brooks (Chemistry)

Faculty Sponsor: Susan Swope

Transformation of bacteria can be utilized to generate proteins capable of in vitro production of a wide variety of organic products. Eugenol oxidase (EUGO) is an enzymatic protein that has been well characterized and is known to carry out a variety of reactions. The production of vanillin, a major component of vanilla flavor, comes

from the reaction of vanillyl alcohol. Due to the high cost of vanilla beans, chemically synthesized vanillin is used in most vanilla-flavored products but is not environmentally friendly. Biotechnological processes have been developed for the clean production of vanillin. In this study, *Escherichia coli* were transformed with a plasmid containing a gene from *Rhodococcus* sp. responsible for EUGO production. The bacterial culture was grown under ideal conditions for the production of EUGO and then harvested for the collection of the enzyme. The cells were lysed and the soluble proteins were separated from the insoluble cell components via centrifugation. Eugenol oxidase was then purified by column chromatography. The purity of the enzyme was analyzed by Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis (SDS-PAGE). After purification the enzyme was quantified and characterized by determining the kinetic parameters for various substrates.

Poster Session C

49. A Climatological Study of the Winds at Mount Washington, New Hampshire

Student Researcher: Kevin Cronin (Meteorology)

Faculty Sponsor: Eric Kelsey

Extreme winds (e.g., >100 mph) occur frequently on the summit of Mount Washington, New Hampshire, which has given the mountain and the Mount Washington Observatory much attention over the last 80 years of continuous weather observations. Understanding the atmospheric patterns responsible for severe winds on Mount Washington would be beneficial in forecasting future extreme wind events on mountainous terrain. This study begins with the methods and instruments used by MWO observers to measure wind. Then, a climatological analysis of the Mount Washington wind record since 1932 is presented.

The anemometers used at the summit have been custom-made to withstand heavy icing conditions combined with hurricane force winds. The anemometer type has progressed from a custom made heated anemometer constructed by the Mann Instrument Company in the 1930s to heated pitot tube static anemometers that have been used since 1946. To keep the anemometers free of rime and glaze ice accretion, heating elements in the anemometers are supplemented with manual deicing from an observer. During the most severe icing events, observers manually deice multiple times each hour to ensure accurate measurements of wind speed.

Observational and reanalysis data were used to examine the synoptic scale conditions that produce extreme wind events. Monthly, seasonal and annual averages of wind speed and direction were computed from hourly wind observations to assess climatological trends. The wind speed and direction time series were compared with large-scale atmospheric circulation patterns (e.g., the Arctic Oscillation) to identify the dominant patterns associated with wind on Mount Washington.

50. An Assessment of WRF-ARW Model Forecast Skill for a Winter Storm in the White Mountains, New Hampshire

Student Researcher: Matthew Cann (Meteorology)

Faculty Sponsor: Eric Kelsey

The forecast skill of the WRF model was evaluated across the complex terrain of the White Mountain National Forest in New Hampshire. The WRF model was initialized with 0.5-by-.05 degree operational GFS analyses and used GFS analyses for the lateral boundary conditions every 6 hours. A two-day forecast of standard meteorological variables was produced for a winter storm event. Forecast skill was assessed for temperature, humidity, sea level pressure, precipitation, and wind speed and direction at 25 sites. These sites include Mount Washington Observatory's Mesonet, ASOS/AWOS sites, and roadside weather stations run by Plymouth State University and New Hampshire DOT. The 25 sites are well-distributed horizontally and vertically (155-1920 m asl), providing an ample representation of weather conditions across the White Mountains. The forecast skill was evaluated at each site as a function of elevation, slope, aspect, and other environmental parameters to improve our understanding of WRF forecast strengths and weaknesses in the White Mountain National Forest.

51. Celebrating the 50th Anniversary of the Wilderness Act

Student Researchers: Kim Bourgoiun, Eryka Reid, Rebecca Brown, Andy Butuzov (Environmental Science and Policy)

Faculty Sponsor: Mary Ann McGarry

This year marks the 50th Anniversary of the Wilderness Act of 1964. The Wilderness Act formally pioneered the beginning of large-scale land conservation within the United States and was the world's first effort to preserve undeveloped wild land. The Act signified the importance of wild areas and established a process for protecting these areas for future generations. Our Wilderness Areas, National and State Parks, and National Forests have become so much a part of United States that the monumental efforts and accomplishments behind saving these wild areas from development become lost. This poster recognizes the collaborative and dedicated effort of those who spent many years creating the act. The main goal of these celebratory and informational posters is to inform the laypeople of the importance of wilderness areas and the Wilderness Act how the law has changed our country's identity as an industrialized nation to a nation that respects the natural as much as the human made world.

52. Wilderness Act 50th Anniversary 1964-2014

Student Researchers: Zachary Lebreux, Jacob Brendle, Colin Wilkey, Evan Cove, Sam Durfee (Environmental Science and Policy)

Faculty Sponsor: Mary Ann McGarry

It's time for a celebration! 2014 marks the 50th anniversary of the 1964 Wilderness Act, which was the first ever conservation bill that paved the way for Americans to protect their most pristine natural lands for future generations. The act designated wilderness areas as places "untrammelled by man" and "for preservation and protection in their natural condition." Without the Wilderness Act our National Parks, National Forests and Natural Landmarks that we all know and love today would be nothing but buildings, parking lots and high-end shopping malls. Today because of this act all Americans have access to nearly 110 million acres of natural lands for activities ranging

from hiking, camping, backpacking, fishing and more. The Wilderness Act has provided us with rare, wild places that are safe havens from the pressures of society and it has provided us with places where we can find relaxation, healing, relief and solitude. As said by John Muir, "wilderness is a necessity...there must be places for human beings to satisfy their souls." By celebrating the 50th anniversary of the Wilderness Act it allows us the opportunity to applaud all of the accomplishments we as Americans have made over the past 50 years and to remind us of what we are capable of achieving in the next 50 years.

53. The Atmospheric and Environmental Conditions Responsible for High Stream Flow at the Hubbard Brook Experimental Forest in New Hampshire

Student Researchers: David Morgan (Meteorology)

Other Collaborator: Scott Bailey*

Faculty Sponsor: Eric Kelsey

In light of the increase in destructive flooding events in the mountainous terrain of northern New England (e.g., remnants of Katrina 2005, Tropical Storm Irene 2011), more research into atmospheric and environmental conditions that lead to these flooding events is needed. The goal of this project is to understand the atmospheric and environmental conditions responsible for high stream flow from a small-scale watershed (42 ha) at Hubbard Brook Experimental Forest located in the White Mountain National Forest of New Hampshire. Synoptic scale atmospheric conditions for the top 30 high stream flow events during a 56 year record of continuous monitoring were assessed using gridded atmospheric data (sea level pressure, lower tropospheric temperature and wind, precipitable water, precipitation rates, and 500 hPa geopotential height) from the 20th Century Reanalysis dataset. Storm tracks, moisture sources, moisture pathways, and seasonality of these atmospheric conditions were categorized for each high stream flow event. Daily precipitation amount and weekly snow depth measured in the watershed were examined for their relative contributions to high stream flow. Results showed that atmospheric rivers were present during all of the top 30 events. Extratropical cyclones were associated with 87% of the events and the other 13% were associated with tropical or post-tropical cyclones. A combination of moderate rainfall and snow melt contribute to high stream flow events during winter and early spring. High precipitation amounts from multi-day rain events or tropical systems were the dominant contributors of water for late summer and autumn high stream flow events.

54. Livermore Falls Project

Student Researchers: James McManus (Tourism Management and Policy); David Coy (Geography)

Faculty Sponsor: Mark Okrant

The project was for Dr. Okrant and Dr. Guldbrandsen's class, Community Research Experience. It was a consulting project with The Friends of The Pemi regarding Livermore Falls and what could be done to improve the stewardship of the site by its visitors.

55. Using Community Based Social Marketing to Encourage Lead-Free Fishing Practices in New Hampshire Lakes and Rivers

Student Researcher: Melissa L. Leszek (Environmental Science and Policy)

Faculty Sponsor: Brian W. Eisenhauer, Loon Preservation Committee

Lead is a toxic metal with recognizable hazards that has been noticed for millennia. As many products containing lead such as paint, gasoline, toys, and pesticides has nearly been eliminated, its use in fishing tackle in recreational lakes is still extensive and can create adverse effects to many species of birds and mammals.

The goal of this project is to effectively encourage the angler community to adopt behaviors that will reduce population-level impacts of lead fishing tackle on New Hampshire wildlife. Community-based social marketing (CBSM) will be used as a framework to design research to develop persuasive communication messages to influence more sustainable fishing practices.

This strategy will support the N.H. Senate Bill 89 legislative efforts (effective June 1, 2016), which aims to ban the sale and freshwater use of lead sinkers and lead jigs weighing one ounce or less. The results of this proposed study will provide usable information to support volitional behavioral change in the New Hampshire angler community to eliminate the use and purchase of lead tackle, utilize marketed alternatives to lead tackle, establish compliance with N.H. SB 89 legislation, and ultimately keep New Hampshire lakes clear of lead and alleviate its effects in our environment.

56. Avian Biodiversity and Recruitment in N.H.

Student Researcher: Maegen Bassett* (Biology)

Faculty Sponsor: Len Reitsma

Interest in landowners' silvicultural practices and their influence on avian biodiversity is on the rise. Timber harvested from small patch cuts can create potentially useful disturbance and openings that may affect avian communities. Work done on a 117 acre parcel with 18 small patch cuts (0.25-1 acre) appears to show that numbers of early successional species have increased without detracting from pre-harvest numbers of mature forest species. Point counts, territory mapping, and telemetry were used to assess changes in community structure and individual success during three consecutive breeding seasons (2011-2013). While this trend is not due to regenerative growth, as it has not yet grown in, the increased edge habitat has undoubtedly been influential in attracting more individuals known to associate with early successional forests. Additionally, in 2013 nest searching was employed to determine either success or failure of and pair's nest. These data supported that nest productivity was not affected by proximity to cuts. Implementing forestry practices that promote recruitment of early successional bird species should ideally be planned at landscape scales being mindful of the ecological needs of forest-interior bird species.

57. Determining relationships between past and current climate and water quality conditions in Ossipee Lake and Squam Lake, N.H. to establish lake functioning baselines and improve monitoring strategies (SRAC)

Student Researcher: Melanie Perello* (Environmental Science and Policy)

Faculty Sponsor: Lisa Doner

The vital role that lakes play in central New Hampshire's economy is evident in the billions of sales dollars and thousands of jobs they generate, even as they provide drinking water (Shapiro and Kroll 2003). The continued welfare of New Hampshire lakes is threatened directly by degraded water quality and indirectly by land use pressures and climate, in particular from changes in surface runoff and lake stratification (Gibbs et al. 2002, Halstead et al 2003, Williamson et al 2009). Because of the high heat capacity of water, and their large water volume, lakes are particularly susceptible to climate change. But the relationships between climate forcing and water quality is poorly constrained. This project is part of an ongoing study that assesses year-round lake function, current and past, with an emphasis on factors related to climate and water quality. It creates time series of temperature versus depth, conductivity, dissolved oxygen, major ions and phosphorus in lakes Ossipee and Squam in every season. By combining monitoring of water temperature and quality with lake sediment analysis, we provide central and northern New Hampshire lake managers with the ability to assess how ongoing lake functioning compares over long timescales, including intervals prior to European Settlement.

58. Characterizing Iceland Lake Sediments: Identification of Storm Surge And Flooding Events In A Climate Sensitive Northern Latitude Lake

Student Researcher: Nadine Orejola (Environmental Science and Policy)

Other Collaborators: Lisa Doner, Brad Hubeny

Faculty Sponsor: Lisa Doner

Investigations of climate sensitive environments, such as a northern latitude Iceland lake, can be used to reconstruct paleostorm surge and flooding events. Conceivable links exist between storm frequency and historical floods. Wet winter conditions and increased cyclone activity prevail during the positive North Atlantic Oscillation (NAO) phase. Located in close proximity to the ocean and sensitive to marine incursions, the back-barrier lake, Rekavíkuvatn (Rekavík) (66°24'50.40"N, 23°1'47.06"W, 1m), seems an ideal location to investigate past regional climate and environmental response. Here, I present research findings on lacustrine sediment cores collected in 2013 and 1996, plus a snapshot of lake water column conditions from July 2013 revealing conductivity, temperature, and dissolved oxygen. Sediment data includes carbon content, particle-size distribution, magnetic susceptibility, and major/trace elemental geochemistry. Statistical analyses allow correlation of findings with historical records of major regional flood and storm events. I hypothesize that changes in lake hydrodynamics from high-energy storm surges and coastal flooding create predictable variations in lake sediment characteristics. Inferred storm and flood frequencies may reflect past phases of the NAO or the Atlantic Multidecadal Oscillation (AMO). This work reconstructs regional climate patterns beyond the historical written record.

59. Can Spatial Variation in Contaminants Found in Northern Crayfish Provide Insight into the Loon Decline on Squam Lake?

Student Researcher: Amanda Hollenbeck, (Environmental Science and Policy)

Other Collaborators: Tiffany Grade, Nicole Ramberg Pihl, Harry Vogel

Faculty Sponsor: Kerry Yurewicz

The loon population on Squam Lake in New Hampshire experienced a dramatic decline starting in 2004, and adult survival rates and reproductive success remain low. Many stressors likely contributed to this decline, and one factor that may have played a role is contaminants in the environment. The goal of our study was to examine contaminant levels in crayfish from a range of sites to gain insight into potential pollution across Squam and the surrounding region. Crayfish are common in freshwater systems and contribute to loons' diets. As relatively long-lived and sedentary benthic invertebrates, crayfish may be particularly useful indicators of local environmental conditions. From 2012-2013, we collected samples of northern crayfish (*Orconectes virilis*) from 11 different loon territories on Squam, 5 tributaries feeding into Squam, and 7 reference lakes in the region. Specimens were measured and then analyzed at external labs for organic contaminants and trace metals. To date, samples from 6 loon territories on Squam and one reference lake (Winnepesaukee) from 2012 have been analyzed. A variety of organic contaminants (e.g. PCB, DDT, PBDEs, PFOSs) and trace metals (e.g. Ba, Cr, Mn, Se, Sr) were measured in the crayfish, and the levels varied among sites. Data from the 2013 samples will further our understanding of this spatial variation and its potential connection to the loon decline on Squam.

60. Developing an alternative genetic recombination tool for *V. cholerae*

Student Researchers: Ashley Maxner* (Biological Sciences); Keyandra Barchey-Robinson, Kyle Brumfield, William Armstrong (Biotechnology); Calli DeGrace, Stephanie van Loon (Biology)

Faculty Sponsor: Mike Son

The aquatic Gram-negative bacterium *Vibrio cholerae* is the causative agent of the re-emerging infectious intestinal disease cholera. The mechanism by which *V. cholerae* causes disease has been well established however, the genes and mechanism(s) regulating the level of virulence remains unclear. Through the use of recombinant tools researchers are investigating the function of genes hypothesized to be involved in regulating virulence factor production and overall virulence. While the existing recombination tool can be used, it is designed for prototypical *V. cholerae* laboratory strains which are resistant to polymyxin B and high concentrations of streptomycin. This presents a challenge when conducting genetic manipulation in clinical and environmental isolates in which antibiotic resistance is not naturally occurring. The goal of this research is to develop an improved genetic recombination tool that can be applied to all *V. cholerae* strains. To this end, we will use an auxotrophic *E. coli* donor strain in conjunction with a non-antibiotic resistance counter-selectable marker, sacB, incorporated into a new allelic exchange vector. This new recombination tool will improve the efficiency of merodiploid resolution and alleviate the problem of screening false positive clones, saving both time and resources. *This project is part of Plymouth State's participation in the National Institute for Health's IDeA Network of Biomedical Research Excellence (INBRE).*

61. Evaluating the Ecosystem Service of Nutrient Removal in a Coastal Watershed: A Case Study of New Hampshire's Great Bay

Student Researcher: Chelsea Berg* (Environmental Science and Policy)

Faculty Sponsor: Shannon Rogers

New Hampshire's Great Bay, valued as one of 28 "estuaries of national significance," provides a host of economic, ecological, and social environmental services that are threatened by the deterioration of water quality and increased levels of nitrogen (PREP, 2013). The US Environmental Protection Agency has issued several NPDES permits that mandate the reduction of point source pollution to the limits of technology. In order to meet the new NPDES permits' nitrogen effluent limits of 3 mg N/L standard, the aging built infrastructure must be updated, and the combined capital costs are about \$354 million (DES, 2010; Kessler, 2010). Alternatives, such as land conservation and natural infrastructure, provide ways of reducing nitrogen sources from stormwater runoff or nonpoint source pollution. Relying on expert stakeholder input, we will develop several land use scenarios to model the various levels of nitrogen reduction. Two modeling programs, the University of New Hampshire's water balance model FrAMES and the Natural Capital Project's InVEST nutrient retention model, will be utilized to execute the stakeholder-informed scenarios. Based upon the comparative results from InVEST and FrAMES, we will determine whether alternative management programs can avoid some of the projected costs of wastewater treatment plant upgrades. *This project is part of a statewide research and education project known as Experimental Program to Stimulate Competitive Research (EPSCoR).*

62. Record Influence of Ocean Effect Snow in Southern Maine

Student Researcher: Michael Clair (Meteorology)

Faculty Sponsor: Jason Cordeira

Over the semester I have been working on a research project with a case study on the influence of ocean effect snow in Southern Maine during the Blizzard of February 2013. I believed that this was a topic worth researching because the blizzard brought the heaviest snowfall on record to Portland, Maine. Dropping 31.9 inches of snow, the storm shattered the previous record of 27.1 inches, but would not have done so if not for the addition of ocean effect snow before the storm even began. Using historical radar data and public information statements from the National Weather Service, I determined that 6.6 inches of snow fell at the Portland Jetport from the ocean effect bands before any snow from the storm itself moved in. I only focused on the pure ocean effect snow, and this was enough to prove that it was what made the storm a record breaker.

63. Mass Wasting in New Hampshire: Landslides

Student Researchers: Jane Duggan, Jaime Wright, Don Smialek, Valerie Laverdiere, Sondra Love, Sean Donohoe, Justin Buteau (Environmental Science and Policy)

Faculty Sponsor: Mary Ann McGarry

In our Natural Hazards Science and Policy Seminar course we examined how extreme events impact society and how mitigation techniques can prevent loss of life and property damage. Mass wasting and landslides in particular are two of the hazards that we see locally in New Hampshire due to the freeze thaw that occurs at this latitude. Past glaciation has created the perfect combination of landforms for mass wasting/landslides

to occur with steep slopes in places like Franconia and Crawford Notch, two prominent tourist attractions.

This educational outreach poster covers the different types of landslides, the general triggers that cause them along with triggers specific to New Hampshire, specific instances in New Hampshire and mitigation techniques. With this poster we intended on creating a public educational resource regarding mass wasting/landslides. Our goal is to make our research accessible to the public and hopefully give them an understanding of the hazards in their local environment. We are planning on sharing our poster with the US Forest Service to better distribute our information.

64. Manipulation of the Protein Gradient with Dinitrophenol to Combat Amyloid Beta Toxicity

Student Researchers: Trevor Gordon (Chemistry)

Faculty Sponsor: Susan Swope

Alzheimer's is a neurological degenerative disease generally affecting the elderly of our population. The amyloid beta protein has been associated with the disease and may be linked to the cause. Amyloid beta exist in many forms, but is known to be most toxic in its soluble oligomer form. Previous studies have been conducted to reduce the effects of the oligomer using compounds ranging from metals like copper and zinc to natural products like polyphenols. Polyphenols' effectiveness in reducing amyloid beta toxicity may be due to their ability to function as uncouplers. Dinitrophenol is a chemically-made phenol that is known to uncouple and disrupt the proton gradient. In this study, a genetically engineered strain of the model organism *Caenorhabditis elegans* (strain CL4176) is used to express the human amyloid beta protein. When the *Caenorhabditis elegans* express the amyloid beta protein they succumb to paralysis and die. By introducing dinitrophenol to the *Caenorhabditis elegans* expressing the amyloid beta peptide we expect to see an increase in life span when compared to *Caenorhabditis elegans* expressing amyloid beta without treatment

65. Efficiency of phase-transfer catalysis in reactions involving alcohols

Student Researchers: R. Nathaniel Workman, Katie Hills-Kimball, Matthew Foster (Chemistry)

Faculty Sponsor: Jeremiah Duncan

A phase-transfer catalyst (PTC) is a catalyst that works by transferring a species into an organic phase from an aqueous phase, or vis versa, to react with a species that does not share its same solubility properties. PTCs have been found to perform desirable organic reactions with high yield and environmentally preferable conditions. Recent work has shown the potential of thiol-functionalized supported gold nanoparticles in catalyzing reactions. In our work, reactions involving the common phase-transfer catalyst tert-butylammonium bromide (TBAB) were performed and analyzed for general performance as compared to thiol functionalized gold nanoparticles attached to tert-butylammonium ligands. These reactions included an oxidation of benzhydrol to benzophenone and a synthesis of tert-butoxybenzene from phenol.

66. A Spatial Analysis of the Impacts of Road Salt on Trace Metal Concentrations in New Hampshire Rivers

Student Researcher: Jessica Wilhelm (Environmental Science and Policy)

Faculty Sponsors: Mark Green, Kathleen Bush

Trace metals can pose a direct threat to people and freshwater ecosystems. This research explores the association between road salt and metal concentrations in New Hampshire and pursues the question, “does road salt impact metal concentrations in N.H. rivers?” To work toward the answer, we evaluate the major metal ion concentrations from a statewide water quality snapshot. Water samples were taken during Summer 2013 and analyzed for basic water chemistry including temperature, conductivity, and nutrients as well as trace metal concentrations. Conductivity is correlated to metal ions and we hypothesize that conductivity is a good predictor of trace metal concentrations. We consider cation exchange an important driver of trace metal mobilization. Through this exchange, Na⁺ may spur the mobilization of trace metals partitioned in the soil, making metals available for transport to rivers. This work compliments past studies and ongoing work in the Northeast and Northern Forest on road salt and offers a unique look at the trace metals in freshwater ecosystems related to road salt use. Human and environmental are the focus of this research. We hope to contribute information that will inform local decision-making, land use planning, and road management.

67. Localization and Expression of the CLOCK Protein in the Central Nervous System of *Limulus polyphemus*

Student Researchers: Kyle Kenyon, Katherine Fondo (Biotechnology)

Faculty Sponsor: Christopher Chabot

Circadian clocks are present in virtually all organisms and, in animals, are comprised of proteins such as CLOCK, PERIOD, and TIMELESS. While the location and expression patterns of these proteins are understood in some model organisms, they have not yet been determined in chelicerates such as the American horseshoe crab, *Limulus polyphemus*. The goal of this study was to localize the circadian clock within the *Limulus* central nervous system and to determine if CLOCK, a core circadian clock protein, exhibited daily expression rhythms. CLOCK Immunohistochemistry was performed on brain slices and ventral nerve cord whole mounts of adult horseshoe crabs during mid-light (n=6) and mid-dark (n=6) time points. Results showed that CLOCK was localized to the cytoplasm of cheliceral ganglia cells in the brain with no expression in the VNC. Additionally, anti-CLOCK fluorescence was significantly higher during the day than night (p=0.03). These data suggest that the CLOCK protein is part of the circadian clock, which for the first time has been localized to the cheliceral ganglia in *Limulus*. *This project is part of Plymouth State's participation in the National Institute for Health's IDeA Network of Biomedical Research Excellence (INBRE).*

68. Quaternary Ammonium Salt Functionalized Gold Nanoparticles as Phase Transfer Catalysts

Student Researchers: Katie Hills-Kimball, Matthew Foster, R. Nathaniel Workman (Chemistry)

Faculty Sponsor: Jeremiah Duncan

The use of phase transfer catalysts is prevalent in a wide range of industrial applications including pharmaceuticals, polymers, agricultural chemicals, dyes, and pigments. A

phase transfer catalyst allows reactions to occur in which the reactants are dissolved in different phases by transferring one of the reagents into the other phase. Quaternary ammonium salts are often used as phase transfer catalysts, especially in interfacial type phase transfer, where the catalysts are interface soluble. This research looks at the effects on catalytic rate of a quaternary ammonium salt functionalized gold nanoparticle as a phase transfer catalyst. It is hypothesized that attaching a phase transfer catalyst to the surface of a gold nanoparticle will increase catalytic rate. Nanoparticles tend to localize in the interface between phases and decrease interfacial tension, which will allow for direct targeting of the catalyst. Gold nanoparticles with mixed ligand shells were directly synthesized through the reduction of gold in the presence of both a tetrabutylammonium bunte salt and a polyethylene glycol bunte salt. The use of bunte salts allowed for direct synthesis and size tuning of the nanoparticles, which enabled testing of the nanoparticles' catalytic capability at a specified size.

69. Embryophyte Community Structure And Water Chemistry Relationships Across A Condition Gradient In Red Maple – Sphagnum Basin Swamps: A Working Proposal

Student Researchers: Jennifer Bell* (Environmental Science and Policy)

Faculty Sponsor: Joe Boyer

The majority of New Hampshire's wetlands are forested, yet the dynamics of how these natural communities respond to disturbance in terms of their ability to perform ecosystem services, such as water purification, is understudied. The hypothesis is that water chemistry and embryophyte community structure are statistically related across a condition gradient in red maple - Sphagnum basin swamps. These swamps are naturally low in pH and nutrient poor. As condition is degraded, it is expected that proportion of native flora will decrease, pore water will be more alkaline, and nutrient concentrations will increase. If so, the results would support the idea that community structure is a good indicator of condition and water chemistry. In July and August of 2014, 11 red maple - Sphagnum basin swamps representing a range of condition will be sampled. Land use, stressor, and buffer data will represent condition. Embryophyte community data will include full species lists, species richness, and floristic quality. Water samples obtained from soil pore water will be analyzed for specific conductance, pH, and nutrient concentrations. Soil data will include texture, moisture levels, depth to water table, and organic matter decomposition. Canonical correspondence analysis will be used to parse out distribution patterns.

70. Post-Embryonic Development of Mouthparts and Abdominal Appendages in the Mayfly *Hexagenia limbata*

Co-Authors: Christopher Gonzalez (Biology); Christopher Chabot

Faculty Sponsor: Brigid C. O'Donnell

The common body plan of insects consists of an appendage-bearing head and thorax with an appendage-less abdomen. However, some insects, such as mayflies, exhibit different morphologies. Mayfly nymphs are aquatic and feature appendages called gills on their abdomen some nymphs also have tusks on their mandibles for digging burrows. Despite their distinct structure and adaptive importance, the development of mayfly appendages has been poorly studied. In this study, we describe the post-embryonic development of mouthparts and abdominal appendages in *Hexagenia limbata*

(Ephemeroidea). *H. limbata* nymphs and eggs were collected from Sky Pond, N.H. during the summer of 2012 and 2013 specimens were subsequently imaged live or after preservation in 70% ethanol. Our results show that hatchlings lack gills, then develop six pairs of unbranched gills. The first five gill pairs then develop a single branch; these gills continue to increase in branch number, eventually developing 12 branches and an intra-branch bifurcation. The mouthparts increase in size; however, tusks were not observed, indicating that they develop later. In sum, these results not only enhance our understanding of post-embryonic appendage development in mayflies, but also create an organismal context for future appendage-related molecular work. *This project is part of Plymouth State's participation in the National Institute for Health's IDeA Network of Biomedical Research Excellence (INBRE).*

71. Determining the Molar Extinction Coefficient of FAD Bound to EUGO

Student Researchers: Trevor Gordon, Rachel Brooks (Chemistry); Justin Provazza (Biotechnology)

Faculty Sponsor: Susan Swope

The enzyme eugenol oxidase (known as EUGO) is produced by a gene from the genome in *Rhodococcus* that can be expressed in *E. coli* cells. Purified EUGO is then used to catalyze the reaction of eugenol to coniferyl alcohol. In order to fully characterize EUGO, the kinetic parameters for various substrates must be determined. This requires an accurate quantification of the protein's concentration. To determine protein concentration direct UV-vis is utilized. This method is possible only if the compound absorbs strongly in the visible region, and the molar extinction coefficient of the desired protein is known. A previous study assumed a molar extinction coefficient for FAD bound EUGO to be $14.2 \text{ mM}^{-1}\text{cm}^{-1}$; this estimate was based on data from a structurally similar protein. Free FAD has a molar extinction coefficient of $11.3 \text{ mM}^{-1}\text{cm}^{-1}$, and others has assumed this value for FAD-bound proteins. Using the Bradford or similar quantification method, the EUGO concentration will be determined. FAD will be titrated into the EUGO in calculated aliquots until the protein becomes saturated with FAD; this process will be monitored spectrophotometrically. This data allows us to calculate the molar extinction coefficient and determine the credulity of the published FAD bound EUGO molar extinction coefficient.

72. The Effects of Biomedical Bleeding on Orientation of the American Horseshoe Crab, *Limulus polyphemus*

Student Researchers: Courtney Pearson (Psychology), Bailey Carignan (Biology)

Faculty Sponsor: Christopher Chabot

The blood of the American horseshoe crab, *Limulus polyphemus*, is harvested and used to ensure sterility of medical devices and medications. While it has been reported that biomedically bled animals exhibit reduced activity and undirected movement patterns, little else is known about the behavioral effects of this procedure on breeding activity. The goal of this experiment was to determine the effects of biomedical bleeding on the orientation of horseshoe crabs to a simulated spawning beach in a laboratory setting. Animals were bled using a biomedical bleeding procedure during breeding ($n=7$) and non-breeding seasons ($n=8$). Individual animals were placed in a trough (61cm x 61cm x 240cm) that had both a deep and a shallow ("beach") end. The bleeding process caused significant decreases in total movement and significant increases in meander

(a measure of rotational changes). These changes in meander suggest a decrease in orientation behavior. Furthermore, while all animals oriented towards the deep end of the trough before bleeding, this response was not observed post-bleed in breeding season animals. Overall these biomedical bleeding-induced changes in orientation may negatively impact the fitness of *Limulus* by decreasing the likelihood that animals will locate and arrive at spawning beaches during the breeding season. *This project is part of Plymouth State's participation in the National Institute for Health's IDeA Network of Biomedical Research Excellence (INBRE).*

HUB Room 109

2:30 - 3:00 p.m.

DSLR Camera Video Training Course

Student Scholar: James Lawson (Communication Studies)

Faculty Sponsor: Scott Coykendall

I will be sharing my work to date on my independent study's main project: a video training course for students wanting access to the CMS Department's new DSLR Cameras. The training course uses 3 minute training videos paired with Moodle quizzes to train students how to use the new cameras safely and effectively. Once complete, the course will consist of 10 units (or topics). I will be showing some of the completed training videos and demonstrating how students will proceed through the course and quizzes on Moodle.

4:30 - 5:15 p.m.

The effect of cold compression therapy on anaerobic performance and lactate clearance in collegiate male and female rugby players

Student Researchers: Brianna Jackson, Tasha Wyatt, Emily McCular, Rob Madonna, Arianna Kinder, Nicole Soucy, Meredith Shea, Catherine Masson, Jane Baruch, Brandon Foley, Andrew Garbino, Shane Caito, Rick Gaeta, Jacob Sjoberg (Exercise and Sport Physiology)

Faculty Sponsor: RYANNE Carmichael

Introduction:

Cryotherapy is a recovery modality used to relieve pain and reduce inflammation, while the application of compression increases venous return. By coupling these modalities, athletes may improve performance. This study examined the effect of cold compression on blood lactate (La^-) and power during anaerobic exercise.

Methods:

10 collegiate rugby players (Male: $n=8$, VO_2max $51.03 \pm 2.64 \text{ ml.kg.min}$, Female: $n=2$, VO_2max $36.35 \pm 1.48 \text{ ml.kg.min}$) completed five, 6 sec cycle sprints followed by a 30 sec Wingate test. A 15 min intervention of passive (PR), active (AR), or cold-compression (CCR) recovery was then administered. Participants then completed another 30 sec Wingate test. Peak (PP) and mean power (MP) were measured during Wingate 2 and La^- was measured throughout.

Results:

There were no significant differences in PP or MP across the three interventions of recovery (PP: CCR 711.9 ± 55.6, AR 755.2 ± 46.2, PR 730.6 ± 52.0 W; MP: CCR 543.2 ± 35.3, AR 553.9 ± 34.3, PR 543.1 ± 33.1 W). There were also no significant differences found in La- across recovery interventions.

Conclusion:

The lack of significant differences between recovery methods warrants future investigation. Exploring different recovery durations and types of exercise may yield varying results.

HUB Room 109 -- Student-Designed Games and Interactive Programs 3:00 - 4:30 p.m.

Video Game Design: A Study in Small Mistakes and Monstrous Results

Student Scholar: Kayla Banks (Communication Studies)

Faculty Sponsor: Cathie LeBlanc

Video Games have become an incredibly important function of today's media landscape. Almost everyone can qualify as a "gamer"- from hardcore tournament players to the person playing Candy Crush on their phone to pass the time. But it is not well known how much work goes into a game, and how much perfection is needed to make everything work without a problem. I have learned this lesson first hand, and I present the culminating work that I have done to make a game - my study in how the smallest mistakes can send the whole code crashing down, and the smallest tweaks can have the biggest results.

Jumping Headfirst Into The Unity Game Engine

Student Scholar: Kirsti Barrows (Bachelor of Fine Arts)

Faculty Sponsor: Cathie Leblanc

For an advanced game design class in the Digital Media and Game Design minor, I had the opportunity to develop a short part of a game using the engine of my choice. Starting only with experience in creating 2D games and some Flash programming knowledge, I decided to use UNITY 3D. My goals were to first learn basics about 3D gaming language and concepts, and navigating and using Unity: what the buttons do, how to input lines of code, what the menus offer, etc. Following this, I wanted to learn specifically about First Person navigation and creating playable environments -- how hills, trees, and paths are created in 3D games for example. This project is a work in progress, and I am excited to continue working with Unity to further develop it into a fully realised game.

Video Game Design or How I Learned to Stop Worrying and Love Unity

Student Scholar: Benjamin Levesque (Information Technology)

Faculty Sponsor: Catherine LeBlanc

For this project, I will be showcasing what goes into the creation and design of video games using the Unity environment. To do this I will be giving live examples of the two games I have created: a tutorial game and a game designed by myself. I will be presenting the two of them by having a laptop connected to a monitor that will allow showing the game in motion and some of the creation process that goes behind creating video games. This presentation will also be showing the connection between the realm of communication studies and the realm of computer science. Both of these groups can come together and create a medium that allows for the technological complexity of computer science as well as the presentation of an idea or story that can be told through the use of video games.

Lunch Meat: An Interactive Narrative

Student Scholar: Miles Winzeler (Interdisciplinary Studies)

Faculty Sponsor: Catherine LeBlanc

My goal with this project was to develop a piece of interactive media that stressed the importance of choice from both narrative and mechanical perspectives. Focus was paid to lessons of game studies and storytelling to ultimately create a project resembling the modern videogame. I constructed the piece using the Unity game engine and UnityScript, and it features original artwork and writing, with the majority of the screenplay receiving voice-acted accompaniment. The end result is a project that engages players with an immersive storyline and dynamic problem-solving, both ensuring that no two players have the same experience.

HUB Room 119 (Student Senate Room)

2:30 - 3:00 p.m. Concussion: What's the ImPact?

Student Researchers: Allison Standish (Athletic Training), Stephanie Paynter (Athletic Training)

Faculty Sponsor: Linda Levy

This presentation will introduce the audience to the impact of mild traumatic brain injury. The presentation will include the definition of concussion, potential mechanisms of injury, signs and symptoms that occur following injury, neuroimaging used to diagnose the condition, and explore the neuropsychological tests used to assess brain injury. Members of the audience will have the opportunity to participate in the ImPact test where they will learn about Oral Word Association, Trail Making, Wechsler Digit Span, Wechsler Symbol Test, and Stroop Color Word Test. Discussion will include factors that influence ImPact testing results, return to play criteria and progressions, principles that apply to young athletes as well as home care instructions.

3:00 - 3:30 p.m.

Debating Global Issues on an International Stage

Student Researcher: Travis Bennett (Political Science)

Faculty Sponsor: Filiz Otucu

The PSU Model United Nations attended an international Model UN conference, April 9th-12th in Helsinki, Finland. The Finnish Model UN Society (FINMUN) organized and hosted the Conference, which was attended by many students of various nationalities, from several different countries around the world. Each student attending from PSU, as well as from around the world, represented a certain country - such as France, Chile or South Korea - in either the Security Council, which debated a Cyber Security Scenario, or the General Assembly, Social, Cultural and Humanitarian Committee (SOCHUM) which debated both issues of, Girls in Conflict and Individuals Right to Privacy in the Digital Age. In both committees, each student had to accurately represent their countries interests, working to form draft resolutions with other delegates, and ultimately voting on proposed resolutions and amendments, with the aim of successfully passing a resolution. As an additional part of this Model UN experience, daily pre-planned social events had been organized by the FINMUN Society Secretariats and staff, to immerse participants into Finnish culture. Speakers and Finnish Government officials also briefed the FINMUN delegates on their roles in dealing with women's rights and cyber-security. FINMUN participants also had the opportunity to visit the US Embassy and meet a professional foreign officer, who's worked extensively in the international diplomatic arena. This was truly a unique experience for students of various international backgrounds, to come together in order to learn, debate and attempt to find creative solutions to challenging global problems.

3:30 - 4:00 p.m.

PSA: How Society Influences Gender Identity in Young Girls

Student Researcher: Kaitlyn Belair (Early Childhood Studies)

Faculty Sponsor: Patricia Cantor

This Public Service Announcement video explains how young girls believe they should be acting and believe what they should be playing with as a result of how society implies that acting a certain way or playing with a certain toy is wrong.

PSA: Media Impact on Childhood Obesity

Student Researchers: Nicole Corey (Early Childhood Studies)

Faculty Sponsor: Patricia Cantor

In my PSA you will learn about how the media impacts childhood obesity and how children are at risk of many health problems due to low physical activity. Obese children have low self-esteem and self-confidence which have been linked to low academic performance and depression in children. Learn about how you as a parent, caregiver, or educator can limit screen media time for children and how to decrease the risk of childhood obesity. "Eat healthy, get active, and live a happy, healthy childhood."

4:00 - 4:30 p.m.

Teaching Social Studies for a New Generation of Writers

Student Researcher: Heather Hooker (Social Studies Education)

Faculty Sponsor: Michael Kopish

In today's schools, students need to be able to communicate effectively through writing in order to be college and career ready. However, research indicates social studies teachers struggle with teaching writing and call for deeper analysis of ways that teachers implement successful writing practices in social studies.

I want to research the best practices of explicit instruction and constructivist approaches to teach high school students evidence-based historical writing. I believe that scaffolding students through different forms of writing is the most appropriate way to do so. My research will identify best practices in teaching writing and will enable me to develop curriculum. Students need opportunities to employ reasoning embedded in evidence-based historical writing to see history as an interpretive discipline in which they must make an argument (Monte Sano, 2008). This inquiry is significant since the social studies discipline lacks vital writing knowledge specific to improving writing within social studies content areas, such as United States History and Civics.

My inquiry will focus on three research questions:

- How do teachers integrate writing in meaningful ways in social studies classrooms?
- How are social studies teachers using reading skills or written texts to improve student writing?
- How are different forms and modes of writing used in social studies?

From the inquiry of best practices, I plan to create an evidence-based historical writing curriculum to enact during my student teaching in the fall of 2014. The project is designed to examine teaching and learning in classrooms through analysis of assessment data. Specifically, my project focuses on improving students evidence-based historical writing through curriculum development around the following ideas: integrating writing in meaningful ways (e.g., Do-Now Journals); reading skills and written texts to improve student writing (e.g., paragraph structure analysis, text annotations with mini-writes, and primary source integration); exploration of different forms and modes of writing (e.g., narrative, argumentative, and inquiry).

Ultimately I believe developing curriculum supported by best practice research will improve student writing. In addition, with the sound findings from this study, social studies educators and institutes of higher education involved in educator preparation will be able to fine-tune social studies teaching and learning practices to meet the demands of literacy skill development and college and career readiness.

4:30 - 5:00 p.m.

Defining Inclusion Through Perception and Practice

Student Researcher: Kate Evans (Special Education)

Faculty Sponsor: Ann Berry

As a word regularly used in schools but excluded from federal laws and statutes, inclusion causes confusion amongst stakeholders. The interpretation of the very statutes that provide for and protect special education students varies greatly in both perception and practice. In examining what is appropriate, in terms of inclusion, for special education students, it is important to first examine what is required by federal mandates and focus on practices which yield the best results for all students. In most cases,

inclusive practices satisfy both of these necessities, but must be clarified to create unity between schools, districts, and states. The interpretation of inclusion by stakeholders is both affective and reflective and has a significant impact on student socialization and learning. This action research project is designed to first define inclusion with clarity, through an extensive literature review and then investigate the local climate for inclusion in a school district in rural New Hampshire.

5:30 - 6:00 p.m.

Exploring the Catalysts behind the Decline in Vaccinations in Pakistan via the Perspectives of Health Care Workers

Student Researcher: Jami Woodworth (Anthropology/Sociology)

Faculty Sponsor: David Starbuck

The World Health Organization's (WHO) initiative to eradicate polio in Pakistan is slowly failing. This is due to a country-wide refusal of western-derived vaccines made to prevent individuals from contracting it. The purpose of this project is to determine the causative factors behind the steadily declining vaccination rate in Pakistan. I plan on analysing if having less access to health care and primary education creates a heavier reliance on spiritual communities. The mistrust of western medicine felt by the spiritual leaders of these communities has directly affected the vaccination movement in Pakistan. I will be gathering data from three foundations - the first being secondary data analysis of sources already discussing this topic. The second part will be a series of interviews with medical professionals involved in the WHO's Pakistan initiative. I will also be in contact with doctors who have worked directly with Pakistanis who have refused vaccinations. I expect to find that less access to health care and education creates a negative view of western medicine and an overall decline in health nationwide. I am also expecting that the ingrained suspicion of western medicine stems from the ongoing resource wars that have had a detrimental effect on the lives of Pakistanis. In regards to solving this crisis, I hypothesize that organisations with stronger connections to the pop culture of Pakistan will have a higher success rate in giving out vaccines.

HUB Room 123 Presentations

2:15 - 2:45 p.m.

Herring or Hellfire-A Presentation on: Seventeenth Century Mercantilism, Bulk Trades, and the Herring Industry: How Herring Caused the First Anglo-Dutch War

Student Researchers: Peter Kovacs (Bachelor of Fine Arts/History)

Faculty Sponsor: Marcia Schmidt Blaine

For many years historians have analyzed the rise of the Dutch trading empire from humble beginnings to a world power that dominated the political, economic, and military theaters of Europe, Asia, and the Indian sub-continent. In doing so, many people question how such a small republic, in the midst of traditional powers such as Spain, France, and the Holy Roman Empire, rose to such prominence. The answer is simple, yet complex: fish. During the early fifteenth century, because of innovations in fishing technology, the waning of traditional military powers, and their ability to

export this raw, lucrative, necessity to their neighbors, the Dutch Republic found a way to gain an economic advantage over their neighbors. Through this initial cornering of the fishing trade, the Dutch were able to integrate themselves into the essential Baltic Sea bulk trades, and, not long after, monopolize them. However, such success did not come without cost. The Dutch had garnered their finned gold from the North Sea, a body of water that the English considered traditionally theirs. Because of this territorial transgression, and the Dutch economic success, the English and Dutch strode inevitably towards the first of their four conflicts, the First Anglo-Dutch War.

2:45 - 3:15 p.m.

Recruiting for the active industry

Student Scholar: Katharine Kennedy (Marketing)

Faculty Sponsor: Deborah Brownstein

In the beginning of the semester, I was lucky enough to join the JBCStyle recruiting team as an intern. JBCStyle is the number one permanent placement recruiter for fashion in the United states. Within JBCStyle, my division works specifically with companies with action, athletic, and outdoor industries. I go into work 3 days a week for a total of 16 hours. While I am there I have many responsibilities and contribute a great amount to the company. I am responsible for the social media of JBC Active. I add to discussions on LinkedIn everyday, tweet all week, and have created their very first facebook. I have been working on creating a new logo and am in charge in recruiting followers for each of these groups. Before I started, there was barely any social media going on for the group.

The other component of the internship is actually recruiting candidates for our clients. I get the opportunity to talk to human resources people at each company to find out what is going on in their company and the kind of talent they are looking for. After that, I use a CRM to search for people to connect with to fill the job. I also form leads through LinkedIn and other forms of social media. From there, I network with each candidate by cold calling. I get to find about what they do currently, what they enjoy the most in their job, and what they want in their next career. From there I pitch them the job and hopefully put them in play for the role.

3:15 - 3:45 p.m.

Conserving Grassland Bird Habitat on Private Land in the Upper Valley

Student Researcher: Jamie Sydoriak* (Environmental Science and Policy);

Other Collaborators: Rosalind Renfrew, Pamela Hunt, Shannon Rogers, Len Reitsma

Faculty Sponsor: Len Reitsma

See Poster Session B (#25)

3:45 - 4:15 p.m.

NH iPhone Repair

Student Scholar: Chad Johansen (Management)

Faculty Sponsor: Brad Allen

Two years ago, after clumsy me broke my own iPhone and iPad, I saw there were no affordable, easy-to-access repair shops in New Hampshire. From there, NH iPhone Repair was born. I started off with hopes that this small business would give me some extra spending money. It turned into me leaving my summer job and commuting back

and forth from Plymouth to Bedford 3-4 times a week. I am excited to show how a college student turned a little idea into a successful business that has seen thousands of customers and broken devices come through his kitchen for repairs.

4:15 - 4:45 p.m.

Linkages between the North Atlantic Oscillation and watershed response from northwest Iceland lake sediments

Student Researchers Benjamin Bolaski* (Environmental Science and Policy)

Other Collaborators: Lisa A Doner, Isla S Casteneda, Bradford Hubeny, Nadine Orejola

Faculty Sponsor: Lisa Doner

A new proxy for continental mean annual air temperature (MAAT) and soil pH, the MBT/CBT paleothermometer, relies on the temperature and pH dependent dispersal of bacterial membrane lipids, branched glycerol dialkyl glycerol tetraethers (GDGTs), in soil organic matter. The Branched and Isoprenoid Tetraether Index (BIT), based on the relative abundance of terrestrially derived branched tetraethers versus lacustrine-derived crenarchaeol tetraethers, is a novel proxy for examining provenance of sediment organic matter. As part of a multiproxy approach we'll use the MBT/CBT indices and BIT index to investigate environmental controls on the distribution and abundance of branched GDGTs in watershed soils and surface sediments from a >6000 year-long piston core record from Lake Vatnsdalsvatn, an oligotrophic lake in Northwest Iceland. We test our hypothesis that soil and sediment geochemistry act as a factor controlling GDGT distribution and abundance. The applicability of the MBT/CBT paleothermometer to Northwest Iceland will also be tested. Trace element geochemistry in a 1996 freeze core from Lake Vatnsdalsvatn shows an 80-100 year periodicity for the past 900 years, hypothesized to result from erosion associated with strong, positive phases of the North Atlantic Oscillation (NAO), (Doner, 2003). X-Ray Fluorescence (XRF) geochemistry from a Vatnsdalsvatn sediment core will be used to reveal periods of increased erosion (allochthonous) input to the lake. This new study examines the relationship between geochemistry and the distribution and abundance of branched GDGTs within soils and sediments, while seeking to create linkages between soil erosion, temperature and the NAO since the mid-Holocene at Lake Vatnsdalsvatn, Northwest Iceland. *This project received funding from the National Science Foundation.*

4:45 - 5:15 p.m.

Direct Synthesis of "click-able" mixed ligand gold nanoparticles with controlled reactive group densities

Student Researcher: Katie Hills-Kimball (Chemistry)

Faculty Sponsor: Jeremiah Duncan

Nanoparticles have been used in a multitude of applications due to the unique properties that occur as a result of core size. Well-defined organic ligand shells can also be incorporated to introduce additional functionality for complex applications. Customizing the ligand shell allows for the production of nanoparticles with different physical properties as well as additional reactive sites. Current synthetic methods often focus on the production of nanoparticles for a specific application and then modify functionality through ligand exchange. This results in complications throughout the ligand exchange process and core size can often not be controlled. We demonstrate

an alternate approach for nanoparticle synthesis where reactive sites for further functionalization are introduced directly during synthesis. This approach allows for the direct synthesis of nanoparticles that can serve as building blocks that are easily modified to serve in a wide variety of applications. Markedly, these water-soluble nanoparticles show promise in biomedical applications requiring biocompatibility, high reaction efficiency, and specificity. Further, the ease of synthesis and subsequent modification facilitates access to a breadth of related materials allowing for rapid screening of structure activity relationships. *This project received funding from the National Science Foundation.*

HUB Tower Room Presentations

3:00 p.m. - 4:00 p.m.

Comparison of quantitative foot pressure mapping and current clinical based measures as predictors of falls in older adults

Student Researchers: Samantha Sheehan, Arianna Kinder, Carly Burrows, Garrett Loomer (Exercise and Sport Physiology); Stephanie Grajek* (Athletic Training)

Faculty Sponsor: Marjorie King, Jonathan D. Lurie

Falls occur daily in the elderly population that can affect the person's health. The purpose of the study was to determine if there was a relationship predicting falls risk between the quantitative MatScan® and two commonly used qualitative clinical assessments, the Timed Up and Go and the Berg Balance Scale. Participants, ages of 65-79 years old, able to ambulate with no more than a cane assist were recruited. Prior to testing, a Health and Activity Questionnaire and Balance Confidence scale were obtained. During one physical testing session, subjects completed a center of (foot) pressure test using the Sway Analysis Module -SAM™ MatScan® System assessment, a Timed Up and Go (TUG), and the Berg Balance Scale (Berg). No strong correlations are noted in the data with the current subjects tested. However, of the subjects tested, less than 19% are considered potential Fallers. This limited dispersion in the data set lessens the possibility for strong correlations and suggests that those who are at risk for falling, fear being tested. As work continues, High Risk Fallers will be recruited and statistical analysis will be repeated. *The project is part of Plymouth State's participation in the National Institute for Health's IDeA Network of Biomedical Research Excellence (INBRE).*

4:15 - 5:00 p.m.

Event Marketing: Chili Cook-Off 2014

Student Scholar: Jon Gilbert (Marketing)

Faculty Sponsor: Eileen Bennett

I will be presenting about this year's Chili Cook-Off, the road blocks we encountered in the planning, and the experience as a whole. As the Event Manager, this experience has been both gratifying and a challenge. The Cook-Off will be taking place April 26th from 12-3 pm. It is benefiting New England Disabled Sports and we hope to see you there.

College of Business Student Advisory Council (CoBA SAC)

Student Scholar: Jon Gilbert (Marketing)

Faculty Sponsor: Eileen Bennett

Learn how the College of Business Administration Student Advisory Council (CoBA SAC) represents and supports students. Through events and other projects, we work to make a better College of Business Administration.

6:00 - 7:00 p.m.

Comparison of quantitative foot pressure mapping and current clinical based measures as predictors of falls in older adults

Student Researchers: Samantha Sheehan, Arianna Kinder, Carly Burrows, Garrett Loomer (Exercise and Sport Physiology); Stephanie Grajek* (Athletic Training)

Faculty Sponsor: Marjorie King, Jonathan D. Lurie

Repeat of 3:00 p.m. presentation

Please visit the
Bachelor of Fine Arts Exhibition
in the
Karl Drerup Gallery
and the
Silver Center for the Arts
through May 15, 2014
plymouth.edu/gallery



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