Summer Undergraduate Research with Faculty (SURF)

1. **Student: Nathan Adamson** **Major: Biochemistry**
   Mentor: Neal Tonks, Jr. **Department: Chemistry and Biochemistry**

   Title: *Drug Delivery Polyurethane Materials Using Bio-Based Polyols*

   Polyurethanes are widely used polymer materials that have applications from paint coatings to soft/rigid foams. More recently, polyurethanes are being developed for drug delivery purposes. By incorporating a drug-delivery pre-polymer into the polyurethane matrix, we can produce a material that will slowly release a drug under physiological conditions. There are two significant unique aspects this project. Firstly, only biologically compatible materials will be used. Almost all current polymeric polyurethane materials are made using chemicals derived from petrochemicals. The major material in the final product by mass consists of a soy-based oil. Secondly, new drugs that have never been used for drug delivery purposes before using polymer delivery systems are being investigated. For this study, the anti-inflammatory drug ibuprofen was used initially because of its low cost and its compatibility with this technology. Then a successful drug delivery material was made from nalidixic acid, a simple antibiotic compound. Upon exposing these drug delivery materials to physiological media, significant drug release was observed in as little as 20 hours. The next phase of this research will be to explore new synthetic approaches to these materials to yield products with varying applications including type of drugs being released, rate of drug release, and overall composition of the material. In addition, long-term degradation studies of these materials will be necessary to confirm their safety in biological environments.

2. **Student: Emily Beam** **Major: Biology**
   Mentor: Allison Welch **Department: Biology**

   Title: *Plasticity in habitat preferences of adult toads during reproduction*

   Selecting an appropriate habitat is important for the success of many organisms. Many animals express behaviors that influence where they live and spend their time, and these behaviors affect their ability to survive, grow and reproduce in their environment. However, human impacts on the environment are altering the habitats available to other organisms. As a result, many organisms are faced with the challenge of selecting an appropriate habitat among a novel array of choices. Habitat selection is especially important for amphibians because their complex life cycle and permeable skin make them highly sensitive to their environment. An emerging form of habitat modification is salinization, or increased salt levels in the environment, for example due to agriculture, road salts, or sea level rise. Amphibian larvae, including tadpoles, are intolerant of high levels of salinity in the aquatic environment. Thus, we are interested in how increased salinity affects habitat selection by toads as they prepare to release their eggs. During non-reproductive periods, adult toads do not avoid mildly salty environments, even though similar levels of salinity can be lethal to their tadpoles. Consequently, we predict that adult toads will alter their habitat preference when they are ready to release their eggs, enabling them to avoid habitats that would be harmful to their young. This type of behavioral flexibility, which has not previously been investigated in amphibians, could help to mitigate the effects of habitat salinization and other forms of environmental change on amphibian populations.

3. **Student: F. Garrett Boudinot** **Major: Geology/Religious Studies**
Mentor: Todd LeVasseur **Department: Religious Studies**

Title: *Grow the Scorched Ground Green: Values and Ethics in the Transition Movement*

The global climate crisis, now well established as a product of human combustion of fossil fuels, calls for immediate reform of our current, fossil fuel-based human lifestyles. The Transition Movement is one such emerging reform movement, with an emphasis on local sustainable agriculture and post-oil lifestyles. This project aims to better understand those lifestyle practices, and more specifically, the ethics and social norms that guide those practices. It is hypothesized that ethics and norms that are "ecocentric," or centered on the health of the ecological whole rather than simply the human society, will be present in the Transition Movement. In such a worldview, nature is considered sacred, and this yields humans as caregivers to larger ecological systems. Essential in this analysis is the causal relationship between ethics and practices, an emerging area in the study of religion and nature. The lifestyle changes embodied in the Transition Movement will be compared and contrasted with the town planning, ethics, and economic systems that have dominated the Industrial West for the last one hundred years. The Movement began in the Transition Town of Totnes, in the United Kingdom, and such Towns are now established worldwide. This project will utilize participation in training programs, interviews, and emersion in Transition Movement culture available in Totnes as data for analysis. Furthermore, the training will be applied upon return to Charleston to begin a student-led Transition group, with the goal of propagating Transition ethics and practices into the greater Charleston area. Given the sensitivity of Charleston's ecology, such research and action will greatly improve the city's resilience and health.

4. **Student: Aubrey Butcher** **Major: Marine Biology**
Mentor: Craig Plante **Department: Biology**

Title: *Effects of Beach Renourishment on Benthic Microalgal Communities and Biological Sediment Armoring*

One of South Carolina's most valuable resources is its beaches. They provide protection from storms, sustain diverse biological populations, and provide recreational activities. One method of preserving beaches against the effects of erosion and sea level rise is beach renourishment. Folly Beach, a local Charleston beach, began a renourishment project in January of 2014 that is expected to be complete by July. The renourishment project at Folly involves taking sediment from an offshore borrow site and depositing it on the beach face via pipeline. The purpose of renourishing Folly Beach is to reverse the effects of erosion; however other components of the marine ecosystem are affected as well.

Environmental assessments of beach renourishment include both physical (e.g., water quality) and biological criteria, typically endangered species, fish, or benthic invertebrates. This study will instead monitor the effects of renourishment on benthic microalgae (BMA), a group of photosynthetic microbes found in coastal sediments. BMA, as primary producers, represent the basis of nearshore food webs. They also release extracellular polymeric secretions (EPS), which bind together sediment particles thereby inhibiting erosion and sediment transport. Though BMA play these vital roles in marine ecosystems, few studies have examined the effects of beach renourishment on these microbes. By studying benthic microalgae biomass, composition, and EPS, this project will reveal the effects of specific renourishment practices (e.g., use of coarse borrow sediments) on benthic microalgae.

This work could lead to changes in renourishment protocols that favor BMA communities, thereby indirectly enhancing stabilization of newly added beach sands.

5. **Student: Thomas Cannon** **Major: Astrophysics**
Mentor: Jon Hakkila **Department: Physics and Astronomy**

Title: *Independent Verification of Results of Hakkila and Preece Using Additional Data*

Gamma Ray Bursts (GRBs) are among the brightest events in the universe. Some GRB light curves are simple while others are complex, but all are composed of pulses. A recent study (Hakkila and Preece, 2014) finds that GRB pulses are not simple rising and falling functions: they have complex shapes that may shed light on their underlying physics. We will verify these results using GRBs observed by BATSE (the Burst And Transient Source Experiment on NASA's Compton Observatory). GRB light curves will initially be fitted using a standard rising and falling shape (Norris et al. (2005)), with the shape deviations obtained by studying the residuals (observed minus modeled values). The Hakkila and Preece result finds correlations between the characteristics of the pulse residuals and the symmetry of the fitted pulse shape. We plan to test this result by using BATSE data not included in the original study. For our analysis, we will select GRBs observed late in BATSE's mission. We will fit single-pulsed bursts with the Norris et al. pulse shape using a statistical fitting algorithm written in the Interactive Data Language (IDL) programming language. We will apply a second statistical fitting algorithm to the residuals to obtain another set of coefficients. These coefficients and the corresponding pulse symmetries, will be compared to the Hakkila and Preece results.

6. **Student: Patricia Cooney** **Major: Biology**
Mentor: Christopher Korey **Department: Biology**

Title: *An Analysis of the Behavioral and Physical Processes Associated with the Autotomy of the Large Snapping Claw in the Snapping Shrimp, Alpheus angulosus.*

The snapping shrimp, *Alpheus angulosus*, exhibits a unique quality in which its two claws differ. These claws, the snapper, used for defense and communication, and the pincer, used for food collection and habitat manipulation, differ in shape and size. When held by the larger snapper claw, the shrimp will drop it in the interest of survival, regenerate a pincer where the snapper was, and a new snapper in the place of the previous pincer. While the process of regeneration appears to be standard among the shrimp, the claw dropping behavior may differ among various subgroups of the species. To evaluate these differences and understand the role of nervous system control in this process, we intend to divide shrimp specimens into the following categories: sex, size range (as a proxy for age), stage of molt cycle (as an indication of the amount of energy available for claw regeneration), and reproductive stage of females (carrying embryos, carrying embryos and yolk, carrying yolk, or no sexually mature development). The likelihood to drop the snapper will be observed in samples of each category through a standardized threat process with a relationship to threat duration and threat frequency. With these data, we will be able to further understand the evolutionary context of snapper dropping behavior, as well as the amount of neural control involved in this process, forming a groundwork with which to use this species as a potential resource for more nervous system regeneration studies.

7. **Student: Patricia Copley** **Major: Psychology**
Mentor: Jennifer Wilhelm **Department: Psychology**

Title: *Does estrogen signaling mediate the exercise-induced enhancement of axon regeneration after peripheral nerve injury in female mice?*

Thousands of people each year suffer from peripheral nerve injury. Treatment options are limited, and recovery is often incomplete. Treadmill exercise can enhance nerve regeneration; however, this appears to occur in a sex-dependent manner. Females respond best to short duration, high speed interval training; whereas, males respond best to slower, continuous training. The

underlying causes of this sex difference are unknown. Evidence has suggested a role for androgens, such as testosterone, and estrogens in the process of axon regeneration, but it is unknown whether these hormones are involved in the exercise-mediated enhancement of axon regeneration. The proposed project aims to investigate the role of estrogen signaling in exercised and unexercised female mice. We will transect the sciatic nerve of female mice and treat the axons with an estrogen receptor antagonist to block estrogen signaling. We will compare axon regeneration between mice treated with estrogen receptor antagonists and untreated mice that have received treadmill exercise. Based on our preliminary results which suggest that increasing estrogen inhibits axon regeneration, we hypothesize that blocking estrogen receptors will enhance axon regeneration after peripheral nerve transection. We predict that this enhancement will be similar to that found in untreated, treadmill trained mice. The results of this project will help use better understand how exercise facilitates axon regeneration and will provide us with a better understanding of the causes of the sex difference so that we can use this knowledge to create more treatment opportunities to patients with nerve injuries.

8. Student: Samantha Dahabi **Major: Theatre**
Mentor: Charlie Calvert **Department: Theatre and Dance**

Title: *Scenic Design for the Environmental Space*

Like all art forms, scenic design for the stage is an experience that requires theory *and* practice to properly master. Every project is different and comes with its own set of challenges. For instance, in the entertainment industry, outdoor events are becoming an increasingly popular addition to a theatre company's season. However, producing plays or musicals in spaces that are not equipped to function as a theatre presents a variety of obstacles. How can a grass plot take the place of stage floor? How do we weatherproof our show? How do we hide all of the things we don't want an audience to see?

This project will explore the challenges a scene designer faces working in environmental spaces while also giving a student real-world experience in designing scenery for nationally recognized theatre companies in the Washington, DC and New York City area.

The Shakespeare Theatre of New Jersey will be staging *The Learned Ladies* by Moliere and Olney Theatre Center will be producing *The Tempest* by William Shakespeare. Both productions will appear in outdoor performance venues. The faculty mentor will serve as the lead designer on these productions. The student will experience and participate in every aspect of the design process, ultimately leading to a portfolio of professional work on the outdoor stages of these two critically acclaimed theatre companies.

9. Student: Winslow DiBona **Major: Computer Science**
Mentor: P. Chris Fragile **Department: Physics and Astronomy**

Title: *Creating an Educational iPad App on Blackholes*

The end goal of this project is to make an educational iPad app about blackholes targeted for grades K-12. Given the age difference in that group there will be different parts of the app that appeal to younger and older sections of the targeted audience.

The application will be centered around the theme "Journey to the Center of the Galaxy: Sagittarius A*" which is the supermassive blackhole at the center of our galaxy. The app will contain general information about blackholes and their presence in our universe. Animations and simulations that the user will be able to learn from will also be incorporated. The subject of blackholes is one that many people cannot grasp. With more hands on activities and images, students will be able to better understand blackholes.

10. Student: Tess Dooley **Major: Marine Biology**
Mentor: Robert Podolsky **Department: Biology**

Title: *Fertilization success in single- and multi-pair spawnings of sea urchins: contributions of gamete quality and sperm-egg compatibility to resisting ocean acidification*

The burning of fossil fuels has driven atmospheric carbon dioxide (CO_2) to its highest level in the last several million years. In addition to influencing climate, CO_2 is also being absorbed by the world's oceans, resulting in an increase in ocean acidity. Ocean acidification ("OA") has become a major environmental concern because it disrupts the production of skeletal material by many marine organisms (e.g., corals, molluscs) and can also interfere with other biological processes. For example, our recent research has shown that levels of OA predicted in the next 50-100 years have negative effects on both sperm activity and egg fertilization in animals that spawn gametes, such as the sea urchin *Arbacia punctulata*. Literature reviews have noted, however, that fertilization appears more sensitive to OA in studies that have crossed single male-female pairs than in those that have used sperm and eggs mixed from several individuals, suggesting that group spawning could lessen the effects of OA on fertilization success. To rigorously test this hypothesis, studies are needed of single and mixed crosses involving common sets of individuals. More generally, we lack information about variation among individuals and among male-female pairings in the sensitivity of fertilization to OA. To address these issues we will perform single- and multiple-pair crosses using the same individuals at different CO_2 levels to assess how gamete quality among individuals and gamete compatibility between individuals contribute to resisting the increasing threat of OA to reproduction in marine organisms.

11. Student: Taylor Duguay **Major: Biochemistry**
Mentor: Richard Lavrich **Department: Chemistry and Biochemistry**

Title: *Synthesis and Structural Characterization of Modified Peptides: The Effect Targeted Chemical Modifications Have on the Shapes Adopted by Peptides*

The three dimensional shape adopted by biomolecules has far reaching implications on the biochemical process in which they are involved. By selectively changing certain areas within the biomolecule, it is possible to influence their function. Chemical modification will be made on a series of natural amino acids. The change in the preferred shape they adopt will be measured using spectroscopic methods. These changes will also be modeled using high level computational studies.

12. Student: Clay Dustin **Major: Math**
Mentor: Timothy Callahan **Department: Geology and Environmental Geoscience**

Title: *Trees as green infrastructure: how transpiration affects the water budget in forests*

Land use and land cover change has continued at a rapid pace in the United States, and one of the fastest-changing regions is the Southeast. Urban area in the greater Charleston, SC metropolitan region has increased 250% from 1973 to 1994, with an additional change of 200% predicted by the year 2030. The standard protocol for urban development is to remove the forest stands (typically pine mixed with certain hardwoods), prepare the acreage by ditching in order to lower the water table, add infrastructure including roads and utilities, and build stormwater conveyances and ponds to mitigate rainwater runoff impacts. It is this reduction of "green infrastructure" of woodlands that is a challenge to urban planning worldwide. In the Southeast U.S. the humid climate, the high probability for intense rainstorms, and shallow water table conditions create special challenges to managing stormwater. This project focuses on the collective services that trees provide by extracting a large volume of groundwater through transpiration. Removing trees creates an imbalance in the

landscape's water budget, and here we will quantify the volume of transpired water at two natural forests: Congaree National Park near Columbia, SC; and the Francis Marion National Forest near Cordesville, SC. Long-term weather and water-table depth will be analyzed for transpiration signals, and these data will be compared to data from Dixie Plantation in Meggett, SC where some trees have been harvested. This will allow us to quantify the "before and after" effect of land cover change on the water budget.

13. Student: Kelsey Fervier **Major: Anthropology**
Mentor: Brad Huber **Department: Sociology/Anthropology**

Title: *Social Complexity and Control of Female Sexuality: Cross-Cultural and Evolutionary Perspectives*

This project investigates the negative sanctions used in sixty, nonindustrial societies to restrict female premarital and extramarital sex. We distinguish five major types of sanctions: 1) corporal sanctions (e.g., mutilation); 2) property sanctions (e.g., fines); 3) social sanctions (e.g., imprisonment); 4) reproductive sanctions (e.g., barring remarriage); and 5) supernatural sanctions (e.g., the belief that gods will impose death). Our data comes from a cross-cultural sample of foraging, horticultural, pastoral, and agricultural societies from around the world. We hope to shed light on how socially stratified and egalitarian societies differ with respect to the kinds of sanctions they employ.

14. Student: Kellan Fluette **Major: Data Science**
Mentor: Paul Anderson **Department: Computer Science**

Title: *Developing and Optimizing Computational Techniques for NMR Metabolomics Compound Identification*

Nuclear magnetic resonance (NMR) metabolomics is a method of analyzing the contents of a biological sample to gain insight. In performing NMR-based metabolomics research we are faced with the problem of having a large amount of data that needs to be quantitatively analyzed. This data is difficult and extremely tedious to work through manually; as such, researchers have devised computer algorithms to solve the problem of analyzing the data. Our goal is to improve upon these existing methods and to attempt to develop a novel method of our own. Success will be measured as the ability to improve upon this analytic accuracy without a significant increase in processing cost or complexity. We will address the subproblem of computational metabolomics focusing on the identification of small molecules within a biological sample. This is a critical step in gaining insight into complex biological processes that are actively researched by a variety of disciplines, such as medicine, marine biology, and environmental science.

15. Student: Lincoln Fraley **Major: Physics**
Mentor: Ana Oprisan **Department: Physics and Astronomy**

Title: *Direct imaging of concentration-induced fluctuations in nanocolloids*

Nanoparticles are used in many applications, from highly efficient solar cells to cancer treatment.

However, little is known about the solubility, mobility, and toxicity of nanoparticles when used for biomedical applications. The purpose of this project is to determine both thermal and mechanical properties related to the dynamics of nanoparticles dispersed in viscous fluids. We will experimentally investigate fluctuations produced at the interface between water and silver, gold nanocolloidal suspensions, each at four different concentrations. The nanocolloid consists of tiny spherical particles of gold or silver with diameters in the range of 5 to 100 nanometers suspended in a water-soluble inert agent. In order to observe the interface between water and a water-miscible nanocolloid,

the nanocolloid must have a relatively high concentration of nanoparticles. Concentration inhomogeneities inside the fluid lead to local differences in fluid properties. As a result, the interface is not perfectly flat but has microscopic "bumps" (fluctuations) that can significantly change the speed of the diffusion process. Since in addition to temperature and fluid properties the fluctuations of the interface are strongly influenced by the concentration of nanoparticles in suspension such interface fluctuations are called *concentration fluctuations.*

We plan to record images of a glass cell unit that experiences concentration fluctuations and analyze the images offline. We will use image and data analysis methods such as Fourier transform, power spectrum, curve fitting tools to compare the results obtained for the correlation time of fluctuations in each experiment and to determine the power law exponents in each case.

16. Student: Avigeet Gupta **Major: Biochemistry**

Mentor: Timothy Barker **Department: Chemistry and Biochemistry**

Title: *The Synthesis of Unnatural Amino Acids*

Amino acids are the basic building block of all living things. There are twenty naturally occurring amino acids in nature. We propose to make unnatural amino acids in the chemistry laboratory that have previously never been made. These unnatural amino acids will then be connected into a string of natural amino acids. These new combinations of unnatural and natural amino acids could potentially be used for studying the function of amino acids chains in different life forms. During the summer research session, we will focus our efforts on the synthesis of the unnatural amino acids and performing analysis on them to determine their structure and other properties.

17. Student: Nicholas Harris **Major: Biology**

Mentor: Jennifer Fox **Department: Chemistry and Biochemistry**

Title: *Mechanism of Cofactor Installation during Cytochrome Oxidase Assembly*

The cells of our bodies and of other organisms must orchestrate an intricate series of chemical reactions through which all the components of the cell are created, broken down, and transformed into useful molecules. The machines that perform these chemical reactions are proteins, and there are thousands of unique proteins within a cell, each with its own specific role. In this project, we are determining how the cell synthesizes the large protein complex called cytochrome oxidase, which has a crucial role in the cell's ability to generate energy.

The cell constructs cytochrome oxidase from 13 different protein components through a stepwise assembly procedure, which requires the assistance of more than 30 additional proteins. The aim of our work is to determine the mechanism for this complicated assembly process, starting by focusing on one of the steps that has not yet been elucidated. We will modify the key protein responsible for this assembly step and determine the effects that modification has on the assembly of cytochrome oxidase. The overall goal is to map the cytochrome oxidase assembly pathway to better understand what processes are impaired in patients who have cytochrome oxidase genetic disorders. In addition to its role in these genetic disorders, cytochrome oxidase has a broad impact on human health, including processes of aging and neurodegeneration, as it is a crucial component of the respiratory chain that our cells rely on to produce the energy needed for life.

18. Student: William Hester **Major: Physics**
Mentor: Gardner Marshall **Department: Physics and Astronomy**

Title: *Investigating the Composition of Dark Matter*

Dark Matter is the name given to an invisible form of matter that is prevalent throughout the universe, interacts gravitationally with all ordinary matter, but has not yet been directly detected in the lab. First proposed in 1933, dark matter was deduced to exist in order to account for the mass necessary to hold galaxies together while they spin [1]. For the past 80 years scientists have remained unable to solve the mystery of what dark matter is actually made of. The most up-to- date data from the Fermi Gamma-ray Space Telescope (FGST) [2] and the Alpha Magnetic Spectrometer (AMS) [3] experiment aboard the International Space Station have observed an excess in cosmic-ray electron and positron flux. It is theorized that dark matter annihilates into particles which will subsequently decay into positrons and electrons over time, accounting for the measured excess. For this project we will use the FGST and AMS data to develop a model of particle physics that accounts for the excess in positron and electron flux with dark matter annihilation as the source. We will then determine if the predicted flux of annihilation products can be fit to match the data obtained by the FGST and AMS.

19. Student: Savannah Jones **Major: Biochemistry**
Mentor: Timothy Barker **Department: Chemistry and Biochemistry**

Title: *Hydroxymethylation of Heteroaromatic Compounds*

Heterocycles are molecules with a ring of carbon atoms that also contain nitrogen, oxygen or sulfur. Heterocycles are an important class of molecules to study because they are often found in drug candidates and medicines. The ability to easily modify a heterocycle is useful to medicinal chemists because they are then able to create many drug candidates with slightly different structures and physical properties. We are proposing a method to modify heterocycles to provide medicinal chemists an efficient way of preparing many different drug candidates from a single heterocycle starting material.

20. Student: Andrea Lavieri **Major: Exercise Science**
Mentors: William Barfield **Department: Health and Human Performance**
Robert Holmes **Department: MUSC - Orthopaedics**

Title: *Early Identification of Heterotopic Ossification following Extremity Blast Injury with a Biomarker Assay*

Heterotopic ossification (HO) is characterized by the formation of mature bone in the soft tissue and is a common complication that occurs following bone and muscle trauma. HO is prevalent in patients with severe extremity wounds that may result from blast injuries during combat and also due to civilian injuries including closed head injury (concussions), injuries to the human pelvis, when there is fracture to joint where the leg meets the pelvis (acetabulum) and even elbow injuries, where the bone or bones that join at the elbow are broken. Soft tissue pain is a common symptom of those who develop HO. The incidence of HO in patients with multiple injuries has been found to be as high as 57%. The purpose of this proposed study is to contribute to the body of knowledge related to the issue of HO, by using a rat model to examine the biology of heterotopic bone formation. The goal will be to identify biomarkers in this animal model that may be applicable to humans. Once HO is developed, surgery is required to treat the patient. Our research hypothesis is that biomarkers can be identified that will allow for prophalytic treatment of the patients that may be at risk for HO development so surgery can be alleviated. If our goal can be reached the initial bone and soft tissue trauma may be reduced so that patients can return to a productive civilian life.

21. Student: Kellen Lawson **Major: Astrophysics**

Mentor: Joe Carson **Department: Physics and Astronomy**

Title: *Searching for Extrasolar Planets with the Subaru SEEDS Survey*

The SEEDS survey is a five year international astronomical survey with 120 nights of observations using the Subaru telescope atop Mauna Kea in Hawaii (Tamura et al. 2009). The intent of this survey is to directly image exoplanets and disks (the reservoirs of material around young stars from which these planets form) around stars and to better understand how they form and are related.

More specifically, our research comprises a group within SEEDS that focuses on extrasolar planets around high mass stars. The importance of these stars is, in part, due to the fact that they often produce higher mass planets. Such planets retain more heat and are therefore more visible in the infrared wavelengths in which we observe (Baraffe et al. 2003). Additionally, we will prioritize targeting the youngest stars in this category, for similar reasons to those above; namely, these systems will have more residual heat, again making planets more visible in the infrared.

Alternative indirect detection strategies discover planets by observing their effects on the star, such as a wobble or a slight drop in stellar brightness due to a transiting planet. Besides revealing the fact that the planet exists and offering basic limits on planet mass, these approaches are limited in the knowledge they provide. With the light from direct imaging, we can produce information regarding the planet's temperature, composition, and atmospheric chemistry. While technically difficult, this method allows us unique insights into characterizing planets and the parameters that affect their formations.

22. Student: Danielle Massé **Major: Mathematics**

Mentor: Jason Howell **Department: Mathematics**

Title: *Computational analysis of wall shear stress in arterial aneurysms*

The prevalence of intracranial and aortic aneurysms in the general population is estimated to be at least 0.5%, and rupture of an aneurysm often directly leads to mortality. Biomedical research has recently indicated that some specific dynamic characteristics of the blood flow inside arteries with aneurysms are risk factors for both the enlargement and rupture of the associated aneurysm. This project seeks to analyze these blood flow characteristics inside arteries with aneurysms from a mathematical and computational standpoint. This will be accomplished by: (a) implementing a mathematical model of the blood flow in a computational framework, (b) conducting numerous simulations of aneurysms with different shapes, and (c) analyzing the data gathered from the simulations. The mathematical model of the fluid flow will be derived from well-known equations that govern the behavior of complex fluids such as blood. An idealized model of the shape of an aneurysm will be constructed and subsequently adjusted to account for several different characteristics found in actual aneurysms. The primary objective of the project is to determine the influence that the shape (geometry) of an aneurysm has on these specific characteristics, and to construct a procedure for finding the features of aneurysm geometry that minimize the enlargement and rupture risk factors. A potential long-term impact of this research is to provide medical professionals with more knowledge regarding the mechanics of enlargement and rupture of aneurysm, which will hopefully assist in the development of treatment procedures based on patient-specific data gathered from medical imaging.

23. Student: David Medley **Major: History**

Mentor: Tim Carmichael **Department: History**

Title: *The Somali Youth League and the Rise of Somalian Nationalism, 1940s-1950s*

The purpose of this project will be to collect and analyze information held at the Kcw National Archives in London, England that are otherwise unavailable for study. Within these archives are

plethora of documents relating to the British activities in Somalia. Several documents in particular are on the African political clubs in Somalia after the Second World War. The club that is of primary importance to this research is the Somali Youth League {SYL). The SYL was paramount as one of the first major nationalist groups to emerge in British ruled Somalia that spread the political idealism that would eventually influence an independent Somalia and many modern political parties in the state. The ideologies of the SYL are still apparent today as they have been adopted by many political organizations such as Al-Shabaab which seeks to espouse a narrative of Somali Nationalism. However, most scholarly interest in Somalia focuses on the communist influence, the failure of the state, the military conflicts that erupted at the end of the twentieth century, or piracy. There exists very few analytical works dedicated to the Somali Youth League and the influence this group has had on modern Somali nationalism and politics. As historians, we believe that it is paramount to review the records kept at the Kcw National Archives in London to ascertain a greater understanding of the Somali Youth League's organization and ambitions and create a publication to share the importance of this group that has been overlooked by scholarly critique.

24. Student: Stephanie Meier **Major: Biology**
Mentors: Beth Sundstrom **Department: Communication**
Andrea DeMaria **Department: Health and Human Performance**

Title: *Understanding knowledge, attitudes, and behavioral determinants for contraceptive use decision making among reproductive-aged women*

The Affordable Care Act requires health insurance to cover all FDA-approved contraception. Research suggests that with the barrier of price removed, women will have increased choice among contraceptive options. Despite access to highly effective contraception, half of all pregnancies in the United States remain unplanned. In 2012, the American College of Obstetricians and Gynecologists (ACOG) determined that long-acting reversible contraceptive (LARC) options, such as the intrauterine device (IUD) and the implant should be first-line recommendations for all women. LARC options and nondaily contraceptive methods, such as the injection, nuvaring, and patch, decrease user error and offer higher rates of effectiveness when compared to the oral contraceptive pill and daily options.

Little research has been done to understand how to increase acceptance and use of nondaily and LARC methods among women. This study seeks to explore women's knowledge, attitudes, and contraception decision-making in order to provide recommendations to improve access to these methods and to develop an intervention targeting behavior change. This study will conduct formative research, including focus groups, in-depth interviews, and a web-based survey, to develop a contraceptive access campaign. Specifically, researchers will test messages in order to identify concepts and design features that resonate with women. Qualitative research is essential to understand contraceptive use behaviors, knowledge, access, and messages to impact the development of communication efforts. Findings from this study will extend theoretical and practical opportunities to reduce unplanned pregnancies among women.

25. Student: Aaron Moriarity **Major: Biology**
Mentor: Jason Vance **Department: Biology**

Title: *The Development and Senescence of Flight Performance in Honey Bees (Apis mellifera)*

A major concern in life is how behavior and age affect an individual's performance. Flight in insects is among the most metabolically expensive observed in nature; as such, we observe shorter lifespans in honey bees that forage bees than bees that perform non-flight tasks inside the hive. The purpose of this

project is to investigate how development and aging affect the flight performance of honey bees, and correlate individual flight performance to changes in muscle composition across age. We hypothesize that maximum flight performance in forager bees will increase throughout days 10-20 of age, plateau between 20-30 days of age, and decline after 30 days of age, and will be associated with changes in their ability to beat their wings during flight. We also hypothesize that maximum flight performance will be correlated to changes in the composition of the flight muscle. We plan to test the flight performance of forager and nurse honey bees across 40 days of age using a custom force measurement system and high-speed video cameras. Afterwards, tested bees will be frozen and provided to the Southgate Lab in a collaborative effort, to analyze muscle composition. This study will be the first known attempt to correlate individual variation in maximal flight performance to mechanistic changes in muscle composition thought to facilitate such flight performance.

26. Student: Grace Moxley **Major: Biology**
Mentors: Andrea DeMaria **Department: Health and Human Performance**
Beth Sundstrom **Department: Communication**

Title: *Understanding knowledge, attitudes, and behavioral determinants for contraceptive use decision making among reproductive-aged women*

Advances in nondaily (e.g., vaginal ring, patch) and long-acting reversible contraceptive (e.g., intrauterine device, implant, injection) methods have led to new recommendations for reproductive-aged women. Despite increased effectiveness and user-friendly nature of nondaily and long-acting reversible contraceptive options, the oral contraceptive pill remains America's most- used form of birth control (27.5%). Unlike the pill, however, long-acting reversible contraceptive methods, which are administered by health professionals, have success rates that do not differ in their "typical use" and "perfect use." For example, the intrauterine device has a failure rate of merely 0.2%.

In the coming years, as contraceptives are covered by the Affordable Health Care Act, long- acting reversible contraceptive methods will become available for women of lower socioeconomic status, to which cost has been a barrier. Over the course of our study, we plan to test message concepts and design features in order to develop a health campaign to inform women about nondaily and long-acting reversible contraceptive methods. By using formative research to develop and test the effectiveness of messages in a variety of settings (focus group discussion, in-depth individual interviews, and web-based surveys), we hope to produce an effective campaign that can be implemented in Charleston, and across South Carolina. Qualitative research is essential in understanding knowledge, behaviors, and access related to contraceptive choice, in order to inform communication efforts. Using qualitative methods, in conjunction with a quantitative survey will allow for strength in our methodologies, results, and generalizability.

27. Student: Marino Mugayar-Baldocchi **Major: Psychology**
Mentor: Daniel Greenberg **Department: Psychology**

Title: *Anchoring Autobiographical Memories*

Adults tend to say that their earliest memory comes from about age three. They also tend to say that the memory is vague and fragmented-perhaps nothing more than a hazy image that captures a single moment in time. How reliable are these age estimates? For that matter, how reliable are the memories themselves? Can they be altered by outside influences, and how powerful do those influences need to be? Previous research has shown that these memories can be influenced by social pressure, but here we will use a more subtle technique. Specifically, we will see if memories can be influenced by the *anchoring effect.* In this effect, the presentation of a number affects people's

estimates of a subsequent uncertain quantity, and thus the number anchors the later estimate. Participants will be given a high anchor, a low anchor, or no anchor (the control group), and then all participants will be asked to estimate the age of their earliest memory. After that, we will ask them to rate the memories on a series of scales. We hypothesize that participants who are anchored to a lower number will report an earlier first age and less vivid memories than other participants.

28. Student: Tyler Perini **Major: Mathematics**

Mentor: Amy Langville **Department: Mathematics**

Title: *The Humility Project: Text Analysis for Characteristic Linguistic Patterns*

We are placing one of the most elusive psychological constructs, humility, under an analytical lens to see if it can be observed and quantified, primarily through language. We will accumulate data sets from online samples including the individuals' humility score, measured by a previously-validated humility scale, and written essays about questions intended to inspire humility-related language. Several different text analysis methods will be employed to identify linguistic patterns between high vs. low humility groups. Mathematically, these methods will model each document as vectors in higher-dimensional space, in which we may then use methods such as term weighting, normalizations, and matrix decompositions to highlight any patterns that exist within the data. In addition, we may use a computer software tool, Linguistic Inquiry and Word Count (LIWC; Pennebaker & Francis, 1996), that analyzes the frequency of words in set dictionaries in order to find different linguistic patterns (e.g., the use of pronouns, emotion words, etc.) between the groups. Further methods may be employed that take into account linguistic properties other than word choice and term frequency, including syntactic, categorical, or semantic analysis. The objective of these methods is to find observable configurations of written language that are uniquely characteristic of people possessing vs. lacking humility. Secondary objectives will be to use these findings to predict one's humility score from written samples, to similarly evaluate the humility of popular "moral exemplars" based on their speeches, and to visually display relevant data in a useful way.

29. Student: James Pinner **Major: Biochemistry**

Mentor: Amy Rogers **Department: Chemistry and Biochemistry**

Title: *Investigation of the crystal structure of endothelial nitric oxide synthase in the presence of novel tetrahydrobiopterin analogs*

It is not uncommon to hear about molecules that are harmful and should be avoided. But have you ever heard of a dangerous molecule that you actually need? Nitric oxide (NO), a toxic, free-radical gas, is just that molecule. In fact, it was awarded Molecule of the Year in 1992 for its surprising role as a neurotransmitter, vasodilator, and anti-cancer agent. So how is NO synthesized in the body with such precision that it delivers Dr. Jekyll's effect and not evil Mr. Hyde's? The enzyme nitric oxide synthase (NOS) produces NO *in vivo* by converting the molecule L-Arginine into L-citrulline and NO but exactly how this is done is not well understood. There are several cofactors that are needed by NOS in order for the reaction to proceed; one of them is called tetrahdyrobiopterin (BH4). Without BH4, the reaction does not proceed and toxic products are formed. But the exact role of the BH4 is unknown. We believe that one key factor in understanding how NOS produces NO lies in understanding what the BH4 is doing during catalysis. Our studies focus on probing the role of BH4 by spectroscopic and catalytic assays as well as X-ray crystallography. We believe this important cofactor provides not only reducing equivalents to the reaction center, but also a proton. Uncovering the role of BH4 could provide insights into how NOS produces a toxic gas in the perfect concentration as to allow such beneficial things as neurotransmission or cardiac blood flow.

30. Student: Taylor Ann Spencer **Major: Theatre**

Mentor: Janine McCabe **Department: Theatre and Dance**

Title: *Developing the Costume Design Process*

Development as a theatre artist cannot be fully achieved in a classroom setting. The nature of this collaborative art form requires immersion in realized production work that takes ideas communicated in coursework and puts them into practice for an in-depth understanding.

"Developing the Costume Design Process", allows for an intensive look into the day-to- day work and research involved for the Costume Designer on a professional theatrical production. Using the creation of an original costume design for Flat Rock Playhouse's production of *My Fair Lady* as the framework, this project will allow for the student to gain an understanding of the processes of theatrical design and to be exposed to professional theatre with high production values.

The project requires in depth analysis of the script and characters, extensive period research, communication and problem-solving techniques in a collaborative atmosphere while interacting with all members of the production's creative team hired by Flat Rock Playhouse. While the faculty mentor will serve as the lead designer on the production, the student participant will collaborate in all stages of the design process and execution of the design.

At the conclusion of this project, the student will have experienced complete immersion in the costume design process, interaction with many theatre professionals, developed skills as a theatre artist and have high quality professional work at a nationally recognized regional theatre added to her resume and portfolio.

31. Student: Benjamin Stephens **Major: Biochemistry**

Mentor: Neal Tonks, Jr. **Department: Chemistry and Biochemistry**

Title: *Synthesis and Characterization of Biobased Polyurethane Foams*

The chemistry field is currently in the middle of a push for more "green" techniques and sources for materials. Academic and industrial groups are moving from petroleum sources to biological sources in an effort to advance the "Green Chemistry" movement. This move towards more ecofriendly chemicals promises more readily available sources for medicine, chemical engineering, and other chemical dependent industries. The focus of this project will be polyurethanes, a group of chemicals that the "Green Chemistry" movement has had a large influence on. Paints, fibers, foams, and adhesives all contain these types of polymers. Over the summer, we plan to create bio-based polyurethane foams as opposed to petroleum-based that dominate the polyurethane industry. While using bio-based molecules in our foam syntheses, we plan to create foams that are environmentally friendly; while at the same time will be up to industrial standards for foams that exist today. The required components needed for the project have already been acquired, as well as the bio-based surfactants. Once the "green" foams are synthesized, we plan to analyze our results using confocal microscopy, as well as other physical characterization measurements. Since environmental awareness has grown over the past few years, we will be making sure that our foams will not only meet product quality, but also environmental standards as well. These environmental standards for polyurethane foams are set by CertiPur. These standards require that the foams do not emit volatile gases when exposed to higher temperatures, and must prove to be environmentally friendly.

32. Student: Nicholas Taylor **Major: Chemistry**

Mentor: Jennifer Fox **Department: Chemistry and Biochemistry**

Title: *Protein–Protein Interactions of Cytochrome Oxidase Assembly Factors*

Enzymes are the machines that perform chemical reactions in the human body and in other organisms. Enzymes are governed by common principles and may share similar features, but ultimately each enzyme is unique in both its structure and its function within a living cell. Most enzymes perform only one specific chemical reaction. Therefore, the cell requires many different enzymes working together to perform a complicated task. One of the tasks that cells must accomplish is to build structures that are required for life, such as the electron transport chain, which plays a crucial role in the cell's ability to generate energy.

This project focuses on one step in the assembly of the electron transport chain. The principal enzyme required for this assembly step exists as a complex of several components. We are determining how each component in the complex interacts with its neighbors and the role of those interactions in creating a functional enzyme complex. Understanding how this enzyme works will give us valuable insight into both the assembly mechanisms for the electron transport chain and what defects occur in patients with disorders of the electron transport chain. The electron transport chain is implicated in aging and neurodegeneration and therefore has a broad impact on human health.

33. Student: Travis Varner **Major: Chemistry**

Mentors: Justin Wyatt **Department: Chemistry and Biochemistry**

Richard Himes **Department: Chemistry and Biochemistry**

Title: *Design and Synthesis of a Novel Bis-Indenyl "Batwing" Catalyst*

Everyone is familiar with different everyday polymers, such as Styrofoam and spandex, and with common drugs such as antibiotics. The method for making these materials involves controlling the formation of specific bonds within the structures. The control aspects that are involved are numerous, but one key factor needed is a molecule called a catalyst. There are problems associated with current catalysts; therefore the design and formation of novel catalytic systems is necessary. This research describes the synthesis and computer modeling of designing an original metal catalyst.

34. Student: Alexis Violette **Major: Chemistry**

Mentor: Justin Wyatt **Department: Chemistry and Biochemistry**

Title: *Designing Novel Dual-Action Anticancer Agents Targeting Two Specific Sites of Cell Division*

A popular topic of research for the treatment of cancer is creating compounds that interrupt the cancer cell's division process, making the cancer unable to spread and better yet, kill it. Current methods affect one target involved in cancer cell division and have high cytotoxicity. To make treating cancer more effective, compounds can be created to interact with two or more targets within the cell division process. Because these new compounds can, in theory, be twice as effective, the cytotoxicity would be half that of the current compounds. Reducing the toxicity of treatment compounds would be very beneficial to cancer patients, as chemotherapy, being unable to distinguish healthy cells from cancer cells, causes uncomfortable, even intolerable side effects for some cancer patients. The aims of this research are to design, create, and test new dual-action anticancer compounds that are tailored to target two specific sites in cell division. These compounds will be tested on cancer and "healthy cells" to determine their levels of effectiveness to kill cancer and their levels to not kill "healthy cells". Undergraduate students will synthesize and test these compounds and if successful, second and third generation derivatives will be created to increase their effectiveness in the treatment of cancer.

35. Student: Chelsea Woodruff **Major: Biology**

Mentor: Jason Vance **Department: Biology**

Title: *The Effects of Natural and Experimental Wing Wear on Honey Bee (Apis mellifera) Flight Performance*

As animals age, they accumulate wear and tear that eventually impairs behavioral performance. This is especially true for flying insects, where wing wear degrades the available surface area available to produce lift, and no mechanisms exist to repair such wear when it occurs. For some insects, such as bees, wing wear is directly correlated to the length of their life span; thus, as a bee accumulates wing wear, it experiences an increased probability of mortality. Furthermore, wing wear appears to negatively impact foraging decisions and behavior, which can also affect the fitness of the colony. The purpose of this project is to determine how natural and experimental wing wear affects the flight performance of honey bees. We hypothesize that bees maximum flight capability is limited by how fast they can move their wings as wing wear decreases available wing area. We plan to collect honey bee foragers and record the degree of existing natural wing wear; bees free of wing wear will be given artificial wing wear by carefully cutting small amounts of wing area in a pattern similar to that observed in nature. We will test the maximal flight performance of each bee using a custom force measurement system and high-speed digital video, and analyze how bees adjust their wing beats to mitigate wing wear. We anticipate that our flight experiments will identify elements that limit maximum flight performance and provide insight into mechanisms that functionally link wing wear to increased mortality and impaired behavioral performance.

36. Student: John Zeringue **Major: Computer Science**

Mentor: James Bowring **Department: Computer Science**

Title: *Engineering an Open Source Visualization Engine for the Earth Sciences*

In any scientific field, data visualizations are important to both the transmission and understanding of information among scientists. For over two decades, earth scientists in many countries have depended on a software program named ISOPLOT [2] for a special set of visualizations. However, as the software's author has retired recently (2012), ISOPLOT is no longer supported and will not run on the most recent operating systems. Users of the program are also eager for new features, including improved usability and new types of visualizations based on advances in the field. U-Pb_Redux [1], a geochemistry software program that has been developed by Dr. Bowring at the College of Charleston for the last several years, already includes some of the basic functionality of ISOPLOT. The applicant is currently funded through a MAYS grant to pursue the initial phase of this work with Dr. Bowring. This project will build on this foundation and focus on producing a working prototype of a graphical user interface (GUI) to support use of the visualizations produced during the MAYS grant work. This GUI will be published online for initial review by ISOPLOT users in the earth science community. The resulting software and documentation will be available to anyone via the Internet.