COLLEGE of CHARLESTON

UNDERGRADUATE RESEARCH AND CREATIVE ACTIVITIES

2013 - 2014 Award Recipients

The office of Undergraduate Research and Creative Activities is pleased to announce the following Grant Award Recipients for 2013 – 2014 academic year. Please join us in congratulating these students and their mentors.

Academic Year Research Grant (AYRA)

1. **Student: Nathan Adamson** **Major:** Biochemistry
   Mentor: Neal Tonks **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. The gross mass of the final product consists of a soy-based oil known as Agrol 2-100 supplied by Bio-Based. Secondly, two antibiotic compounds will be incorporated into the polyurethane for drug delivery that have never been used for this purpose before. For this study, Ibuprofen was used initially because of its low cost and its compatibility with this technology, but the next phase of the project will integrate Nalidixic Acid and Ofloxacin into the drug delivery polyurethane material. Application of this technology is far-reaching as it may serve to create a more efficient way to deliver antibiotics to patients. The final product is a hard gel-like material that could be implanted anywhere on or within the body for a site-specific release of a drug. Furthermore, the drug can be released slowly over time, which creates for a more efficient treatment option.

2. **Student: Brett Snyder** **Major:** Chemistry
   Mentor: Neal Tonks **Department:** Chemistry and Biochemistry
   Title: *Presentation at SERMACS of: Using Bio-Based Materials to Synthesize a Novel Surfactant in the Production of Polyurethane Foams*

The primary focus of this research is to improve foam fonnation in the production of polyurethane foams, using bio-based materials. Industrially, poly-ethylene glycol based surfactants are derived from petroleum oil. In contrast to these petroleum-based surfactants, our surfactants are based on renewable fatty acid sources, thus, being more environmentally favored. Surfactants reduce the surface tension between isocyanates and poly-ether or poly-ester based polyols, which allows for more unifonn mixing during polyurethane formation. We have started synthesizing polyurethane foams, comparing foams made with bio-based surtactants to foams made with traditional, poly-ethylene glycol based surfactants. Degradation studies will be investigated using the standards set forth by CertiPur, which is the industrial method used to ensure that foams do not emit any volatile organic compounds (VOCs) upon degradation. Image analysis based on scanning electron microscopy and confocal microscopy will allow for comparisons of average foam cell size distributions between the polyurethane foam samples. A more uniform foam cell distribution indicates the surfactant had a greater impact on the mixing process during polyurethane tonnation. Upon further interpretation of the results, we hope to conclude that polyurethane foams synthesized using bio-based surfactants are comparable to polyurethane foams manufactured using petroleum-based surfactants used in industry.

Major Academic Year Support (MAYS)

1. **Student: John Bullard** **Major:** Biology
Mentor: Gamil Guirgis **Department:** Chemistry and Biochemistry
Title: *Synthesis, Spectroscopy. Environmental Impact and Theoretical Calculations of Cyclic-Organosilanes*

This project will be on the research of organosilicon and germanium compounds in a ring form. From a chemist's viewpoint, silicon, carbon, and germanium are very similar, and at an atomic level; silicon tends to act like a flexible softer carbon. When rings of carbon are created, they form complex geometric shapes. For example, when six carbon atoms with 12 hydrogen atoms are formed into a ring, the resulting shape is not a 2D hexagon but a complex shape called a chair that is easier to form as it is less straining to the carbon. While in carbon this chair is mainly the observed shape, other shapes have not been predicted such as the boat (see figures below) and these shapes or conformations are not normally observed naturally. In the past, Dr. Guirgis and his students have worked on five-member rings with silicon in them. These were observed to prefer interesting conformations that are not normally seen with ring structures containing only carbon. This project plans to extend that research to six-member rings where it is predicted that the boat shape will occur most readily. This is highly unusual and unexpected as in carbon compounds this shape is considered almost non-existent and very unstable, yet with silicon it is preferred. This project will help advance knowledge in this field that is not well understood or well-studied as it involves compounds that can be difficult to work with.

2. **Student: Laura J. Christensen** **Major:** Marine Biology
Mentors: Andrew J. Clark **Department:** Biology
Title: *Biting forces in hagfish*

Hagfishes are elongate soft-bodied marine animals that employ an effective jawless biting mechanism when foraging. A major research theme in my laboratory investigates the biomechanics of prey capture, particularly in hagfishes. Here, we propose to measure *in vivo* bite forces from foraging hagfish specimens, and then categorize these data into static (biting with minimal body movement) and dynamic bites (biting coupled with vigorous movement), based on synchronized high-speed video recordings of head and whole body movements. When dynamically biting on oversized prey, a hagfish usually ties its body into a knot, which is then pressed against prey to amplify biting force. The biomechanics of hagfish knotting is poorly understood but represents the ancestral vertebrate strategy for negotiating oversized prey. By comparing static bite forces to dynamic forces, we will assess the range of bite forces that hagfishes can apply to prey tissue. Furthermore, comparisons of *in vivo* bite forces with theoretically determined bite forces will test the validity of a previous model for hagfish biting, and comparisons with published bite forces of jawed vertebrates will have important implications for the evolution of bite performance, particularly in early vertebrates.

3. **Student: Janis Katina Dabbs** **Major:** History
Mentor: Dr. Irina Gigova **Department:** History
Title: *Rosika Schwimmer: A Study in Internationalism, Feminism, and Pacifism*

This study involves researching women's movements in Central Europe before, during, and after World War I and examining them in the context of the international women's movement during that time. At the center of this investigation is Rosika Schwimmer, who was actively involved in the Hungarian feminist movement as well as the International Woman Suffrage Alliance (IWSA). Rosika Schwimmer is an interesting case study because her work in the international women's movement was very prominent. In 1913, she became a corresponding secretary for the IWSA and moved to London. Once war broke out, her attention shifted from suffrage to peace. Schwimmer's choice reflected a fragmentation within the international women's movement that outlived the war. Her papers, which cover the period from 1890

to 1948, could provide insight into why her focus changed. Through the IWSA monthly paper, *Jus Suffragii,* one can track Schwimmer's activities before and during World War I, but her papers would help pinpoint her goals in the IWSA and the shift in priorities that led her to joining the radical Women's International League for Peace and Freedom (WILPF) in 1915. The Hungarian women's suffrage organization actively promoted peace and Schwimmer's efforts to end the war, both of which became controversial subjects in *Jus Suffragii* in 1915. Schwimmer's papers could reflect this tension and lead to a better understanding of how conflicting alliances during the war affected the international suffrage movement.

4. **Student: Lauren Deasy** **Major:** Psychology
Mentor: Daniel Greenberg **Department:** Psychology
Title: *Personality, Sociability, and Autobiographical Memory*

Memory is a fundamental part of human life. On an individual level, our memories provide us with a record (albeit an inaccurate one) of where we have gone, what we have done, and who we have been. On a social level, they help connect us to a point in history (as with memories of 9/11 or the Kennedy assassination), and they help us create and maintain social connections with other people. Much of the time, people recall memories that are detailed, rich, and vivid: if they are remembering a walk on the beach, for instance, they might remember the smell of the ocean, the feeling of the sand under their feet, and the surprise they felt when they were drenched by an unexpected wave. In other cases, however, people remember memories that are overly general: they might simply say that they often take walks on the beach, and they will be unable to come up with any specific details, even when pressed. People who tend to retrieve overgeneral memories are at greater risk for depression and other mental illnesses as well as several forms of cognitive decline.

We want to learn about the factors that are associated with overgeneral memory. We are particularly interested in looking at these relationships in older adults, since they are at particular risk for many of the problems described above. Therefore, in this study, we will examine the relationship between personality, social support, mood, and memory. We view this study as a first step towards understanding this issue and untangling the causal relations between these factors. Before we can explore these relations in more detail, however, we need to know whether a relation exists at all.

5. **Student: Clayton Ehasz** **Major:** Biochemistry
Mentor: Marcello Forconi **Department:** Chemistry and Biochemistry
Title: *Expression, purification, and functional characterization of MelF*

The melF gene of *Mycobacterium tuberculosis* has been implicated in protection of the bacterium from reactive oxygen species. This advantage probably favors the bacterium persistence and dissemination. The encoded protein, called MelF, shows primary sequence similarities to the bacterial luciferase and to the alkane-1-monooxygenase families; however, its function is still unknown. We have undertaken a collaborative project with Jeffrey Cirillo (Texas A&M Health Science Center) to determine the function and the optimal substrate for MelF. The first part of the project consists in the expression and purification of the MelF protein using a vector that contains the melF gene. The purified protein will be then used to determine its function through laboratory assays. We will then perform a systematic variation of the substrate, using commercially available compounds, to determine the optimal substrate for the protein.

6. **Student: Taylor Hammock** **Major:** Biology
Mentor: Mark Lazzaro **Department:** Biology
Title: *Mitochondrial photobiomodulation*

Low-level laser therapy (LLLT) is a rapidly expanding treatment technique in the medical, veterinarian, and dental industries for its proven benefits in pain relief and accelerated wound healing. The cellular mechanism behind LLLT remains unclear although some research indicates that the activity of Cytochrome C Oxidase (COX) in mitochondria is enhanced by low-level laser energy.

The Cytochrome C Oxidase complex is bound to the inner mitochondria membrane. It is made of many protein subunits and consumes oxygen in the last step of cellular respiration. Arabidopsis is a flowering plant with a fully sequenced genome and several hundred mutant seed lines are available where a single gene and protein are eliminated. Some of these lines lack specific subunits of the COX complex. These seeds are inexpensive and can quickly grow into mature plants. Since mitochondria function is very similar across all organisms, our research with Arabidopsis should be applicable to human tissue.

We will grow mutant and parent lines of Arabidopsis, collect leaves, and isolate mitochondria. We will use an oxygen electrode and a COX activity assay to measure laser treatment induced changes in oxygen consumption and COX activity in the isolated mitochondria. By comparing rates of consumption and COX activity amongst mutant lines, we hope to identify which COX subunits directly respond to LLLT. Identifying these subunits enhances the understanding of the molecular mechanisms involved and the medical success of LLLT.

7. **Student: Jamie Harrell** **Major:** Psychology
Mentor: Jennifer Wilhelm **Department:** Psychology
Title: *Estrogen and nerve regeneration*

Thousands of peripheral nerve injuries occur each year. Unlike the central nervous system, the peripheral nervous system has the ability to regenerate. However, functional recovery often is poor, and patients are left with some form of long-term disability. Exercise in the form of treadmill training can enhance axon regeneration after peripheral nerve injury. Interestingly, this enhancement occurs in a sex-dependent manner. The mechanisms mediating this sex difference are relatively unknown. Previous studies have shown that androgens, such as testosterone, can enhance the regeneration of nerve following a nerve injury. However, testosterone can be converted into estrogen; therefore, the enhancement by testosterone treatment may be due to an increase in estrogen. Pilot experiments conducted during Summer 2013 found that estrogen treatment may inhibit rather than enhance axon regeneration. The proposed project aims to more fully examine the interaction of estrogen and treadmill training in the process of axon regeneration after sciatic nerve injury in males and females. Mice will be treated with estrogen or saline for two weeks after surgical nerve transection. Some mice also will undergo treadmill training during those two weeks to examine the interaction between estrogen and exercise. Axon regeneration will be assessed by counting the number of neurons whose axons regenerate past the site of nerve transection. We predict that estrogen treatment will inhibit enhancement of axon regeneration found in treadmill trained males and females. Better understanding of the effects of estrogen in treatment of peripheral nerve injury can lead to development of more effective rehabilitative therapies.

8. **Student: Susan Jackson** **Major:** English
Mentor: Julia Eichelberger **Department:** English
Title: *Letters of a Lifetime: The Correspondence of Eudora Welty and Frank Lyell, 1930-1977*

In January 2014 the student and mentor will visit the Mississippi Department of Archives and History in Jackson to examine correspondence housed there between American author Eudora Welty and her lifelong friend Frank Lyell. This correspondence between Welty and Lyell, which began in 1930 and continued until 1977, includes over 3000 individual pieces (pages, enclosures, and envelopes) available for study. Welty's previously published correspondence reveals Welty's views on current events, other literary works, and her own work in progress. This extensive collection of unpublished letters between Welty and Lyell will offer new insights on the life and work of an author who received over forty major literary awards during her lifetime. After studying the correspondence, the researchers will obtain copies of the most meaningful Welty-Lyell letters and transcribe and edit this material for book publication.

This research project will be a major step forward in a longer process of presenting previously unpublished letters according to accepted academic editorial practices, and in introducing and annotating

these letters so that both scholars and the general reader will profit from reading them. Publication of these letters will significantly contribute to a greater understanding of an illustrious American author who wrote five novels, four short story collections, a memoir, and numerous essays. When published, these letters will also serve as a helpful primary resource to those interested in discerning the cultural climate of the deep South during a tumultuous period in this country's history. Welty, not being silent in her literary works regarding complex social issues facing the South, surely shared her thoughts on this subject in a lifetime of letters to her close friend Lyell, which means that these letters will be useful to both literary critics and historians alike.

9. **Student: Carissa James** **Major:** Biology
Mentor: Elizabeth Meyer-Bernstein **Department:** Biology, Program in Neuroscience

Title: *Oscillation of gene expression in the starlet sea anemone, Nematostella vectensis, in response to a simulated tide.*

Animals display rhythms in physiology and behavior that are governed by a self-sustaining biological clock. External stimuli, such as light, serve to synchronize endogenous biological processes with the environment. Circadian rhythms are the most widely studied clock outputs, expressed as a 24 hr oscillation. In marine organisms, non-photic environmental cues such as hydrostatic pressure can also influence clock function. Circatidal rhythms generated in response to hydrostatic pressure are observed every 12.4 hrs, distinguishing them from the 24 hr circadian period. Unlike circadian rhythms, the molecular mechanisms underlying these circatidal rhythms remain unclear. We have observed circatidal behavior in the starlet sea anemone, *Nematostella vectensis* when exposed to a simulated tide in the laboratory. We believe patterns of gene expression are responsible for generation of these rhythms observed in the presence of an oscillating tide. To determine whether known circadian clock genes also underlie circatidal behavior, we will analyze gene expression in *N. vectensis* individuals exposed to a simulated tide. Oscillation of these genes will be quantified at various time points, and compared to gene expression under the influence of a light:dark cycle alone. We expect the addition of a simulated tidal cycle to a light:dark cycle will alter rhythms of circadian gene expression, demonstrating the ability of *N. vectensis* to respond to tidal cycling and further describing the molecular underpinnings of the biological clock.

10. **Student: Douglas Jansen** **Major:** Biology
Mentor: Agnes Ayme-Southgate **Department:** Biology

Title: *Does variation in troponinT isoforms correlate with flight performance in forager and nurse bees?*

All living creatures have the ability to change, at least partially, in response to the demands of their environment, as well as through their life cycle. Honey bees are superb examples of such adaptations stemming in part from their "social status" within the hive, in particular the transition undergone by some bees from nurses to foragers. How this transition happens is still largely unknown, but some of the body adaptations have been documented. Forager bees are lighter in weight and able to sustain higher wing beat frequencies for longer duration. In this proposal we look at one of these adaptations in the muscle protein troponin T (TpnT), which is implicated in the muscle response and ultimately the force produced during flight. The gene for TpnT can produce related, but slightly different protein isoforms by the molecular process known as alternative splicing. After individual bees are caught from the hive on top of Rita Hollings Science Center and classified as either nurses or foragers, they will be tested for maximal hovering performance (using Dr. Vance's insect flight assay). We will then perform a molecular analysis to determine the relative amount of the TpnT isoforms. The data will be analyzed for a correlation between the abundance of a particular isoform and the magnitude of maximal flight forces and wing kinematics. Our hypothesis is that one of the isoforms will increase in relative amount at the beginning of the forager stage, and possibly decrease later in life.

11. **Student: Alexandra Keane** **Major:** Political Science
Mentor: Annette Watson **Department:** Political Science
Title: *A Visual Ethnography of Gullah/Geechee Subsistence Economies*

Ethnographers – researchers who depict cultures or events holistically – have been adopting many new digital technologies to both analyze and share their work. Although terms such as "the digital humanities" are starting to gain traction in a variety of disciplines, to date there has been little production or critical reflection on the implications of digital techniques for ethnographic research in the social science of geography. For this project, a geographer is collaborating with an undergraduate in the Computing in the Arts program and another in the Department of Political Science to develop a visual ethnography of Gullah/Geechee subsistence practices, extending an existing collaborative project with Gullah/Geechee communities. The Gullah/Geechee are the descendants of Africans who had been enslaved on the Sea Islands, stretching from North Carolina to Florida, and whose relative isolation allowed them to maintain many of their indigenous African traditions, while adapting to their new context by co-evolving as a community for over 300 years. Geographic research has shown that they often practice a "subsistence" economy: such as fishing for their dinner, sharing, and small scale trading/cash economy. This visual ethnography aims to collect, analyze, and visually present a variety of digital materials – such as interviews, focus groups, archival materials – about this subsistence economy, to aid in coastal management. Products of this work will be two short edited videos and a weblhyperlink interface, collaborating with the Gullah/Geechee to ensure accuracy of the data, and thereby allowing us to rigorously share their cultural and economic practices and beliefs with the world.

12. **Student: Serena-Kaye Kinley-Cooper** **Major:** Psychology
Mentor: Michael Ruscio **Department:** Psychology
Title: *Effects of Social Environment on Estrogen Receptor Expression in the Central Nervous System of the California Mouse (Peromyscus californicus).*

The simple notion of estrogen as exclusively "the female hormone" has long been debunked by a wealth of empirical research. Estrogen affects a variety of behavioral and physiological functions in both male and female vertebrates. For example, the neuroanatomical distribution of the estrogen receptor is known to predictably correlate with degree of sociality in both males and females within and across several rodent species. Our primary aim is to determine if the concentration and distribution of estrogen receptors change with alternations in the social environment (isolate vs. pair housed) in a highly social rodent species (monogamous and biparental), the California mouse (*Peromyscus californicus*). Isolation is known to cause a variety of impairments in social behavior across mammals. Our hypothesis is that alterations in the concentration of estrogen receptors within particular areas of the brain (limbic system) underlie these changes in behavior. Furthermore, we predict that these changes should be particularly acute in a bi-parental and monogamous rodent, as compared to more generic animal models such as the common laboratory rat (*Rattus norvegicus)* or mouse (*Mus musculus*). As a secondary hypothesis, we plan to correlate the changes in estrogen receptor with changes in neurogenesis caused by social housing. Previous research in the lab has demonstrated statistically significant changes in neurogenesis relative to housing condition and we will determine if estrogen receptors are expressed in these newly born adult cells relative to social environment.

13. **Student: Kellen Lawson** **Major:** Astrophysics
Mentor: Joe Carson **Department:** Physics and Astronomy
Title: *Searching for Extrasolar Planets with the Subaru SEEDS Survey*

The **S**trategic **E**xploration of **E**xoplanets and **D**isks with **S**ubaru (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 lies in the fact that they often produce higher mass planets. Such planets retain more heat and are therefore more visible in 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 on 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.

14. **Student: Tammy Matthews** **Major:** English
Mentor: Julia Eichelberger **Department:** English
Title: *Letters of a Lifetime: The Correspondence of Eudora Welty and Frank Lyell, 1930-1977*

In January 2014 the student and mentor will visit the Mississippi Department of Archives and History in Jackson to examine correspondence housed there between American author Eudora Welty and her lifelong friend Frank Lyell. This correspondence between Welty and Lyell, which began in 1930 and continued until 1977, includes over 3000 individual pieces (pages, enclosures, and envelopes) available for study. Welty's previously published correspondence reveals Welty's views on current events, other literary works, and her own work in progress. This extensive collection of unpublished letters between Welty and Lyell will offer new insights on the life and work of an author who received over forty major literary awards during her lifetime. After studying the correspondence, the researchers will obtain copies of the most meaningful Welty-Lyell letters and transcribe and edit this material for book publication.

This research project will be a major step forward in a longer process of presenting previously unpublished letters according to accepted academic editorial practices, and in introducing and annotating these letters so that both scholars and the general reader will profit from reading them. Publication of these letters will significantly contribute to a greater understanding of an illustrious American author who wrote five novels, four short story collections, a memoir, and numerous essays. When published, these letters will also serve as a helpful primary resource to those interested in discerning the cultural climate of the deep South during a tumultuous period in this country's history. Welty, not being silent in her literary works regarding complex social issues facing the South, surely shared her thoughts on this subject in a lifetime of letters to her close friend Lyell, which means that these letters will be useful to both literary critics and historians alike.

15. **Student: Melanie Overcash** **Major:** Biology
Mentor: Christine Byrum **Department:** Biology
Title: *Expression of the nuclear transport proteins IPO5 and IPO11 in embryos of the sea urchin Lytechinus variegatus*

Our research focuses on better understanding roles of nuclear transport proteins in animal development. In this project, we examine the temporal and spatial distribution of two nuclear transport proteins, importin 5 (IPO5) and importin 11 (IPO11), in the model organism *Lytechinus variegatus*. Like other importins, IPO5 and IPO11 facilitate the transport of cargo from the cytoplasm, through the nuclear pore complex, and into the nucleus. More specifically, IPO5 is reported to transport histones (important DNA packaging proteins) and ribosomal components to the nucleus in vertebrates, while IPO11 transports ubiquitin conjugating protein and the ribosomal protein L12 from the cytoplasm to the nucleus. Last Spring, we amplified transcripts of IPO5 using the reverse-transcriptase polymerase chain reaction, and confirmed their identities by sequencing the amplified fragments. We found that expression of IPO5 was not ubiquitous, but varied during different developmental stages. In this project we will continue to

characterize the roles of IPO5 and IPO11 in the sea urchin by examining temporal expression of IPO11 and by using wholemount *in situ* hybridization (WMISH) to detect which cells express both genes in the developing sea urchin. Hopefully this will allow us to develop hypotheses about the roles of IPO5 and IPO11 in the developing sea urchin embryo and to learn more about roles of these proteins in animal development.

16. **Student: Evan Reinhold** **Major:** Psychology
Mentor: Jen Wright **Department:** Psychology
Title: *The Individual and Social Structure of Greed*

Evan and Dr. Wright will explore the nature of greed, as well as its relationship to personality and socio-moral attitudes and to social/economic structures. The purpose is to gain insight into the variables that affect the development of greed on individual and societal levels, allowing us to develop strategies that could be employed to discourage it. In order to do this, we need to have a better handle on what greed is and how it works, especially in relationship to other aspects of our personality and social environment.

To this end, we are developing a scale to measure greed along three dimensions: attitudes about material goods, personal goods (e.g., emotional/relational connections), and societal goods (e.g., social authority/status). Once this scale construction is, we will use a well-known game, *StarPower* (Simulation Power Systems) – designed to illustrate the behavior of human beings in a system that naturally stratifies them economically or politically – to simulate the development of social/economic stratification and the distribution of goods across social groups. We will run several versions of this game to investigate how subtle changes in either internal focus or external "social" structure change the way people respond to opportunities to accumulate and/or share wealth. They will also take a series of personality and social attitude surveys (to look at the relationship between their actions during the game and other variables, such as empathy, social dominance, narcissism) and be given opportunities to either share or keep goods given to them for their participation in the study.

17. **Student: Benjamin Wilson** **Major:** Computer Science
Mentor: Joe Carson **Department:** Physics and Astronomy
Title: *Extrasolar Planets and Disk Imaging using the Hubble Space Telescope*

The Hubble DICE survey is a team approved by NASA. The team consists of nineteen multinational experts in the field of astrophysics. Led by Dr. Glenn Schneider (Univ Arizona), there is an ongoing effort to study eleven carefully-chosen stars with known debris fields, or circumstellar disks. The disks surrounding these young stars are interesting because they are believed to be the birthplaces of planets. By discovering evidence of planet formation in these disks, either by imaging disk gaps caused by forming planets or by directly imaging the planets themselves, one can gain invaluable insights to guide planet formation theories and ultimately help better understand the origins of our own solar system.

We use the STIS camera equipped on the Hubble Space Telescope to observe our target stars, utilizing high resolution imaging techniques to probe precise and detailed structures of the circumstellar disk. Aided by the precision of the STIS camera, combined with the sensitivity of the Hubble Telescope, we collect data from these target stars at multiple telescope roll rotations. These observations allow us to, for the first time, explore sub- structures and, in particular, asymmetries that indicate the presence of recently formed planets.

In particular, I have been working under the guidance of Dr. Joe Carson to develop a Variable-Pixel Linear Reconstruction, or “Drizzling”, procedure. This allows us to take advantage of the multiple roll angles in order to sub-pixelate the final image and increase the imaging resolution. We have successfully proven the procedure with a sub-set of the Hubble DICE data and now aim to apply it to the entire collection of data.

18. **Student: Kelsey Yetsko** **Major:** Marine Biology
Mentor: Andrew Shedlock **Department:** Biology
Title: *Prediction and Annotation of Genomic Repeat Dynamics using Hidden Markov Models*

Mobile elements cover an extensive amount of the genomes of both plants and animals. However, current homology, or similarity comparison, based search tools are optimized only for analyzing and annotating repeats in humans and well known experimental models such as mice and *Drosophila*. This skewed taxonomic distribution of reference data makes homology-based search tools less sensitive and less accurate towards older mobile elements, evolutionarily speaking, and also misses many targets in poorly examined genomically diverse lineages. With these limitations in mind, we propose to build and use Hidden Markov Models (HMMs) to use in repeat annotation in the gastropod mollusk species *Biomphalaria glabrata*. This species is of biomedical importance as the intermediate host in intestinal schistosomiasis transmission, a debilitating disease that is a major medical concern in 74 developing countries in the Western hemisphere and tropics. Comparative genomic information for mollusks is also virtually unknown except for commercial species like the pearl oyster (*Pinctata fucata*). We will compare the HMM profile repeat annotation output to other currently available methods, such as RepeatMasker, in order to assess comparatively whether there is an advantage of using *de novo* model-driven repeat annotation methods over homology based tools. Finally, we will use PCR to amplify certain choice repeat segments to verify experimentally the output we receive computationally *in silico*.

19. **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. This project will focus on isolating and encapsulating the replicated functionality present in *U-Pb_Redux* as a preliminary step in developing a full replacement for *ISOPLOT*. The resulting software and documentation will be available to anyone via the Internet.

Research Presentation Grants (RPG)

1. **Student: Nathan Adamson** **Major:** Biochemistry
Mentors: Neal Tonks **Departments:** Chemistry and Biochemistry
Title: *Drug Delivery Polyurethane Materials using Bio-Based Polyols*
Conference: South Eastern Regional Meeting for the American Chemical Society

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. The gross mass of the final product consists of a soy-based oil known as Agrol 2-100 supplied by Bio-Based. Secondly, two antibiotic compounds will be incorporated into the polyurethane for drug delivery that have never been used for this purpose before. For this study, Ibuprofen was used initially because of its low cost and its compatibility with this technology, but the next phase of the project will integrate Nalidixic Acid and Ofloxacin into the drug delivery polyurethane material.

2. **Student: Candice Alge** **Major:** Biology
Mentor: Isaure de Buron **Department:** Biology
Title: *The Myxozoan Kudoa inornata Parasite in the Spotted Seatrout Cynoscion nebulosus: Is Spore Density Correlated to Increased Post Mortem Muscle Softness?*
Conference: Annual Meeting of the Southeastern Society of Parasitologists

Kudoa inornata is a spore producing parasite that inhabits the skeletal muscles of spotted seatrout, *Cynoscion nebulosus*. A problem often found in infected seatrout is that after capture infected flesh becomes softer than it normally does if uninfected, rendering it not appealing to consumers. To determine if the increase in softness may be correlated with the number of parasitic spores infecting the fish, muscle samples from infected and uninfected seatrout were taken at 24, 72, and 144 hours post-capture and kept at either 4°C or 11°C. Muscle softness and spore density were determined for each sample at 4°C. Results showed that muscle was softer in infected fish and that there was variation in spore density among fish examined. However, muscle softness was not correlated to spore density. Data for the 11°C treatment will determine if the parasites' effect on the fish muscles may be temperature dependent as shown in other *Kudoa* species.

3. **Student: Cassandra Awgulewitsch** **Major:** Biology
Mentor: Christine Byrum **Department:** Biology
Title: *Quantitative analysis of ECM proteins in vascular cell aggregates for application to scaffold-free tissue engineering*
Conference: American Society for Cell Biology Annual Meeting

Some medical conditions involve blood vessel damage; conventional treatments and even cutting-edge engineering methods face major drawbacks. Scaffold-free tissue engineering is an alternative engineering method in which the patient's own cells are used to form blood vessels. These vessels must be both strong and elastic enough to withstand blood pressure. A functional extracellular matrix (ECM), composed of proteins, provides this strength. The goal of this project was to assess how different cell types in aggregates influence production of ECM proteins. We fabricated four groups of aggregates: (1) smooth muscle cells (SMCs), (2) SMCs with serotonin, (3) SMCs with endothelial cells, and (4) SMCs, endothelial cells, and fibroblasts. We evaluated ECM protein production using the Western blot procedure. Mixed aggregates in Groups 3 and 4 showed increases in ECM protein production compared to Group 1 aggregates. These results provide insight into the best cell type combinations to achieve optimal ECM production.

4. **Student: Jami Baxley** **Major:** Classics
Mentor: James Newhard **Department:** Classics
Title: *The Use of Structured Light Scanning for the Study of the Linear B Deposits from Pylos, Messenia, Greece*
Conference: Annual Meeting of the Archaeological Institute of America

The project is imaging the Linear B tablets from the Palace of Nestor at Pylos. These tablets are administrative documents from one of the major centers of the Bronze Age Greek world, written in the earliest known examples of Greek. The project entails the imaging of this corpus using the latest technologies, including structured light scanning (SLS). Although slower than the more widely-used laser scanning, SLS retrieves raw data of greater accuracy, with less error, and most importantly, in color. This summer, approximately 150 tablets were captured via SLS. Innovations developed this summer not only reduced the image capture, but also the processing time, allowing the entire process to take less time than other recording methods. This poster presents initial data from the project's first season and outlines the methodological improvements that enable SLS to be viewed as a viable and preferred alternative to laser scanning.

5. **Student: F. Garrett Boudinot** **Major:** Geology
Mentor: Vijay M. Vulava **Department:** Geology
Title: *Sorption and Transport of Sildenafil in Natural Soils*
Conference: American Geophysical Union 2013 Fall Meeting

Pharmaceutical Chemicals mainly enter our ecosystems from discharge of treated wastewater, and have direct effects on their ecological health. Sildenafil (Viagra) is one such chemical, whose effect on natural ecosystems is heretofore unknown. Given that sildenafil consumption (and concurrently disposal) is on the rise, it is essential that its behavior in the natural environment be understood. Thus, the goal of this study was to quantify how sildenafil travels and functions in differing natural soils. Experiments were performed using pristine organic-rich and clay-rich soils collected from a managed forest near Charleston, SC. Data from the experiments indicate strong chemical bonding of sildenafil to all soils, with clay-rich soils showing stronger bonding. Soil bonding acts as a filter in groundwater, effectively removing those bound chemicals from the water system. These results show that very little sildenafil will remain in the groundwater upon discharge into natural soils.

6. **Student: Jonathan Brown** **Major:** Biology
Mentor: Allison Welch **Department:** Biology
Title: *Individual and combined effects of ibuprofen and its photodegradant on southern toad tadpoles*
Conference: Society for Integrative and Comparative Biology Annual Meeting

Many pharmaceuticals are not completely broken down within the body and may not be adequately removed during treatment of wastewater. Ibuprofen is one of the most commonly used pharmaceuticals and appreciable quantities are released into the environment. In the presence of sunlight, ibuprofen is converted into another molecule (referred to as a photodegradant) with chemical properties suggestive of higher toxicity. We tested the relative toxicity of ibuprofen and its photodegradant to tadpoles of the southern toad and found that the photodegradant was approximately ten times as toxic as ibuprofen. We also tested a mixture of ibuprofen and its photodegradant and determined that the mixture was more toxic than predicted based on the effects of either compound alone. Understanding the biological effects of pharmaceuticals and their degradants, alone and in combination, is important for assessing how pharmaceutical pollution may impact the health of freshwater ecosystems.

7. **Student: Timothy Allen Brown** **Major:** Dance
Mentor: Gretchen McLaine **Department:** Theatre and Dance
Title: *Nostalgia: A choreographic research project*
Conference: American College Dance Festival Southeastern Regional Conference

This work was selected by a panel of dance faculty members to be developed and presented at the American College Dance Festival southeast region conference. My choreographic work is based on a quote by Carson McCullers. The quote conveys one being homesick and looking for a place where they belong. The idea of the piece is to have the dancers represent that homesick feeling and show one's struggle while finding the place where they fit in. Designing and teaching the movement will take approximately 60 hours. To make this piece fully realized on the stage, I am able to find music for the movement and collaborate with the costuming and lightning designers from the College of Charleston Theatre program. The finished product will be a modem dance piece, approximately six minutes in length. Eight dancers will perform this piece in front of approximately 400 students, professors, and teaching artists.

8. **Student: F. Jamie Claire** **Major:** Chemistry
Mentor: Justin K. Wyatt **Department:** Chemistry and Biochemistry
Title: *Synthesis of Novel Dual-Action Phthalazinone Chemotherapies*
Conference: Southeastern Regional Meeting of the American Chemical Society

The goal of this project was to synthesize multiple new chemical compounds that could be used to fight cancer cells. Six compounds were derived from a known chemotherapeutic drug, Combretastatin-A4 (C-A4), and designed to attack cell in two ways to be more cytotoxic. C-A4 only attacks cells in one way and, while relatively effective at killing cancerous cells, has also been found to be harmful to healthy cells. The derivatives synthesized during this project will be tested at the Medical University of South Carolina on lines of prostate cancer cells and healthy brain (neuroblastoma) cells. The results from these tests will conclude which of the derivatives kill the cancer cells effectively with little harm to the healthy cells. These results will be presented at the conference as well as the data from the synthesis process.

9. **Student: Patricia Cooney** **Major:** Biology
Mentor: Christopher Korey **Department:** Biology
Title: *The Snapping Shrimp, Alpheus angulosus: A New Model System for Studying Neural Development and Plasticity*
Conference: Society for Neuroscience 2013 Annual Conference

We are interested in developing the snapping shrimp, *Alpheus angulosus*, into a new laboratory model because of its brief embryonic development and relatively large embryos. As an adult, this species demonstrates lateralization of its two claws: one large snapping claw, and one smaller pincer claw. When threatened, the shrimp can switch claw lateralization by dropping its snapping claw and transforming the former pincer claw into a snapper. This process requires extensive rewiring of both motor and sensory neural components. Characterizing the neural development from embryo to adult will reveal how neural asymmetry in the claws develops and help us to understand the evolution of crustacean nervous systems. In this study, we observed embryonic nervous system development using antibody that highlights neural pathways. Thus far, we have examined embryos spanning Day 5 through Day 17 of development and will present initial characterization of the stages of neural development in *A. angulosus*.

10. **Student: Lundy L. Davis** **Major:** Biology
Mentor: Brooke A. Van Horn **Department:** Chemistry & Biochemistry
Title: *Tuning Iodine Content in Poly(epsilon- caprolactone): Synthetic Hydroxylamines for Grafting*
Conference: Southeastern Regional Meeting of the American Chemical Society

X-ray imaging is a common technique used in medical science in which contrast agents injected in the body are illuminated to detect and diagnose disease states. Our lab aims to guide X-ray imaging science away from the current limitations associated with small molecule contrast agents (often with iodine) and toward polymer systems. These polymeric systems we are building have the benefit of being tunable in size and in the contrast agent content on the polymer chains. In Summer 2013, we (1) reproduced the synthesis of a single iodine-containing agent to attach to polymers, (2) successfully attached it to polymers in collaboration with another undergraduate, and (3) began the synthesis of the new triiodo molecule. This poster presentation at SERMACS will highlight the specifics of our small molecule syntheses and characterization gathered during our Summer 2013 SURF and Fall 2013 CHEM 481 efforts.

11. **Student: Kate Diederich** **Major:** Chemistry
Mentor: Marcello Forconi **Department:** Chemistry and Biochemistry
Title: *Chemical Modification of a Computationally-Designed Enzyme*
Conference: Southeastern Regional Meeting of the American Chemical Society

Recent advances in computation have led to the design of a series of enzymes. One of these enzymes, RA-61, uses an active site lysine to catalyze the chemical transformation of its substrate. One of the hallmarks of enzyme catalysis is the precise positioning of substrates and active site residues within the enzyme's active site. However, it is still poorly understood whether this also applies to the computationally-designed RA-61. To address this problem, we are currently investigating whether perturbation of the active site lysine leads to a significant change in the activity of the enzyme. Our results will help in the understanding of the failures and successes of the design process.

12. **Student: Caley Doud** **Major:** Psychology
Mentor: Chad Galuska **Department:** Psychology
Title: *Assessing Rats' Behavioral Persistence When Disrupted in Choice and Non-Choice Contexts*
Conference: Association for Behavior Analysis International Annual Conference

Research investigating the factors governing behavioral persistence in the face of disruption has focused on the reinforcement rate prior to disruption. For example, when rats' lever presses for reward are disrupted by discontinuing reinforcement, the number of presses made before responding ceases (persistence) is determined by how frequently lever pressing was reinforced prior to the disruptor. We seek to determine the role that response freedom has on behavioral persistence. In the critical conditions, we will analyze responding after disruption in cases where (a) rats can respond on two levers for food, and (b) only one lever is available to produce food. The overall reinforcement rate prior to disruption will be held constant. Identifying which preparation leads to greater response persistence may shed light on optimal training strategies (e.g., training the response in isolation or with several options) to establish new skills that are resistant to common disruptors in daily life.

13. **Student: Sylricka Foster** **Major:** Geology
Mentor: Timothy Callahan **Department:** Geology and Environmental Geoscience
Title: *Groundwater dynamics and water budget analysis at a wetland- dominated forested floodplain*
Conference: American Geophysical Union 2013 Fall Meeting

This study investigated the relationships between groundwater behavior, vegetation communities, and soil characteristics in the old-growth forests at Congaree National Park, South Carolina. Groundwater data (depth below ground surface, response to storm events, and affects by transpiration by

vegetation) were collected and analyzed from ten different water wells from 2009 to 2013. Rock and soil types at each site and the water level data were used to look for relationships to explain groundwater behavior. A separate analysis of transpiration by vegetation signals helped assess potential feedbacks between vegetation and groundwater in this wetland- dominated setting. We found that transpiration by vegetation and evaporation values were higher in the summer than in the winter because of the higher rate of evaporation of water from the soil and vegetation needs more water in the summertime.

14. **Student: Craig Garrison** **Major:** Anthropology
Mentor: James Ward **Department:** Historic Preservation
Title: *A Catalog of Carriage Steps in the Historic District of Charleston: Paving the Way to Understanding the Historic Streetscape of Charleston*
Conference: 2014 Joint Annual Meeting of the Archaeological Institute of America and the American Philological Association

Carriage steps were important and functional streetscape features during the eighteenth and nineteenth century in Charleston, South Carolina. Their presence on the street today is a reminder of the long history of this place and a testament to the value of preservation that keeps them there, even though their function is no longer relevant. As transportation progresses over time so do the social patterns that develops around them. Carriage steps thus serve as testament to these past social and economic interactions. In the summer 2013, 105 extant carriage steps were located in the historic district of Charleston. A brief analysis of the styles and materials used for these objects suggest that the use of carriage steps were not limited to a static nature but rather served in a dynamic way to guide people from one point to the other. When analyzed as a collection, these artifacts offer insights into different architectural and social patterns that developed around early urban settings, specifically-how the private domestic and economic world of built structures addressed and interacted with the public, open environment of the street and the relationship of streets to approaching visitors. It represents a critical vestige of a liminal space in Charleston's self- conscious and historic presentation of itself.

15. **Student: Alice J. Gaynor** **Major:** Geology
Mentor: Vijay M. Vulava **Department:** Geology
Title: *Sorption and Transport of Ranitidine in Natural Soils*
Conference: American Geophysical Union 2013 Fall Meeting

Increasing levels of pharmaceuticals have been found in natural water systems all over the world. These chemicals are discharged from wastewater treatment plants, sewage overflow, and leaking septic tanks. Ranitidine is an example of one such pharmaceutical chemical commonly used to treat peptic ulcers and gastroesophageal reflux disease. The objective of this research is to establish chemical binding and transport patterns of ranitidine in soils and determine which soil properties influence these patterns most. Laboratory experiments were performed on organic and clay-rich soils. Chemical binding of Ranitidine was measured using batch reactor experiments and column experiments were used to quantify transport behavior. These experiments indicate that ranitidine is bound more strongly to clay-rich soils than to organic-rich soils, but both have slow reaction rates. It appears that Ranitidine's slow reaction rate does not allow the soils to create an adequate barrier for the protection of surface and groundwater.

16. **Student: Crane Havens** **Major:** Psychology
Mentor: Chad Galuska **Department:** Psychology
Title: *Effects of Reward Size Variability on Preference and Response Persistence in a Rat Model of Gambling*
Conference: Association for Behavior Analysis International Annual Conference

In animal models of gambling, each "play" (e.g., a rat's lever press) has a small but fixed probability of producing a "win" (food pellets). While probabilistic schedules of reinforcement engender high rates of responding that perhaps model slot machine play, little attention has been devoted to studying how aspects

of the payout (size, variability, etc.) affect play. This experiment examines the effects of fixed (e.g., 2 food pellets per win) and variable (e.g., 0-12 pellets per win but averaging 2) payouts on rats' responding, and also will assess preference between these alternatives. Preliminary results suggest that variable reward sizes maintain responding longer, and the choice phase will be completed prior to the conference registration deadline in January.

17. **Student: David Hester** **Major:** English and Classics
Mentor: Anton Vander Zee **Department:** English
Title: *Hart Crane's Queer Classicism*
Conference: American Literature Association Annual Conference

My project explores the intersections of classical studies and literary modernism, focusing on how authors during the post-WWI era simultaneously embraced modernist experimentalism while deploying traditional/classical themes. I consider how numerous writers identified with classical exilic figures, casting themselves as modernist exiles to manage their sense of displacement in a modernizing world. Using historical conceptions of exile as a backdrop, I identify normative connotations of the label "modernist exile"— e.g., the idea of returning "home" by following a "traditional" path—and argue that associating this label with marginalized authors is problematic. I explore this dilemma in relation to Hart Crane, an American poet who attempted to express his nontraditional sexual identity through the lens of modernist exile. Focusing on Crane's letters in particular, I concluded that though Crane fashioned himself as a modernist exile, he was unable to reconcile his unorthodox sexuality and poetics with a normative classicism—an inability that I term a "queer classicism."

18. **Student: Carissa James** **Major:** Biology
Mentor: Elizabeth Meyer-Bernstein **Department:** Psychology
Title: *Are cryptochrome and clock gene expression involved in circatidal rhythm generation?*
Conference: Society for Neuroscience 2013 Annual Conference

Animals display rhythms in physiology and behavior that are governed by a self- sustaining biological clock. Circadian rhythms are the most widely studied clock outputs, expressed as a 24hr oscillation. In marine organisms, non-photic environmental cues such as hydrostatic pressure can influence clock function. Circatidal rhythms generated in response to hydrostatic pressure are observed every 12.4hrs, distinguishing them from the 24hr circadian period. Unlike circadian rhythms, the molecular mechanisms underlying circatidal rhythms remain unclear. The sea anemone, *Nematostella vectensis*, exhibits circadian and circatidal rhythms in locomotion. To determine whether the circadian genes, *clock* and *cryptochrome*, contribute to this circatidal behavior, we have analyzed their expression in animals exposed to a simulated tide and compared that with gene expression during a photoperiod alone. We expect the simulated tide to alter rhythms of circadian gene expression and contribute to our understanding of the molecular underpinnings of the biological clock.

19. **Student: Jessica Kapp** **Major:** Chemistry
Mentor: Marcello Forconi **Department:** Chemistry and Biochemistry
Title: *Cysteine Modification via Nucleophilic Aromatic Substitution*
Conference: Southeastern Regional Meeting of the American Chemical Society

The introduction of specific reporters into proteins is a challenging task. One of the ways to accomplish this task is to chemically modify cysteine residue, which possess reactivity significantly different than any other functional group present in proteins. We are testing this method to introduce nitrile probes into proteins, through a reaction that involves modification of cysteine residues using perfluorinated benzonitriles. Nitriles are unique probes that very precisely report of the electrostatic environment within a close distance to the probe. Our preliminary results suggest that this technique is feasible, and we are now in the process to proceed to protein modification. If successful, this method will represent an easy, cheap way to modify proteins and introduce a probe that is starting to receive significant attention within the protein scientific community.

20. **Student: Serena-Kaye Kinley-Cooper** **Major:** Psychology
Mentor: Michael Ruscio **Department:** Psychology
Title: *Effects of Social Environment on Estrogen Receptor Alpha Expression in the Central Nervous System of the California Mouse (Peromyscus californicus).*
Conference: SYNAPSE (Symposium for Young Neuroscientists and Professors of the South East)

Estrogen affects a variety of behavioral and physiological functions in both male and female vertebrates. Using a highly social rodent species (monogamous and biparental), the California mouse (*Peromyscus californicus*) we will determine if social environment (isolate vs. pair housed) causes changes in estrogen receptor (ER) concentration and neurogenesis (a process known to be independently affected by estrogen and social environment). Isolation causes a variety of impairments in social behavior across mammals. We aim to identify the neural mechanisms that underlie these impairments. To this end we have quantified the expression of neurogenesis, ER and their co-expression (in the same cell) in isolate vs. pair housed animals. Thus far, we have demonstrated significant changes in neurogenesis within the hippocampus across groups. We have also demonstrated co-expression of neurogenesis and ER in the hippocampus. We have yet to determine if there are significant differences in co-expression across groups.

21. **Student: Michelle Manning** **Major:** Psychology
Mentor: Cindy May **Department:** Psychology
Title: *Once and only once: Enhancing prospective memory precision with emotional cues*
Conference: Cognitive Aging Conference

Prospective memory (PM) involves memory for future tasks, such as delivering a message or taking medication. People often use cues (e.g., sticky notes) to remind them of PM tasks, and our study examined the effectiveness of different kinds of cues in reducing PM omission errors (e.g., forgetting to send an important email) and preventing repetition errors (e.g., mistakenly taking medication twice). Participants in this study made judgments about words, and simultaneously had to remember to press a key when a target word appeared. There were fourteen blocks of trials, and within each, the target word appeared three times. Participants were to press the key once (and only once) per block. Half the blocks contained an emotional target word (e.g., vomit, passion), and half contained a neutral target word (e.g., kettle, table). Participants showed fewer omission and repetition errors with emotional relative to neutral targets.

22. **Student: Keith Morgenstern** **Major:** Biochemistry
Mentors: Marcello Forconi **Department:** Biochemistry
Title: *The Alkylsulfatase SdsA1: A True Sulfatase?*
Conference: Southeastern Regional Meeting of the American Chemical Society

SdsA1 is a protein discovered in the pathogenic bacteria *Pseudomonas aeruginosa* that has been implicated in the metabolic assimilation of sodium dodecyl sulfate (SDS), a widely used detergent. However, this enzyme is widespread in bacteria, and has been transferred to eukaryotes too. Thus, it seems unlikely that all these organisms have evolved a very similar enzyme to destroy SDS. These and other observations suggest that SDS might not be the physiologically-relevant substrate for this enzyme. We have started a functional analysis of SdsA1 to garner better understanding into its substrate preference. Our results show that SDS inhibits the enzyme at very small concentrations, while shorter sulfates do not lead to inhibition. We are currently studying an array of different substrates and inhibitors to determine whether SdsA1 exhibits strong preference toward any of them.

23. **Student: Samantha E. Nicolau** **Major:** Biology
Mentor: Brooke A. Van Horn **Department:** Chemistry & Biochemistry
Title: *Tuning Iodine Content in Poly(epsilon- caprolactone): Optimization of the Polymer Synthesis*
Conference: Southeast Regional Meeting of the American Chemical Society

X-ray imaging is a common technique used in medical science in which contrast agents injected in the body are illuminated to detect and diagnose disease states. Our lab aims to guide X-ray imaging science away from the current limitations associated with small molecule contrast agents (often with iodine) and toward polymer systems. These polymeric systems we are building have the benefit of being tunable in size and in the contrast agent content on the polymer chains. In Summer 2013, we successfully (1) synthesized multiple >5 gram quantities of a pre-polymer, (2) reproduced a deprotection and a coupling reaction of the contrast agent to the pre-polymers, as well as (3) began investigating the synthesis of copolymers using an organocatalyst system. The poster presentation at SERMACS will highlight our polymer syntheses and characterization gathered during our Summer 2013 SURF and Fall 2013 CHEM 397 efforts.

24. **Student: Brenna Norton-Baker** **Major:** Biochemistry
Mentor: Justin K. Wyatt **Department:** Chemistry and Biochemistry
Title: *Synthesis of Novel Dual-Active Phthalazinone Chemotherapies*
Conference: Southeastern Regional Meeting of the American Chemical Society

Current efforts to improve chemotherapies aim to more specifically target cancerous cells and reduce or eliminate the toxicity to normal (non-cancerous) cells. An established anti-cancer drug Combretastatin A-4 (CA-4) inhibits cellular proliferation by disrupting the mitotic process. Using a computerized modeling study (a novel 2D-QSAR method), we designed derivatives of CA-4 and used the modeling study to predict possible biological activity. Three compounds were predicted active and synthesized. Through collaborations with MUSC, the compounds have been tested on prostate cancer cells and healthy neuroblastoma cells. Based on these results, we have designed another group of similar compounds, with added structural components to help target another active site. These possibly dual-active compounds are currently being synthesized and will be tested at MUSC.

25. **Student: Derek Novo** **Major:** Physics
Mentor: Sorinel A. Oprisan **Department:** Physics and Astronomy
Title: *What is all the noise about in interval timing?*
Conference: Society for Neuroscience 2013 Annual Conference

Demonstrated in many species, timing in the seconds-to-minutes range (interval timing) promotes rate estimation, decision-making and foraging. Furthermore, a series of neurological disorders, including Parkinson's, Huntington's, and schizophrenia, reveals deficits in interval timing. We implemented a computational model of interval timing that mirrors the thalamo-cortico-striatal loops involved in interval timing. Our striatal beat frequency (SBF) model correctly reproduces peak interval experimental results. Here we investigated the response of the SBF model to conditioning stimuli (CS) with distracters. Specifically, we modeled the most common distracter, a brief CS gap, by strongly hyperpolarizing prefrontal model neurons. The postinhibitory rebound of neurons ensures that the SBF model restarts timing, which shifts the peak response by the sum of the pre-gap duration plus the gap duration. Our results match this experimentally observed behavioral "reset" response.

26. **Student: Anne C.K. Olsen** **Major:** Biology
Mentor: Jeffrey D. Triblehorn **Department:** Biology
Title: *Wind velocity encoding by sensory neurons in three cockroach species.*
Conference: Society for Neuroscience 2013 Annual Conference

Extracting information from the environment is an important function of sensory systems and how this information guides behavior can vary between closely-related species. These animals often have

different responses to the same sensory stimulation, which can be related to modifications within their nervous systems. To understand how modifications to the nervous system underlie response differences, we focus on the wind-mediated sensory system of cockroaches. Cockroach species vary in their wind-evoked behaviors and their nervous system is easily accessible for neurophysiological studies. Our lab previously found a difference in the activity of wind-sensitive neurons (WSNs) that drive motor neuron activity that activate behavior in three cockroach species (one exhibits a wind-evoked behavior, two do not). To determine if the species differences in WSN activity originate at the WSNs or at the sensory cells providing input to the WSNs, I recorded and compared sensory neuron activity from each species.

27. **Student: Samantha Piergross** **Major:** English
Mentor: Chris Korey **Department:** First-Year Experience Biology
Title: *Assessing FYE Abroad Programs: Student Voices Help Develop Global Experiences*
Conference: 33rd Annual Conference on The First-Year Experience

College of Charleston's FYE possesses an institutional structure that engages first-year students in high-impact learning experiences such as undergraduate research, study abroad, and civic engagement. FYE Abroad aims to demonstrate the benefits of studying abroad, encouraging students to make plans early to undertake a more extensive cultural and academic experience later in their college career. We have done a quantitative assessment that is completed in the form of a summarized evaluation of the class and the abroad experience through a basic scale of responses. Our program assessment combines the quantitative responses from participant surveys with a series of three focus group meetings with participants answering eight questions to help close the "knowledge gap" between participants and the program directors. A key goal of FYE Abroad assessment is to determine whether early experience with study abroad encourage students to participate in future study abroad experiences.

28. **Student: Casey J. Rutherford** **Major:** Geology
Mentor: Vijay Vulava **Department:** Geology
Title: *Sorption and Transport of Diphenhydramine in Natural Soils*
Conference: American Geophysical Union 2013 Fall Meeting

Diphenhydramine – an antihistamine – is a pharmaceutical chemical that has been detected in streams and groundwater as a result of sewage overflows, runoff, or sewage treatment facilities unequipped to remove trace levels of pharmaceuticals. The objective of this study is to measure chemical binding and transport behavior of diphenhydramine in natural soils and determine its reactivity to soil components. Studies were conducted in the laboratory using natural soil collected from the Francis Marion National Forest. Equilibrium chemical binding patterns and reaction kinetic rates were measured using batch reactors, while transport behavior was measured using chromatographic column experiments. Kinetic experiments showed that diphenhydramine bound strongly to the clay-rich soils and reached equilibrium after seven days, compared to kinetic reaction rates of ten days in organic-rich soils. The results have implications for how diphenhydramine move in different soil environments, and eventually affect larger ecosystems.

29. **Student: Joshua Schmidt** **Major:** Biochemistry
Mentor: Marcello Forconi **Department:** Chemistry and Biochemistry
Title: *The effect of the hydrophobic environment on the retro-aldol reaction: Comparison to a computationally-designed enzyme*
Conference: Southeastern Regional Meeting of the American Chemical Society

Enzymes are used by organisms to accelerate chemical reactions. Hallmarks of enzyme catalysis are the existence of a hydrophobic region within the enzyme's three-dimensional structure, which binds the specific substrate, and the presence of specific interactions with the substrate. Recent developments in computation have produced a completely new enzyme, capable of accelerating a chemical reaction not found in Nature, the retro-aldol reaction of methodol, by about 5 orders of magnitude. However, it is still unclear what rate acceleration can be achieved by a very simple system with no specific

interactions with the substrate. We investigated this problem by using detergents, which are known to form hydrophobic patches with no specific interactions. We found that almost all of the catalytic power of the computationally-designed enzyme can be achieved by such simple system. These and other results suggest that the computational process did not capture the true nature of enzyme catalysis.

30. **Student: Ryan B. Simpson** **Major:** Classics and Biology
Mentor: Kristen Gentile **Department:** Classics
Title: *The Transformation of Roman Medicine examined with Dynamic Systems Theory*
Conference: Southern Association for the History of Medicine and Science

In the second century CE, Galen of Pergamon succeeded in synthesizing the theories of competing medical communities in the Roman Empire. Few primary resources directly address this rapid transition from disorganized medical sects to Galen's unified theory of medicine. This silence presents an obstacle when attempting to make meaningful observations about the transformation of medicine in the early Roman Empire. This paper employs methods drawn from modern systems theory to overcome this obstacle. Systems theory is a tool that describes relationships between organizations and how they generate innovation through self-correcting feedback loops. The application of systems theory allows for constructive analysis of the processes by which competing schools of thought created new bodies of knowledge and of how Galen systematically built upon that knowledge to create a lasting medical corpus. This paper defines and details these processes, minimizing the amount of guesswork associated with gaps in primary literature.

31. **Student: Brett Snyder** **Major:** Chemistry
Mentor: Neal Tonks **Department:** Chemistry and Biochemistry
Title: Using Bio-Based Materials to Synthesize a Novel Surfactant in the Production of Polyurethane Foams
Conference: Southeastern Regional Meeting of the American Chemical Society

The primary focus of this research is to improve foam formation in the production of polyurethane foams, using bio-based materials. Industrially, poly-ethylene glycol based surfactants are derived from petroleum oil. In contrast to these petroleum-based surfactants, our surfactants are based on renewable fatty acid sources, thus being more environmentally favored. Surfactants reduce the surface tension between isocyanates and poly-ether or poly-ester based polyols, which allows for more uniform mixing during polyurethane formation. We have started synthesizing polyurethane foams, comparing foams made with bio-based surfactants to foams made with traditional surfactants. Image analysis based on scanning electron microscopy will allow for comparisons of average foam cell size distributions between the polyurethane foam samples. Upon further interpretation of the results, we hope to conclude that polyurethane foams synthesized using bio-based surfactants are comparable to polyurethane foams manufactured using petroleum-based surfactants used in industry.

32. **Student: Erica Tracey** **Major:** Biology
Mentor: Christopher Korey **Department:** Biology
Title: *Sensory Neuron Plasticity During Claw Transformation in the Snapping Shrimp, Alpheus angulosus*
Conference: Society for Neuroscience 2013 Annual Conference

Alpheus species' claws are bilaterally asymmetrical: they possess a pincer and a snapper claw that differ both functionally and morphologically. Both claws play important roles in the behavioral interactions of the shrimp. When the snapper is removed, the pincer will morph over a period of four molts into a functioning snapper claw, which has the unique ability of producing a "snapping" sound when the shrimp rapidly closes the large claw. Transformation occurs through a step-like change in shape, nerve growth, and muscle tissue. Setae, hair-like structures on the claw, are the outward projections of sensory nerves; they provide a unique opportunity to use outward morphology as a window into the normally concealed nervous system. We will present our completed analysis of changes in

setae patterns throughout claw transformations and what these changes may reflect in the nervous-system structures underneath the claws' surfaces.

33. **Student: Sarah Turner** **Major:** Biology
Mentor: Allison Welch **Department:** Biology
Title: *Acute and chronic effects of naproxen and its photodegradants on southern toad tadpoles*
Conference: Society for Integrative and Comparative Biology Annual Meeting

Pharmaceutical pollution is an emerging environmental issue. Many pharmaceuticals pass through the body, are not completely removed during wastewater treatment, and are ultimately released into the environment. Naproxen, a widely used pain reliever, has been detected in natural waterways around the world. When exposed to sunlight, naproxen is converted into two related compounds, known as photodegradants, which are predicted to be more toxic than naproxen itself. We tested the toxicity of these three compounds to tadpoles of the southern toad during acute (96 hours) and chronic exposures (until metamorphosis). Acute toxicity of the first photodegradant was similar to that of naproxen, while the second photodegradant was over six times as toxic. During chronic exposures at lower concentrations, both photodegradants reduced tadpole survival and growth, while naproxen had no effect. These results suggest that the degradation of naproxen in the environment may increase risk to freshwater organisms.

34. **Student: Davy C. Vanderweyen** **Major:** Physics
Mentor: Sorinel A. Oprisan **Department:** Physics and Astronomy
Title: *Nonlinear effects induced by stimuli on the phase resetting curve*
Conference: Society for Neuroscience 2013 Annual Conference

Rhythmic patterns of neural activity are ubiquitous phenomena in animals. Central pattern generators are autonomous networks of neurons that control biological rhythms such as the circadian rhythm, heartbeats, etc. The neurons change their firing patters due to the inputs from other neurons. Inputs arrive to the neurons with different amplitudes, durations, and shapes. As a result, each input induces a different neural response. In these computational experiments, we mimicked injected electrical stimulus of different amplitude, duration, and shapes into a neuron model. We found that the relationship between the stimulus strength and the response of the neuron was linear. However, the duration of the stimulus induced a non-linear response. This suggests that the change in firing rate is not strictly proportional to the area under the curve of the stimulus, as previously thought, but is also sensitive to other parameters such as how fast the stimulus reaches its maximum value.

35. **Student: Travis Varner** **Major:** Chemistry
Mentor: Justin Wyatt **Department:** Chemistry and Biochemistry
Title: *Synthesis of Stereospecific Bis-Indene Catalysts*
Conference: Southeastern Regional Meeting of the American Chemical Society

Everyone recognizes the vital role that medicine plays in our society today. However, not many people are aware of the difficulties that organic chemists face when making pharmaceutical drugs. It is often difficult to control certain aspects of a molecule's structure, specifically its three-dimensional arrangement. This spatial arrangement of the drug's structure determines how it will react with the body. For instance, the anti-inflammatory drug known as Aleve could instead act as a liver toxin if its three-dimensional shape is slightly different. Our goal is to fabricate a new molecule, also known as a catalyst, which will aid in making the correctly shaped drug structures. Our newly designed catalyst has been based off a previous molecule that proved successful. Once we have finished producing our catalyst, we hope to soon test its effectiveness in making pharmaceutical drugs that require a specific three-dimensional arrangement.

36. **Student: Nathan Wills** **Major:** Psychology
Mentor: Jen Wright **Department:** Psychology
Title: *Developmental Origins of the Moral Sense*
Conference: Cognitive Development Society

How do children first learn about, and begin to explore, the moral domain? We hypothesized that pretend play serves as an important context for moral learning by providing opportunities for moral evaluation and for moral exploration, as children take on/explore "moral themes.

We studied five children from 2.0 to 5.0-years-old. We coded separately for when they engaged in pretend play and when morally relevant parent/child dialogue occurred, mapping the extent to which these two overlapped. While there was a developmental decrease in the frequency of moral dialogue in general, there was no developmental change in the frequency of moral dialogue within the context of pretend play. Moral evaluation decreased and exploration increased over time. Children increasingly use pretend play as a medium through which to explore moral themes, doing so allows for an increased sensitivity to the feelings, dispositions, and behaviors of those (real/imaginary) with whom they interact.

37. **Student: Amanda Wimbish** **Major:** Biochemistry
Mentor: Justin Wyatt **Department:** Chemistry and Biochemistry
Title: *Synthesis of a Novel Dual-Action Cytosporone E/Triazole Antibiotic*
Conference: Southeastern Regional Meeting of the American Chemical Society

Antibiotic resistance is an issue that has recently taken precedence in the medical community and is rapidly becoming difficult to combat. As more antibiotics are introduced into our water supply, soil, and food, bacterial resistance to these antibiotics escalates, which reduces the effectiveness of current commercial antibiotics. The goal of this project is to create a series of new antibiotics, to which bacteria have not yet grown resistant. To do this we will be combining cytosporone E, a compound shown to have antibiotic properties, with key features of other antibiotic compounds. These new compounds will then be tested against different strains of bacteria to determine how effective they are compared to current antibiotics. The results from these tests will give us insight into how to change and design the next generation of antibiotic derivatives.