2015 Summer Undergraduate Research with Faculty (SURF)

1. **Student: Joyce Biaco** — **Major: Chemistry**
   Mentor: Timothy Barker — **Department: Chemistry and Biochemistry**
   Title: *Lewis Acid-Catalyzed Minisci Reactions*

Many pharmaceutical drugs contain at least one nitrogen atom. If that nitrogen atom is part of a ring with carbon atoms it is called a heterocycle. 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 selectively modify heterocycles that would be useful for the synthesis of new drug candidates.

2. **Student: Paige Bippus** — **Major: Marine Biology**
   Mentor: Erik Sotka — **Department: Biology**
   Title: *Use of herbivory resistance in different populations of the alga Gracilaria vermiculophylla to track its invasive history*

Species that are not native to the habitat they are living in are called 'invasive species'. Both land and marine invasive species are changing the community structure (i.e. food webs and competition for space and nutrients) as well as the surrounding environment. One species of marine seaweed, *Gracilaria vermiculophylla*, has invaded virtually all the coasts of the Northern hemisphere. Although we know it can tolerate a variety of temperatures and salinities, it is believed that the seaweed has adapted genetically to its surrounding environments in order to thrive. Our object for the project is to determine whether or not there are genetic differences in the *Gverm* populations from different regions of the world that it has invaded. In order to determine genetic adaptation, we must test varying phenotypes (observable characteristics). The phenotype we will focus on is herbivory resistance. Many seaweeds, including *Gverm*, are often unpalatable for various reasons to herbivores that feed on it. In order to test whether or not populations from different regions have adapted to ward of herbivores, we will conduct three different feeding experiments in which we feed the *Gverm* to herbivores and see if they will eat it or prefer it to local seaweed. By doing this, we will ideally be able to track the invasive history of the seaweed and discover whether or not it evolved in characteristics that helped it be successful in many environments. We hope *Gverm* will serve as a model for analyzing genetic adaptations of future invasive species.

3. **Student: Joseph Boscia** — **Major: Biochemistry**
   Mentor: Amy Rogers — **Department: Chemistry and Biochemistry**
   Title: *Growth and Purification of Endothelial Nitric Oxide Synthesis for Crystallographic Studies with Novel Pterins Bound*

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 gas similar to carbon monoxide, 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 this toxic molecule made in the body with such precision that it provides 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 BH_4 is unknown. We believe that one key factor in understanding how NOS produces NO lies in understanding what BH_4 is doing during catalysis. Our studies focus on probing the role of BH_4 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 BH_4 could provide insights into how NOS produces a toxic gas in the perfect concentration to provide essential biological functions like neurotransmission or cardiac blood flow.

4. Student: F. James Claire, III **Major: Chemistry**
Mentor: Kristin Krantzman **Department: Chemistry and Biochemistry**

Title: *Simulations to Study the Morphology of Fullerene-Graphene Nanocomposites*

Carbon nanomaterials, such as fullerene and graphene and their derivatives, have attracted considerable attention for their use in nanoelectronics because of their exciting structural, electronic and magnetic properties. The excellent electronic and mechanical properties of carbon nanomaterials enable their use in solar cells, advanced energy conversion and storage devices. Understanding and controlling the carbon nanocomposite interfacial properties and resulting morphology is a crucial factor in tailoring materials properties for use in a wide range of applications. The fullerene molecule, C_{60}, is composed of 60 carbon atoms joined together by single and double bonds to form a hollow sphere. Graphene is a one-atom thick planar sheet of carbon atoms. It is proposed to use computer simulations to study the adsorption of fullerene molecules on a graphene solid substrate. The proposed research will provide a fundamental understanding of the role of physical and chemical properties of carbon nanomaterials constructed from fullerene and graphene. The results will significantly enhance the current understanding of the role of surface and component properties on morphology formation of carbon nanocomposite films and will have direct implications for interpreting experimental results and can be used as guidelines for design of future nanocomposites.

5. Student: Anna Collett **Major: Biology**
Mentor: Jason Vance **Department: Biology**

Title: *Optomotor response to simulated rotations during tethered flight in honey bees*

Honey bees and other insects are capable of rapid maneuvers in response to turbulence and wind during flight. However, it is unclear how bees detect these perturbations. One possibility is that visual feedback can provide the sensory input necessary to modulate this rapid kinematic response. Honey bees' visual system has been well-studied in the context of flight navigation, which contributes to flight odometry, maintaining heading angle, and flight velocity. However, it is not known how vision is used over short timescales for reactive flight control. In the proposed research, we will investigate the reacting time (latency) and frequency response (bandwidth) of the compound eye and ocelli visual feedback. Bees will be tethered within a custom LED arena, and oscillating visual patterns will be presented to simulate rotations the yaw-axis. High-speed videography (6000 fps) will record wing and head movements to characterize the bees' kinematic response. By comparing the bees' kinematic response to the movement of the visual pattern, we can determine the reaction time and frequency range of visual feedback on motor control. This research will determine which visual pathways, compound eyes and/or ocelli, contribute to the initiation and modulation of the kinematic response to flight perturbations in bees.

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

Title: *Mechanisms of Autonomy During Claw Transformation in the Snapping Shrimp*

The snapping shrimp, *Alpheus angulosus*, exhibits a unique characteristic in its front claws. The snapper, used for defense and communication, and the pincer, used for feeding and habitat manipulation, differ radically in shape and size. When grabbed by the large snapper claw, the shrimp will generally drop it in the interest of survival — just as a lizard might drop its tail. Upon dropping its snapper, the shrimp can "switch hands" by regenerating a pincer from the previous snapper limb, and transforming the previous pincer into a functional snapper. While this transformation is standard among snapping shrimp, the specific claw dropping behavior seems to differ within the species. To evaluate these differences and understand the role of nervous system control in this process, we have divided a large group of shrimp into categories by sex, size (as a proxy for age) and molt stage. With these shrimp, we are using a systematic threat process to gauge how long each shrimp must be threatened before dropping its snapper. After this initial threat, each shrimp will be given its assigned number of molt stages to develop its new claw before being threatened and dropping its claw again. 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 the groundwork to make this species a competitive model for regenerative neuroscience studies.

7. **Student: Noah Denman** **Major: Biology**
Mentor: Marcello Forconi **Department: Chemistry and Biochemistry**

Title: *Quantifying the Sulfatase Activity of SdsA1*

The enzyme SdsA1, found in the pathogenic bacterium *Pseudomonas aeruginosa*, has been proposed to be capable of degradation of sodium dodecyl sulfate (SDS), a component of soaps and detergents. Because SDS is a man-made chemical that is not easily biodegradable, SdsA1 might represent a possible target for the bioremediation of SDS contaminations. However, previous results from our lab showed that moderate quantities of SDS inhibit the reactions, suggesting that SDS might not be the real substrate for this enzyme. Here, we are going to study how different chemical compounds that share some similarities with SDS are degraded by SdsA1, in order to better understand the biological function of SdsA1.

8. **Student: David Derouen** **Major: Geology**
Mentor: K. Adem Ali **Department: Geology**

Title: *Satellite Remote Sensing of water quality parameters in the coastal waters of the US Virgin Islands*

Coral reefs in US Virgin Islands (USVI) represent complex and dynamic ecosystems. These habitats provide primary framework for the development, growth and survival of thousands of species, and protect shorelines from wave erosion and storm surges. They are highly valuable as a natural resource, and for ecological services, but yet highly sensitive to changes in surrounding factors (temperature, water chemistry, and human disturbance). The scenic attributes have drawn more and more people to this region, and urbanization has increased as a result. This has caused coral reefs to receive an increased flux of storm water runoff, wastewater discharge, and other contaminants associated with urbanization. These changes are predicted to accelerate with climate change. Reef recovery rates are slow and could thus face severe devastation from continued anthropogenic stresses. A key index that can be used to assess stress on these ecosystems is the water quality. Current water

quality assessment is largely based on *in situ* measurements with limited spatial and temporal resolution. This makes it difficult to understand the dynamics of water quality parameters (WQPs) such as phytoplankton, suspended materials, and dissolved organic matter. Satellite-based synoptic measurements using multispectral sensors provide better resolution, but require the development of algorithms that relate spectral reflectance to the WQPs. The goal of the proposed project is to develop robust regionally tiered model that can estimate concentrations of WQPs from satellite data in the coastal waters of USVI. These synoptic models can provide information critical to the understanding of biogeochemical processes in the ecosystem.

9. Student: Diana Devine **Major: Psychology**
Mentor: Amy Kolak **Department: Psychology**

Title: *Emergent Self-Regulatory Skills Within the Family Context*

The primary aim of this research project is to better understand 2-year-old children's ability to control their behavior with and without parents' help. During a visit to our lab, each toddler was observed in two "don't touch" tasks. In the first one, the experimenter asked the child not to touch toys until she returned and the parents, who were both in the room, were asked to reinforce the "don't touch" rule. In the second, the child was again asked not to touch a wrapped gift until the experimenter returned. In this paradigm, the parents, however, were asked not to reinforce the "don't touch" rule. For this project, we will apply a coding system to assess the attentional focusing strategies the children used during these "don't touch tasks" and examine how these strategies were associated with whether or not they touched the toys or gift. First, we are interested in examining the difference between children's behavior across these paradigms when parents reinforced the rule versus when they did not. Second, we are interested in examining mothers' and fathers' individual parenting and their joint parenting behavior as relates of children's behavior in these "don't touch" tasks. Third, we are interested in examining longitudinal links between children's attentional focusing strategies at 2 years of age and their self-regulation at 5 years of age.

10. Student: Sarina Etheridge **Major: Astrophysics**
Mentor: P. Chris Fragile **Department: Physics and Astronomy**

Title: *Contrasting Magnetohydrodynamic Turbulence with Alpha-Viscosity*

A black hole accretion disk is an accumulation of materials, such as gas and dust, which orbits a black hole. The goal of this project is to create two separate computer simulations of black hole accretion disks. The two computer simulations will use different methods of producing the turbulence that is required for accretion disks to operate.

One of the simulations will use an artificial viscosity put in "by hand." This implies that this method is not a representation of true viscosity, but merely acts like viscosity. No physical mechanism is truly represented. This is how accretion disks have been modeled for decades. The other simulation will incorporate the physical process now known to be responsible for accretion, called the magneto-rotational instability.

The purpose of the project is to compare the two simulations to understand in what ways the real physical process differs from the artificial viscosity treatment. Ours will be the first such simulations done using general relativistic gravity, as is appropriate near a black hole.

11. Student: Lindsay Evans **Majors: Psychology/Computer Science**

Mentor: Sorinel Oprisan **Department: Physics and Astronomy**

Title: *Nonlinear effects in time perception modeled with a realistic cortico-striatal network*

Time is an essential dimension of the world around us, determining the decisions we make, the actions we choose to take, and the very precision of our slightest movements. Millisecond timing is important for speech recognition, auditory processing, playing music and dancing. Circadian timing (hours to days range) controls sleep and wakefulness, and is critical for metabolic and reproductive fitness. Interval timing, or timing in the seconds-to-minutes range, is crucial for rate estimation, decision-making and foraging. Interval timing has been demonstrated in many species, from invertebrates, to many vertebrates, such as fish and birds, and mammals such as rats and humans. In most of these species, the error of time estimation varies quasi-linearly with the estimated duration, a property called scalar property or scalar timing. Deficits in interval timing, including lack of scalar timing, have been reported in Parkinson's Disease, Huntington's Disease, Schizophrenia, Attention Deficit Hyperactivity Disorder, and Alzheimer's disease. We will use a realistic computational model developed by Oprisan and Buhusi (2011) to investigate the effect of the number of neurons allocated to the interval timing task on the scalar property. The striatal beat frequency (SBF) model produces a Gaussian output with a sharp peak centered on the learned interval time, as seen in actual experiments, and, in addition, the output obeys scalar property. The objective of this project is to investigate the neural network parameters that contribute to nonlinear effects that lead to deviations from scalar property.

12. Student: Lucas Freeman **Major: Biochemistry**

Mentor: Richard Himes **Department: Chemistry and Biochemistry**

Title: *Early Transition Metal Complexes for Carbon-Carbon Bond Formation*

The molecules of life are exquisitely complex, a fact which often demands that the chemicals used to influence biology – drugs, for example, with which we hope to prolong or improve life – have a very specific structure to give their intended effect. That effect can be finely sensitive to even miniscule changes in the molecule: switching a single atom's arrangement can lead to an inactive or even hazardous drug, as was learned with thalidomide in the 50s. Synthesizing drugs and other useful organic molecules thus requires very specific control over the reactions in their synthesis. Yet, the simpler the process to make a drug, and the simpler and more readily available the starting materials, the more cheaply and more easily the drug may be made for the public. The synthetic chemist continually looks to more easily build complex molecules: using less energy, using less expensive materials and simpler methods. Building complex molecules from simple reactants requires control over how those reactants arrange their bonds and atoms when they combine. The use of a metal compound – called a catalyst – may provide that control. The goal of this proposed project is to develop the chemistry of inexpensive titanium (abundant, cheap, non-toxic) catalysts for using simple, readily available materials to synthesize molecules with control over their complexity. These specific molecular building blocks can then be further incorporated into desirable, biologically active molecules such as drugs.

13. Student: Laura Galloway **Major: Biology**
Mentors: Agnes Ayme-Southgate **Department: Biology**
Jason Vance

Title: *Differential gene expression in nurse to forager honeybee transition*

Within a honeybee hive, the tasks to be accomplished such as cleaning, feeding, defending and finding the food are divided between different workers. Most inside-the-hive jobs are accomplished by the nurses, which barely ever leave the hive and therefore are not active fliers. On the other hand, finding the food and bringing it back to the colony is the job of the foragers. These are the bees going back and forth between the hive and the flowers, and therefore, they are extremely good fliers. During a worker life cycle, the bee starts as a nurse, but at some point becomes a forager, usually based on the needs of the colony. This process is in a way similar to someone starting a fitness program. So how do you prepare for such a transition in life? Major changes occur to enable the worker bee to transition to this completely different job. Decrease in weight, increase in metabolic and immune activity, and depressed ovary activity are a few of the known reprogramming events. There is also some evidence for modifications of the muscle proteins to generate enhanced flight ability. Starting to understand this process at the molecular level is the goal of this proposal. We will use several molecular biology techniques to investigate the difference in muscle gene expression (usage) between nurses and foragers. Knowing which muscle proteins are either turned down or overproduced during the transition will provide a basis for a molecular dissection of this critical process in honeybee life process.

14. Student: Jasmin Graham **Major: Biology**
Mentor: Gavin Naylor **Department: Biology**

Title: *Reconstructing the Evolution of Hammerhead Sharks*

Hammerhead sharks are unique among sharks in having a laterally expanded head. Currently, there are 8 different recognized species of hammerheads. The various species differ, among other things, in the degree of the lateral expansion seen in the head structure – termed the "cephalofoil". Two conflicting hypotheses have been forwarded to account for the evolution of the structure. The first, based on an assessment of overall form, suggests that the head has become incrementally laterally expanded over the course of evolution, while the second, based on comparison of mitochondrial DNA sequence data, suggests that the early forms already had a highly laterally expanded head that became gradually reduced over time. These two hypotheses invoke opposing directions of natural selection. In the current study, we propose to obtain nuclear gene data using a cross species gene capture approach developed in Dr. Naylor's lab at the College of Charleston that will allow us to address the question from a genomic perspective.

15. Student: Maja Grzejdziak **Major: Public Health**
Mentors: Merissa Hart Ferrara **Department: Communication**
Beth Sundstrom

Title: *e-HOPE: Increasing health care access among rural women in South Carolina*

Rural populations face unique barriers to health care often resulting in health disparities. Residents in rural communities are more likely to report poor health status and are less likely to be insured than their urban counterparts. In 2008, Planned Parenthood of Greater Iowa pioneered the use of telemedicine by providing health services via sophisticated video and fiber equipment at remote clinics. Planned Parenthood Health Systems (PPHS) will initiate a telemedicine program (e-HOPE Plus) in South Carolina in Spring 2015 to address barriers to health care in rural areas, especially in women's services. Existing research demonstrated high satisfaction levels among rural participants in a family

health telemedicine project, noting that this method of care offers a promising opportunity in underserved rural areas.

Over the course of our project, we will work collaboratively with PPHS to evaluate the effectiveness of the telemedicine program in SC rural communities by conducting a pre-/post-test survey design. We will seek to determine the impact of the program on patient contraceptive choice, follow-through, and compliance. This study will expand the limited research regarding the effects of telemedicine as a promising approach to increase health care access and address health disparities. This research will also inform the continued implementation of the e-HOPE PLUS project in South Carolina, as well as other telemedicine projects.

16. Student: Carly Harward **Major: Dance**
Mentor: Gretchen McLaine **Department: Dance**

Title: *Letter to a Man De-constructed: Analyzing choreographic interpretations of mental illness*

Choreography is a collaborative art form that exhibits specific themes, ideas, and is often related to personal experiences of the choreographer. Throughout the planning process it is pertinent that the choreographer make strategic decisions that will allow the audience to perceive the work in the way intended. Once the work is complete and presented, the audience is given the freedom to interpret the piece in the way that they saw it. Because choreography is designed from personal experiences, the question arises of whether the choreographer can successfully transpose the feelings elicited by one with mental illness.

"*Letter to a Man* Deconstructed: Analyzing choreographic interpretations of mental illness" allows for an intensive look into how mental illness affects creativity and how such illness is communicated through non-verbal expression. This research project will investigate how mental illness affects both the messenger and the message in choreographic work. An in-depth analysis of Nijinsky's journals, on-going research on creativity and mental illness, and movement analysis via LMA will clarify how Nijinsky's illness was perceived by Baryshnikov and expressed through the construction of this new work.

17. Student: Daniel Hickman **Majors: Biology/Chemistry**
Mentor: Gamil A. Guirgis **Department: Chemistry and Biochemistry**

Title: *Conformational studies of compounds containing a six-membered ring system consisting of silicon and other atoms in the cyclic backbone*

The proposed project includes the synthesis of four six-membered ring compounds containing three carbon and three silicon atoms in an alternating fashion. These compounds are not well understood in the literature because of difficulties in synthesizing, handling, and studying them. These compounds are interesting and have several possible three-dimensional shapes in space. These compounds can be studied using different instruments at the College of Charleston and at other institutions. I do have long standing collaborations in place at the University of Missouri-Kansas City (UMKC) and the University of Virginia (UVA). The comparison of the data to that of similar known compounds containing only carbon will reveal the nature of the bonding and structure of these compounds, which will be useful for potential applications of these species.

18. Student: Mamiko Higa **Major: Public Health**
Mentors: Andrea DeMaria **Departments: Health and Human Performance**
Beth Sundstrom **Communication**

Title: *e-HOPE: Increasing health care access among rural women in South Carolina*

Rural populations face barriers to health care often resulting in health disparities. Residents in rural communities are more likely to report poor health status and are less likely to be insured than their urban counterparts. In 2008, Planned Parenthood of Greater Iowa pioneered the use of telemedicine by providing health services via sophisticated video and fiber equipment at remote clinics. In South Carolina, Planned Parenthood Health Systems (PPHS) will initiate a telemedicine program (e-HOPE Plus) in Spring 2015 to address barriers to health care in rural areas, especially in women's services. Researchers found very high satisfaction levels among rural participants in a family health telemedicine project, noting that this method of care offers a promising opportunity in underserved rural areas.

Over the course of our project, the Women's Health Research Team will work collaboratively with PPHS to evaluate the effectiveness of their telemedicine program in SC rural communities by conducting a pre-/post-test survey design. We will seek to determine the impact of the program on patient contraceptive choice, follow-through, and compliance. This study will expand the limited research regarding the effects of telemedicine as a promising approach to increase health care access and address health disparities. This research will also inform the continued implementation of the e-HOPE PLUS project in South Carolina, as well as other telemedicine projects nationally and internationally.

19. Student: Lucien Jay **Major: Biochemistry**
Mentor: Timothy Barker **Department: Chemistry and Biochemistry**

Title: *The Synthesis of Allyl Ureas and Carbamates*

Many pharmaceutical drugs contain at least one nitrogen atom. Developing new methods of incorporating nitrogen into molecules is useful to medicinal chemists. We are proposing a method to incorporate a nitrogen atom into molecules that can be further modified into compounds with different properties in a subsequent reaction.

20. Student: Sarah Legendre **Major: Classics**
Mentor: Allison Sterrett-Krause **Department: Classics**

Title: *But Is It a Bottle? Quantitative and Qualitative Study of Roman Glass Vessels*

Archaeologists analyze fragmentary pieces of antiquity, like broken glass, to answer questions about aspects of daily life. To do this, archaeologists study "diagnostic" pieces – recognizable parts of fragmentary glass vessels such as bases, rims, and handles. Such studies record formal characteristics (shape, size, color, and decoration) and functional categories of the pieces. They then compare the fragments to objects with similar forms and functions to contextualize individual objects.

Problems arise when vessels are extremely fragmentary and are compounded when fragments share formal characteristics with many different types of vessels. This is a consistent problem for archaeologists studying Roman glass of the Imperial period (ca. 50 C.E.to 450 C.E.), because the Roman glass industry was international and industrial in scale. While formal features of a fragmentary vessel can reflect its functional category (drinking cup, bottle, plate, etc.), in many cases poor preservation prevents such precision.

Our current research project will propose a statistical model for determining the functional category of glass vessel fragments which are not diagnostics. Using the techniques of statistics and probability, we will test our proposed model for viability on both fragmentary and complete vessels. Our project employs a contextual component as well: studying glass from ancient perspectives to understand Roman

categories for vessels. Combining quantitative mathematical study with ancient literary and visual evidence offers a new avenue for archaeologists studying the creation and use of glass in antiquity. Such a model may provide new methods for archaeologists studying many different time periods and materials.

21. Student: Needhee Patel **Majors: Biology/Psychology**
Mentors: Mike Ruscio **Departments: Psychology**
Chris Korey **Biology**

Title: *Neurogenesis and Neural Development in Snapping Shrimp*

The ability of an adult nervous system to change in response to environmental changes, such as damage to the system, is unique and challenging when scientists are studying vertebrate systems. This is because to observe a response, permanent damage must often be done to the organism's nervous system. Therefore, invertebrates that are known for their regenerative abilities are an ideal system to explore and study the changes an organism goes through to recover or adapt to its environmental needs. The snapping shrimp, or *Alpheus angulosus*, is a small crustacean with two claws, one big and the other small. If a shrimp loses its big claw, its primary defense, it transforms its small claw into a big claw while growing a new small claw. The claws have different purposes and thus different sensory neuron inputs and outputs. We study the neural changes involved in transformation by tracking and studying the sensory hairs' (setae) distribution on the claws throughout the duration of this process. Past studies have revealed that setae change, both in composition and number, mostly on the cutting edge of the claw. This proposal focuses on the development of the sensory hairs, particularly how and where the sensory neurons in the sensory hairs are created and how they develop.

22. Student: Olivia Pearce **Major: Chemistry**
Mentor: Katherine Mullaugh **Department: Chemistry and Biochemistry**

Title: *Voltammetric Determination of Silver Ions Using Chemically Modified Carbon Paste Electrodes*

Today over 1600 consumer products are available that contain nanomaterials with sizes less than 1/1000 the width of a human hair. As nanotechnology becomes increasingly integrated into daily life, the release of nanoparticles into the environment is inevitable. To anticipate the potential environmental effects of nanotechnology, controlled laboratory experiments are required to understand the conditions that control their behavior in the environment and any chemical changes they may undergo after release. Silver nanoparticles, currently one of the most widely used types of nanoparticles because of their antimicrobial properties, are found in products like socks, athletic clothing, and cleaning products. However, it is now well known that silver nanoparticles readily degrade and release silver ions, which are toxic to many aquatic organisms. To better anticipate the environmental impact of silver nanoparticles, more studies are needed to understand the conditions that favor or inhibit the silver nanoparticle degradation process. Two major limitations of existing studies are (1) that they generally require high concentrations because the currently available methods of silver ion detection are not sufficiently sensitive and (2) they require a pre-treatment step to separate silver nanoparticles from silver ions prior to analysis. The goal of this project is to develop an improved method that is sensitive enough to measure silver ions at low, environmentally relevant conditions and can measure silver ions without interference from silver nanoparticles such that no separation is necessary.

23. Student: Dillon Presto **Major: Chemistry**

Mentor: David Boucher **Department: Chemistry and Biochemistry**

Title: *Synthesis and Characterization of Polymer/Graphene Nanocomposites*

Solid thin-films composed of mixtures of polymers and carbon-based structures, such as carbon nanotubes and graphene, are promising materials for the next generation of solar cells and other renewable energy technologies. One of the main problems is getting the polymer and carbon structures to interact strongly with each other. Such weak interactions lower the fundamental electrical properties of these materials, as well as adversely impacting the properties, e.g., ruggedness and crystallinity, of the solid thin-films. In our lab, we are synthesizing polymer/graphene materials using an innovative technique, wherein we make the polymer in a solution that already contains the graphene. We have already shown that this "in situ" polymerization technique improves the characteristics of polymer/carbon nanotube materials; thus, it is highly likely that we will see same results with the polymer/graphene counterparts. In addition to making these materials, we are able to study the surfaces of the polymer/graphene thin-films using an atomic force microscope (AFM). The atomic force microscope allows us to observe the structure of our materials, e.g., how well they're mixed together, on an atomic and molecular level.

24. Student: Ashley Rice **Major: Physics**

Mentor: Ana Oprisan **Department: Physics and Astronomy**

Title: *Investigating Non-Equilibrium Fluctuations in the Presence of Magnetic Field*

Magnetic nanoparticles are used in many applications, from industry to cancer research. However, little is known about the mobility of magnetic nanoparticles when used for biomedical applications. The purpose of this project is to determine physical properties related to the dynamics of magnetic nanoparticles dispersed in water. We will experimentally investigate fluctuations produced at the interface between water and magnetic nanoparticles suspensions both in the absence and in the presence of magnetic field. The nanocolloid consists of tiny spherical particles of iron oxide with diameters in the range of 100 to 200 nanometers suspended in a water-soluble inert agent. In order to observe the interface between water and colloidal suspension, the magnetic 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.* These fluctuations have been so far only investigated in the presence of the gravitational field. However, our plan is to perform two experiments for the same magnetic colloidal suspension in the presence and absence of magnetic field.

We plan on recording images of a glass cell unit filled with magnetic nanocolloids that experiences concentration fluctuations and analyze the images offline. We will use image and data analysis methods such as Fourier transform, power spectrum, and curve fitting tools to estimate the correlation time of fluctuations and to determine the diffusion coefficients for both experiments.

25. Student: Amber Ruby **Major: Biology**

Mentor: Allison Welch **Department: Biology**

Title: *Salinity effects on early life stages in squirrel treefrogs*

Salinity levels are increasing in some freshwater environments due to human activities including road salt runoff, land use changes from agriculture, and rising sea levels. Amphibians are particularly

vulnerable to habitat salinization because they need freshwater to complete their life cycle. Increased salinity can harm amphibian larvae by decreasing survival, reducing growth, and increasing the time to reach metamorphosis. Salinization of breeding habitats may also affect other stages of the frog life cycle, including fertilization and embryo development. Exposure to salinity during fertilization could affect sperm function, decreasing the number of eggs fertilized. Increased salinity can also slow or halt embryonic development. Testing the salinity tolerance of each of these life stages will help us identify which life stages are most sensitive to habitat salinization. In addition, we will test how salinity exposure during fertilization and embryonic development affects tadpole success. One possibility is that early exposure will allow acclimation to salinity, increasing the ability of tadpoles to survive and thrive at elevated salinity. On the other hand, early salinity exposure could have a cumulative effect and decrease a tadpole's ability to tolerate additional stress from salinity exposure, ultimately leading to poorer performance or even death. Studying how salinity exposure during early development affects the fitness of tadpoles will improve our understanding of the effects of habitat salinization during different life stages. Overall, our work will help conservation efforts address the impact of elevated salinity on the most susceptible amphibian life stages.

26. Student: Leslie Sawyer **Major: Psychology**

Mentor: Chad Galuska **Department: Psychology**

Title: *Regulation of Rats' Water Intake by Shifts in Food Reward Availability*

Research in our laboratory has shown that negative incentive shifts involve transitions from favorable-to-unfavorable situations can disrupt behavior profoundly; these sorts of transitions may have relevance to the environmental stressors that trigger alcohol seeking in humans. An existing animal model of negative incentive shifts involves arranging schedules of positive reinforcement differing in the signaled amount of food pellets delivered contingent upon completing a lever-press response requirement. The transition from a just-received large food reinforcer to an upcoming signaled small food reinforcer has been shown to produce profound disruptions in ongoing responding. In the proposed research, we will use this model to determine if these negative incentive shifts trigger excessive water consumption (polydipsia) in non-thirsty rats. The resulting data will inform us as to the feasibility of using this behavioral baseline to induce excessive alcohol consumption in our future research.

27. Student: Sarah Shainker **Major: Marine Biology**

Mentor: Erik Sotka **Department: Biology**

Title: *Heat shock, cold shock, and light tolerance of Gracilaria vermiculophylla*

Gracilaria vermiculophylla is a red seaweed native to the Sea of Japan and Japan's northeast Pacific coast. It has invaded the coasts of North America and Europe. G. *vermiculophylla*'s successful adaptation to a wide variety of diverse non-native environments facilitated its successful invasions all over the Northern Hemisphere. Two adapted traits that have aided G. *vermiculophylla*'s invasive success are its ability to tolerate a wide range of temperatures and varying amounts of light exposure. It is unclear where and when these adaptations occurred. In a pre-adaptation scenario, a subset of the species within the native range may have evolved to acquire advantageous traits which facilitated biological success once spread to non-native regions. In a post-adaption scenario, a subset of the native population may have spread to a non- native area before evolving to acquire advantageous traits after introduction. In a bridgehead scenario, a subset of the native population would have spread to a non-native bridgehead location where it evolved to have advantageous traits before further spreading to additional non-native regions. In order to investigate which scenario or combination of scenarios occurred for G. *vermiculophylla*, samples will be collected from native and non-native regions in Japan, North America,

and Europe. The samples will be exposed to different light and temperature ranges and grown in the lab in order to determine the light and temperature tolerance of samples from various areas. Comparing these traits in native and non-native individuals could provide helpful information regarding the evolutionary pathway facilitating G. *vermiculophylla*'s invasive success.

28. Student: Sierra Raven Small **Major: Public Health**
Mentor: Michael Hemphill **Department: Health and Human Performance**

Title: *Impact of Imbalanced Community Sex Ratio on Acquisition of HIV and other Sexually Transmitted Diseases among African-Americans*

In 2008, the rate of new HIV diagnoses among adults and adolescents in the United States (US) was nine times greater among blacks (73.7 diagnoses per 100,000) than among whites (8.2 per 100,000) (1). This black-white disparity is particularly stark among women. Despite accounting for less than 14.0% of the US female population in 2008 (3), blacks accounted for 66.7% of new HIV diagnoses among women in 2008 (1). Of women who contracted HIV through heterosexual contact living in 2007, 63.5% were black and 18.6% white, a prevalence ratio of 3.4 (1). Several studies have hypothesized a link between certain community level factors and the occurrence of HIV among black women (4, 5-22).

One such community level factor is the community sex ratio, which is defined as the ratio of men to women in a given geographic area (12). Prior research has shown that sex ratios in predominantly black areas are substantially more imbalanced (i.e., fewer men than women) than sex ratios in predominantly white areas (12). The purpose of this project is to assess the impact of the community sex ratio as well as other demographic variables, including income, education, and racial distribution, on the acquisition of HIV and other STDs in South Carolina counties. This research will provide greater insight into the factors that contribute to HIV and STD incidences, and possibly lead to the development of more effective preventive interventions.

29. Student: Ellie Smith **Major: Public Health**
Mentors: Beth Sundstrom **Departments: Communication**
Andrea DeMaria **Health and Human Performance**

Title: *e-HOPE: Increasing health care access among rural women in South Carolina*

Rural populations face barriers to health care resulting in critical health disparities and risks. Residents in rural communities are more likely to report poor health status and are less likely to be insured compared to urbanized areas. In 2008, Planned Parenthood of Greater Iowa pioneered the use of telemedicine by providing health services via sophisticated video and fiber equipment at remote clinics. In South Carolina during Spring 2015, Planned Parenthood Health Systems (PPHS) will launch a telemedicine program (e-HOPE Plus) to address barriers to health care in rural areas, focusing on women's services. Current research shows very high satisfaction levels among rural participants in family health telemedicine. This method of care presents a promising opportunity in underserved rural areas.

Throughout the duration of our project, we will work collaboratively with PPHS to evaluate the efficacy of their telemedicine program in South Carolina's rural communities by conducting a pre-/post test survey design. As a team, we will investigate how the program influences patient contraceptive choice, follow-through, and compliance. This study will contribute to the limited research regarding the effects of telemedicine in order to increase health care access, while addressing health disparities. This research will also ensure the successful implementation of the e-HOPE PLUS project in South Carolina, as well as telemedicine projects pertinent to communities nationally and globally.

30. Student: Heather Thornton **Major: Studio Art**
Mentor: Sara Frankel **Department: Studio Art**

Title: *Contemporary Apotheosis: A Vision Explored in Painting*

The dynamic theme of humankind's quest for spiritual meaning is found not only in art history but in the history of humanity. Today there are newfound methods of searching for personal spiritual significance outside of conventional religions relating to science and the perspective of humanity as an integral component of the universe. Translated through a body of five large-scale oil paintings, Heather Thornton will explore this theme employing a contemporary approach and the guidance of her faculty mentor Professor Frankel. Heather's visual conception, in which figures commingle with heavenly objects and otherworldly spaces is inspired by both fantasy and cosmic imagery. With an emphasis on glowing light emanating from their hearts, hands and minds, each figure in the paintings will resonate a universal energy and awareness.

Utilizing a professional painting process and practice with the academic critique of Professor Frankel, the artwork will achieve a level of fantastic realism and will be suitable for display in professional gallery settings.

31. Student: Travis Varner **Major: Biochemistry**
Mentor: Richard Himes **Department: Chemistry and Biochemistry**

Title: *Synthetic and Theoretical Studies of a Novel Bis-Indenyl Ligand: The "Batwing"*

Everyone is familiar with different everyday polymers, such as Styrofoam and spandex. In the production of some polymers, a molecule called a catalyst is often needed to start the reaction to produce a specific polymer. Designing these catalytic systems has received much attention over the years, in hopes that they can be used to also control other vital aspects of the desired polymer. One of these certain features of interest is the three-dimensional arrangement of a polymer's structure. This simple spatial arrangement can completely change the properties of a product polymer molecule. Therefore, it is vital for a chemist to be able to control this aspect when designing and synthesizing new materials. Certain catalysts have been seen to possess this unique feature of regulation—nonetheless, there is still the need for more exploration of this topic. Using current known catalysts as models, a new "batwing" catalyst has been designed and synthesized. We are seeking funding to support research that involves the synthesis and computer modeling of this original metal catalyst.

32. Student: William Vesely **Major: Environmental Geology**
Mentors: Timothy Callahan **Department: Geology**
Vijay Vulava

Title: *Organic carbon concentrations and dynamics in estuaries and associated watersheds*

Dissolved organic carbon (DOC) is a classification for carbon dissolved in aqueous environments. DOC is increasing in estuaries, which are bodies of water where freshwater combines with tidal waters from the ocean resulting in conditions that can support a wide variety of habitats, such as certain species of fish (red drum) and shellfish (oyster, crab). The most common source of DOC in the estuaries is phytoplankton. The non-estuarine sources of DOC are terrestrial plant debris and freshwater plankton arriving from river flow. An intriguing non- estuarine source, and what will be a focus for this project, is the submarine flow of groundwater. This research will produce a survey of DOC concentrations in surface waters and shallow groundwater in coastal South Carolina.

Water samples will be taken from locations in the Ashepoo, Combahee, and Edisto (ACE) Basin and Charleston harbor. Samples will also be taken in regions located further inland to see DOC content in a forested area. The data will be used look at the DOC differences between a forested areas

and urbanized areas. The main goal of this project is to better understand the amount of DOC in the ACE Basin and Charleston regions. As land use is changed for housing development, less groundwater may be cycling through these systems and thus a source of carbon to the estuaries, relied upon by the aquatic food web, may be impacted.

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

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 polyalcohol derived from a soy-based edible oil. Secondly, new drugs that have never been used for drug delivery purposes before using polymer delivery systems are being investigated. For this study, a series of successful drug delivery materials were made from the anti-inflammatory drug Ibuprofen, nalidixic acid, a simple antibiotic compound as well as two potent chemotherapeutic agents. Upon exposing these drug delivery materials to physiological media, significant drug release was observed in as little as 20 hours. A library of synthetic methodologies for the prodrugs was developed by Nathan Adamson over the last year and a half. The project will continue this summer, specifically by exploring new synthetic approaches to these polymeric 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 performed to confirm their safety in biological environments, and the results will be monitored by LC-MS.

34. Student: Hannah Wilson **Major: Biology**

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

Title: *An Innovative System for 3D Clinical Photography*

We recently developed a low-cost, user-friendly technique to take a single snapshot image using the commercially available Lytro camera and convert this image into a full 3D rendering that can be effective for the diagnostic monitoring of cancer lesions, such as AIDS- induced Kaposi's sarcoma – the leading cancer among men in Mozambique. By utilizing a relatively low cost (~$200) consumer camera as the technology backbone, the technique translates to an estimated cost of around 75 cents per diagnosis. This is an extreme benefit for areas of the world that cannot afford most 3D imaging technology that is available today. In contrast, for example, the commonly used Magnetic Resonance Imaging (MRI) has a typical cost of >$2,000 per diagnosis, as well as requiring expert personnel to operate it and substantial infrastructure to support it. Our technology provides a way for minimally trained personnel to operate it, and the complicated data processing work can take place at a location away from the resource limited setting, allowing relevant results to be succinctly summarized and restored to clinicians in the field. To prove the effectiveness of the technique, we and collaborators successfully carried out a pilot program at Maputo Central Hospital, the largest public hospital in Mozambique, and showed that effective, single-snapshot, 3D images of Kaposi's sarcoma lesions could be obtained bedside by minimally trained personnel. The results are published in the Journal of Translational Medicine (Baghdadchi et al. 2014).