2018-2019 AWARD RECIPIENTS

The Office of Undergraduate Research and Creative Activities is pleased to announce the MAYS and RPG recipients for the 2018-2019 academic year. Please join us in congratulating these students and their faculty mentors.

Major Academic Year Support (MAYS)

Student: Kaitlyn Dalrymple
Mentor: Dr. Kathleen McInvale
Major: Biology
Department: Biology

Can parasites of cryptic shark species be used to identify their hosts?

In 2013, a new hammerhead shark species (the Carolina hammerhead) was discovered along the coast of South Carolina. Little is known about this shark other than it lives along with another shark (the Scalloped hammerhead), which looks alike but differ in its DNA and vertebrae count, hence they are considered ‘cryptic species’. This study aims to test the idea that parasites can be so specific for their hosts that they can be proxies of the hosts’ identities. We will identify the parasite faunas in these two sharks and predict that they will be somewhat different as we expect to find new parasites species in the new Carolina hammerhead. This study was initiated this summer and is carried out in collaboration with the Department of Natural Resources (DNR), who provides carcasses of sharks from Bull’s Bay within the framework of the genetic study they conduct. Thus far, we have collected over a hundred parasites including two types of gill flukes, six tapeworms, and four roundworms, attracting the interest of a world-renowned parasitologist in Brazil with whom we wish to visit and collaborate. Collection of parasites will be pursued through October when sharks migrate out of our waters. Parasites will be identified from individual shark using both microscopy and DNA sequencing. The study will be blind since identity of the sharks can only be determined genetically, which will be done independently by the DNR. Once this three identity will be provided to us, parasites will be matched to their respective host shark species and we will determine if they can indirectly indicate their host’s identity.

Student: Geoffrey Gill
Mentor: Dr. Craig Plante
Major: Biology
Department: Biology

A biogeographic analysis of marine bacteria in the Sargasso Sea using high-throughput sequencing methods

Marine microbes, vital to establishing the environmental characteristics of ocean ecosystems, form specialized communities based upon ecological variables and relationships between species, making them impossible to culture in the lab. Their communities are particularly important in nutrient-poor areas, such as the North Atlantic’s Sargasso Sea. This microbial community must be studied as a whole to understand how
they disperse and change composition throughout the ocean, providing insight into the feedback between microbial diversity and the characteristics of the ecosystem these organisms help establish. This study will analyze samples collected during spring 2018 in the Sargasso Sea using the Illumina MiSeq platform, a next-generation genetic technique, to identify the bacterial DNA sequences present. A previous study using this sample set analyzed community composition with a less nuanced genetic technique, and found that depth limited microbial communities’ distribution to a greater extent than geographic distance and oceanographic conditions. Using Illumina will allow us to identify the species-level makeup of the microbial communities along the sampling track between the Caribbean and New England, providing better insight into how these communities interact in this stressful environment, while more precisely demonstrating how species are distributed over depth and distance throughout the ocean. The study will focus on bacterial communities due to environmental factors, which increase the importance of this class of organisms in the nutrient-poor Sargasso Sea. Better understanding bacterial connectivity in this environment could advance ocean systems and climate modeling, as the Sargasso Sea absorbs atmospheric carbon due to the productivity of photosynthetic microbes.

Student: Samantha Anyim  
Mentor: Dr. Jen Wright  
Major: Psychology  
Department: Psychology  

The intersectionality of Race and Sexual Orientation

This project will investigate the cumulative effects of multiple minority group identity markers (e.g., gender, race, sexual orientation, religion, disability, etc.) on college students’ attitudes about and tolerance towards other people’s beliefs and practices. Specifically, we are interested in testing whether exposure to more than one minority group identity marker increase people’s negative attitudes and intolerance – in other words students will be given scenarios to consider – situations in a protagonist has done something either socially positive or negative – in which the protagonist is identified as having one, two, or three minority group identity markers (e.g., a black female with a learning disability or a Latino female bisexual). The question is how people will evaluate the protagonist’s socially positive or negative behavior – and how this evaluation will be influenced by the presence of these identity markers.  

This will involve both between group and within group samples of incoming freshmen and senior CofC students. For the MAYs grant specifically, we are asking for the funds to bring the seniors into the lab in the fall and spring. While we will be able to gain access to freshmen during the fall semester through the PSYC103 research pool, we will also need funds to follow up with them in the spring. We hope to be able to track the positive mitigating effects of being exposed to multicultural programming and diverse groups of people on campus both within participants (from fall to spring) and between groups (between freshmen and seniors). To this end, we will ask all participants to identify any/all curricular (e.g. taking classes in WGST or other disciplines that discuss these issues) and co-curricular activities (such as meetings conducted by GSEC, PRISM, other campus groups) and they had been exposed to and/or participated in since arriving at CofC.
Long-term consequences of flashbulb memories

Receiving a significant medical diagnosis (e.g., Alzheimer’s, autism) is often difficult, but the nature and intensity of the experience may vary depending upon the information provided at the time of diagnosis and the disposition of the diagnosing physician. For some, a medical diagnosis experience may create a negative flashbulb memory (FBM), or a memory that is highly salient, emotional, and unpleasant. Evidence suggests that FBMs for public events (e.g., Boston Marathon bombing) can affect behavior months, even years later. Our study seeks to extend these findings by examining the long-term consequences of personal FBMs for a medical diagnosis, here the diagnosis of Down syndrome. In a recent study, the experience of receiving a diagnosis of Down syndrome was a highly negative event for some mothers, while for others the experience was neutral or even positive. The mothers’ perception of the experience was dependent on the disposition of the medical professional and the information provided. In our study, we will contact those same mothers, and compare several different long-term outcomes for those mothers whose diagnosis experience was negative relative to those mothers whose experience was neutral or positive. Measures will include relationships with family and friends, likelihood of seeking intervention and support, and education and employment outcomes for the individuals with Down syndrome. Our findings will advance our understanding of the ways in which FBMs influence our behaviors, and will offer important considerations for medical specialists who provide diagnoses for Down syndrome and other significant medical issues.

Polyester Plate Lithography: A Suite of Portraits

Polyester plate lithography began twenty years ago as a low cost professional form of commercial lithography, in which multiple copies of an image are produced but contemporary fine art printmakers have adopted it in their work. It requires no toxic chemicals to create images. This type of printmaking is relatively new, only having been invented in the 1990s. The last standard printmaking innovation occurred in 1798 when lithography was invented. To use this process, the artist draws directly on the plate with a waterproof drawing media. The plate is then heated to set the image. When the plate is ready to print and ink is rolled out, the plate is attached to the printing press with an adhesive. To print, ink is rolled onto the plate, and the plate is wiped with a solution of PH of 4.5-5.5 until it comes up in full. Then, the image can be printed by hand on a traditional lithographic press (located in the printmaking studio at the College). The goal is, that by doing this, we can produce more images, with non-toxic chemicals, and at a lower cost, because a traditional lithographic print done on an aluminum plate costs anywhere from $100- $300. Polyester plates are less expensive, but funds are still needed for inks, paper, and processing materials. Upon completion of this project, I will have recorded detailed instructions on how to process polyester plates, as well as full documentation. I will also document the prints digitally, as well as recording the process, and submit these with my final report.
**Monachopsis: a Graphic Novel**

George F. Roberts invented the process of polyester plate lithography twenty years ago and, since then, it is used as a safer method of lithography. It was originally used for commercial printing, to create large amounts of copies of an image. But because of the lack of chemicals required, it is becoming more common among fine artists. It is still relatively new, only having been invented in the 1990s, but offers possibilities for printing that traditional lithography does not. To use this process, the image needs to be drawn on the polyester plate with a waterproof utensil. For my graphic novel, I will be drawing the pages on paper, scanning them, then printing them onto polyester plates with a laser printer. Inkjet printers (which do not use toner) cannot be used for this, since toner is not used. The plate, which is as thin as a thick paper, then needs to be heated to set the image for printing. When ready to print, the plate will be attached to the lithographic printing press (located in the CofC print studio) with an adhesive and ink is rolled out. Ink is then rolled onto the plate, and the plate is then wiped with a pH solution between 4.5 and 5.5. This process is continued until the ink sticks to the entire image on the plate. The paper is laid on the plate, and the plate passed through the litho press, resulting in a printed image. The process is then repeated until the desired number of prints are made. I plan to complete ten pages with at least ten copies of each page.

**Digitizing the Design Process (mobile version)**

The 21st century has introduced us to the future of communication for theatrical design with the advent of tools like the interactive pen display, digital drawing tablets and color matching products. These tools enable designers to create works of art faster and with more precision than ever before. The tablets and interactive pen display can be used with web applications like Real Time Board, which allows two people to draw and paint on the same file at the same time. Creating works digitally allows artists to collaborate in real time while miles away from each other. No longer will stage designers and directors leave a phone conversation with two separate interpretations of the discussion. Meetings can now take place in real time while viewing actual sketches and research provided by the designer. Works can be seen, commented on, and revised immediately. As this technology and these methods gain speed in the industry a designer’s proximity to a particular theatre company will become less of a deciding factor. Students who are familiar with these types of technologies, can successfully match color across platforms, and are able to communicate well from afar, will be more employable in a wider range of venues, regardless of where they reside.
Recovering from Trauma: Reclaiming Spaces of State-Sponsored Terror in Argentina

During Argentina’s so-called Dirty War (1976-83), an estimated 30,000 people were kidnapped, tortured and murdered by their own government. When democracy was restored, the new government pardoned former torturers and attempted to silence and suppress survivors’ narratives, leaving many Argentines stuck in a continued state of confusion and fear (Feitlowicz 2011). More recently, human rights groups have reclaimed the spaces in which torture occurred and transformed them into “spaces of memory” where they can construct narratives that make visible the crimes committed by the regime and humanize its victims. These public narratives, created through expropriating and refashioning former detention centers as parks, cultural centers, and museums, facilitate a shift in the significance of these events in national narratives. Through ethnographic interview and photography (Collier and Collier 1986), and methods of analyzing spaces as symbolic systems (Lefebvre 2009, Dwyer and Alderman 2008) Hannah will explores how “spaces of memory” serve to shift the Dirty War from its function as a collective trauma, which impairs sense of community (Alexander 2010), to a cultural trauma, which is defined by the population as having undermined their cultural identity as a whole (Smelser 2010). In other words, Hannah will explore the ways that human rights groups use spaces of memory to make sense of a national identity that was threatened by state-sponsored terrorism, and create new counter-narratives where the nation-state takes a more robustly skeptical view of its own capacity to use violence legitimately.

Characterizing Spatial Distributions of Two Nuclear Transport Proteins in Early Embryogenesis

The Byrum lab studies transport of molecules between the nucleus and cytoplasm of a cell. Using the sea urchin as a model organism, we track the time and location of gene transcripts (mRNA molecules) that encode for karyopherins by staining embryos using a technique called wholemount in situ hybridization (WMISH). Karyopherins are nuclear transport proteins that move cargo into or out of the cell and are named accordingly: importins are used for import, exportins for export, and transportins participate both in import and export. Just as students graduate from high school with a general set of skills and then gain more specialized skills as they start jobs, cells re initially unspecialized and later exhibit more specialized features as they differentiate. Karyopherins may help facilitate this process by shuttling molecules needed for differentiation to and from the nucleus. Both sea urchins and humans produce similar karyopherins, so we hope that by examining when and where karyopherins are used in the sea urchin, we will gain a better understanding of their roles in sea urchin and, possibly, human development. This project focuses on two importins, IPO7/8 and IPO9, as a part of the lab’s continuing effort to map the spatial and temporal distributions of all sea urchin karyopherins. Based on expression patterns of these genes in other species, we hypothesize that IPO7/8 and/or IPO9 may influence formation of nerves by regulating transport of factors needed for their development. This project is a critical step in our initial efforts to address this hypothesis.
Evaluating Knowledge Co-Production in the Salmon Peoples of Arctic Rivers

The aim of this project is to develop the design of an Arctic salmon ecosystem assessment based upon the Traditional Ecological Knowledges (TEK) or Indigenous Knowledges (IK) of Arctic peoples. This fisheries assessment, called Salmon Peoples of Arctic Rivers, is an official part of the work plan for the Conservation of Arctic Flora and Fauna (CAFF), a working group of the Arctic Council, an intergovernmental forum dedicated to negotiating environmental issues that affect the region. Dr. Watson is the lead researcher on this project due to her experience in facilitating communication between scientists and tribal communities. The indigenous peoples in the Arctic not only form a network of observers to future changes in the environment; the specific practices and techniques used in these communities can offer other societies a path forward for sustainable environmental management. The collaborative work between student and faculty for this project will be to produce the first draft report of the scoping workshop for the assessment, and develop measures (such as via survey) to understand the efficacy of that scoping workshop. The student-faculty team will attend the February CAFF meeting in Finland to incorporate the country reviews of the draft report, before preparing the final report for the ministerial meeting of the Arctic Council in May.

The Effect of Fetal Exposure of DOSS to the Mouse Guy Microbiome

Metabolic diseases such as obesity have come under scrutiny as an ever-increasing number of individuals are affected worldwide. There is no clear cause for this increase, although it has been linked to a number of factors, including the human microbiome. The human microbiome consists of the combination of microorganisms that live on or inside our bodies. Under healthy conditions, these microbes live symbiotically with their host, and until recently were not considered to play a significant role in overall health. However, an increasing numbers of studies have shown that an altered microbiome can be linked to pathological conditions, including metabolic afflictions. In this project, we will be building off the work of Dr. Spyropoulos. The Spyropoulos lab has demonstrated that the commonly used stool softener DOSS is an obesogen, a chemical that causes weight gain. When DOSS was fed to pregnant mice, the offspring developed obesity themselves, even though they were fed the same diet as untreated lean mice. We intend to look at the differences in the microbiomes between the two groups of mice and see if there is a significant difference in their composition. To do this we will sequence the microbiome of the fecal pellets of both the treated and control groups of mice to create a collection of common microbiomes for each group. These collections will then be compared to find if they are significantly different in composition, or if there are trends in variation between certain groups. This project will pave the way to finding out whether we can reduce obesity rates through product monitoring and microbiome interventions.
**A New Source of Mercury from the Dark? A Compilation of Mercury Contents from the Ocean Floor**

The bottom of the ocean hosts minerals that may contain high levels of toxic elements such as mercury (Hg). These minerals, which contain manganese oxides (Mn-oxides), form in areas of the ocean floor that contain oxygen. As the planet’s temperature increases, there is a rapid and until recently underappreciated side effect which results in the oceans losing oxygen, because warmer water contains less oxygen than colder water. Another side effect of our warming ocean is that ocean currents are also slowing down slightly, which results in ocean water to lose its oxygen because of increased respiration. As these parcels of water with little to no oxygen move across the seafloor in regions that contain Mn-oxides, the Mn-oxides will dissolve. When Mn-oxides dissolve, they will release Hg and many other elements to the overlying waters, which will then be transported globally through ocean currents. Mercury is easily and rapidly accumulated in marine organisms such as algae, fish, and shellfish, and can therefore negatively impact these communities. The bioaccumulation and biomagnification of Hg within the marine food chain may also pose a threat to humans who consume fish and shellfish with high levels of mercury. This study aims to quantify the global amount of mercury in Mn-oxides to constrain how much Hg could be released as oceans get warmer and oxygen levels decrease. We expect to observe a large range of Hg concentrations in different regions of the world’s oceans, but the global amount of Hg is expected to be tremendous.

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**Fishes with Baggy Skins: Comparative Morphology and Material Properties**

Hagfishes and moray eels are two distinct groups of fishes capable of tying their bodies into knots, which are useful behaviors for capturing prey. Knotting is virtually nonexistent in fishes and only appears to be undertaken by hagfishes and morays. Both fishes possess unusually baggy skins that enhance flexibility of the body. Hagfishes also benefit from lacking a backbone and having complex arrangements of swimming muscles. It is unclear if moray eels possess additional adaptations for knotting like hagfishes do. To address this question, I propose to study how the skins of the moray eel respond to mechanical tension and the anatomical structure of their skins and whole bodies. I will compare these data with similar data gathered from hagfish skins and American eel skins. The American eel represents the control in the experiments because, like most species of cartilaginous and bony fishes, it is a species of fish with tightfitting skin covering a relatively simple arrangement of swimming muscles limit flexibility. We predict that the skins of knot-tying species, the moray and hagfish, will be thicker, stretchier, but tend to recover less strain energy from non-destructive stresses. I aim to use a combination of cutting-edge methods like biaxial tensile testing, 3D anatomical reconstruction, and rapid prototyping, coupled with traditional methods like anatomical dissection and X-ray imaging.
Short Time Series Graph Judgement
A common tradition in single subject design research is to evaluate the effectiveness of treatments solely by plotting out time series data on a graph, and making a judgement of effectiveness based on that graph. Sometimes the treatment effect is large and very obvious, and in those situations, this technique is accurate. However, when the treatment effect is smaller, humans tend to struggle on these judgments. Visual inspection of graphs is a highly disputed topic because of its subjective nature. Professionals in support of visual analysis state that although errors may happen, the errors tend to be conservative ones. That is, researchers might incorrectly conclude that there is not an effect when there is one (Type II Error). However, empirical studies looking at precisely this issue have shown that the opposite kind of error is very common. That is, researchers often incorrectly conclude that there is an effect when there is not one (Type I Error). Therefore, visual graph judgment is relatively risky. There has been wide dispute among researchers about the various experiments investigating visual judgement. We propose a set of studies that isolate visual judgement, and at the same time satisfy contemporary researchers' concerns that are not yet addressed in the published literature. This is important because if visual inspection is not a valid method it should be replaced more reliable ones.

Proteins Important for Heme A Biosynthesis
Mitochondria are responsible for the production and storage of chemical energy through the action of the electron transport chain (ETC). Assembly and function of the ETC relies on a complex variety of proteins and cofactors to run smoothly, and errors can result in a myriad of disorders and diseases. To better understand the intricate assembly and function of the ETC, we investigate the interactions between some of these vital proteins with unknown or unclear functions. This project focuses on the information gleaned from discovering new interactions between proteins and further experiments to link those interactions to each protein's unique function. The goal is to gain insight into the processes of ETC assembly so that illnesses caused by its malfunction can be better understood and treated.
The Behavioral Effects of Antidepressants on Southern Toad Tadpoles
Pharmaceuticals frequently enter the environment through our waste water systems. Once in the environment, these compounds can be transformed into related compounds (phototransformation products) through various methods like UV exposure from sunlight. This pharmaceutical pollution may pose a threat to the environment as the effects of these compounds on aquatic life are not well-tested. Various antidepressants, including sertraline (brand-named Zoloft), have been shown to cause a variety of behavioral changes in organisms ranging from molluscs to fish to tadpoles. Amphibian larvae are vulnerable to aquatic pollution due to their permeable skin. In this study, the effects of sertraline and its phototransformation product on tadpole behavior were examined. Observed behaviors include startle response, aggregation behavior, and refuge use, which are all important for avoiding predators. The results from this experiment will help us understand the level of threat that pharmaceuticals like sertraline pose to the aquatic environment.

Long-term Light Curves of Classical Novae
Novae are eruptions that occur on the surface of a white dwarf that has taken gas such as hydrogen or helium from a larger companion star. The gas continues to build on the surface until the pressure causes hydrogen to fuse together, causing an eruption similar to a hydrogen bomb. Many astronomers observe novae during their eruptions, but few are curious as to what happens after the eruption. Not much is known about novae post-eruption due to this fact. I am working on observing and analyzing over a century's worth of data on multiple different novae. I currently have two full light curves for two different novae and have partial light curves for about five other novae. Completing the partial light curves will be the central focus of my fall research and are almost guaranteed to be finished by the conference in the fall, barring any unforeseen circumstances.

Are Moray Eel Skins like Hagfish Skins?
Body knot tying is rarely observed, even in elongate animals like hagfishes and moray eels. Most fishes have skin that is twice as stiff in the hoop axis than the longitudinal axis. Alternatively, hagfish skin is equally to twice as stiff in the longitudinal axis, depending on the species. It has been proposed that skin with increased flexibility in the hoop axis is better for tying and manipulating body knots. This study used quasi-static uniaxial tensile tests, gross morphology, and histology to examine purple mouth moray eel skin. For comparison, additional tensile and morphological data sets were gathered from American eels and Asian swamp eels. Moray eel skin was observed to behave more like hagfish skin, being equally as stiff in the longitudinal axis as the hoop axis. The stiffness in the longitudinal axis supports the proposal that skin with increased compliance in the hoop axis facilitates body knot tying.
Independent Component Analysis of Tidal Creeks in South Carolina
We aim to model the hydrological processes of Huger Creek, a tidal forested freshwater wetland system in the Cooper River Basin, by separating the water level pattern in individual behavior components. We have used Independent Component Analysis (ICA) on a collection of fourteen stream gauge and piezometer data sources during a period in October with no precipitation. The ICA has extracted three independent signals contributing to the behavior of Huger Creek. We propose that these signals correspond to the tidal wave from downstream originating in Charleston harbor; an evapotranspiration signal reflecting evaporation and transpiration by vegetation in the forest; and a ‘noise’ signal which combines less prominent processes in the water system. We will show example results of the deconvolution of these processes. Results suggest that ICA is a promising technique for extracting signals from hydrological data.

Geochemical Niche Partitioning and Biogeography of Marine Iron-Oxidizing Bacteria
Communities adapted to extreme environments help define the limits of survival and the elementary requirements of life. Hydrothermal vents are rare, ancient ecosystems that have served as models of early Earth. Diverse lifeforms can survive at the bottom of the ocean, in part due to bacteria, which form thick biofilms called microbial mats. At hydrothermal vents bacteria cycle essential macronutrients and they are the primary producers. Zetaproteobacteria are iron-cycling bacteria that are considered keystone species in these ecosystems. We compared communities at two different sites to discover patterns governing microbial ecology in hydrothermal vents, determine which site promotes greater microbial diversity, and determine community overlap between the two sites. Our analysis hinted at a complex relationship between genetic variation and geography. It further provided some indication for differential niche partitioning. This study contributes to growing evidence for a relationship between microbial taxa and geochemistry.

Development of novel prodrugs for use in bio based drug delivery systems
Polyurethane materials can be found in a variety of day to day items ranging from paint coatings to insulation foams. More recently, polyurethanes are being utilized as drug delivery systems. By incorporating a drug during the polymerization reaction, a material is formed with the desired drug incorporated into the polymer backbone. Under physiological conditions this material allows for slow release of the active drug. Previous work has successfully produced drug delivery polyurethanes using a list of drugs: Nalidixic acid, trimethoxy cinnamic acid (TMCA), alpha methyl cinnamic acid (AMCA), ibuprofen, and naproxen. In this study a Nalidixic acid, a drug used to treat urinary tract infections, was used along with a soy based polyol and a variety of diisocyanates. The objective of this study was to successfully synthesize pro-drugs, incorporate them into the polymer backbone, and determine the effects different diisocyanates have on the release of the drug.
**Rotation of the Yucatan 230 -170 Ma**
The Gulf of Mexico is an important economic resource in the United States. Because many of its resources form due to past geologic conditions, there has been much research into its tectonic evolution. The Yucatan peninsula is a small tectonic plate, and 250 million years ago, it was in the present-day Gulf of Mexico. There is little evidence of its exact location at that time, or how it moved when it rotated to its present location. Our research considers the previously ignored physical markers left behind after episodes of stretching that opened the Gulf itself. Because basins record the dominant forces at the time, we can use them to track the movement of the Yucatan. We created a map of these basins to show the dominant forces at different times. From this, we can describe the motion of the Yucatan.

**Lewis Base Activation of Benzylboronic Acid Pinacol Ester for Nucleophilic Addition**
In modern medicine, 20% of commercially available pharmaceutical drugs contain at least one fluorine atom. Drugs are typically large molecules that are hard to make, often requiring numerous small molecules that combine together over multiple steps. One of the main goals of drug synthesis is finding faster and more efficient ways to make molecules. The research presented here shows a carbon-carbon bond forming reaction on a fluorine containing molecule. This reaction is efficient and provides a new method to create molecules that are potentially pharmaceutically relevant.

**ATPase Afg1 helps maintain protein homeostasis in the mitochondrial matrix**
Mitochondria are cellular organelles that perform many important roles for the cell. One of their most important roles is the production of energy, which is used to fuel diverse cellular processes necessary for life. In order for mitochondria to function, they must utilize an intricate set of protein complexes known as the electron transport chain (ETC). Although much is known about the ETC, there are various proteins involved in ETC assembly and maintenance whose functions remain unknown. Any defect in these proteins could potentially lead to ETC failure and, ultimately, the death of the cell. By discerning the functions of these unstudied proteins, we hope to provide valuable insight into creating treatments and cures for mitochondrial diseases in humans.
**Long Term Light Curves of Classical Novae**

A nova is a sudden increase in brightness of a binary star system caused by runaway thermal nuclear reactions on the surface of one of the stars. My research project was to build century-long light curves for post-nova systems to study how their brightness’s change. By understanding the long-term trends in brightness of these systems, we can learn more about the evolution of these systems over their lifetimes. The current theory predicts that the brightness to decline in the time period we are observing for but so far, our results have been mixed and do not cleanly follow what is expected.

**Bilayer Interactions of the Endogenous Opioids**

The endogenous opioids are a class of signaling molecules found in the human brain. These neuropeptides play roles in many neurological processes most notably the mitigation and sensation of pain. As the human brain contains water-rich regions as well as fatty, lipid bilayers around its cells, we seek to determine and compare the shape of these molecules in both environments, since biological function depends upon molecular shape. Interestingly, an identical sequence of amino acid building blocks is conserved at one end region of all the endogenous opioids. We are comparing the shape of these conserved portions in several opioid peptides with different overall sequences; we suspect that the structure of these molecules is different, even in regions where they share identical composition. Our study is therefore a comparative structural analysis of the enkephalin, adrenorphin, and α-neoendorphin members of the opioid family, which we hope will inform future drug design efforts.

**Structural and Biophysical Characterization of Human Neuropeptide Galanin**

Neuropeptides are proteins that act as signaling molecules in the brain and help control normal bodily functions. Galanin is a neuropeptide implicated in the control of mood, seizures, and the perception of pain, and has potential medicinal use. However, a high-resolution 3D structure of galanin is needed for drug development. The first half, or N-terminus, of galanin is particularly important for binding its receptor in the body. This study uses Nuclear Magnetic Resonance Spectroscopy to measure distances between hydrogen atoms in fragments of galanin’s N-terminus. The distances are then used to generate 3D structures of these fragments. In comparing these structures, we observed a potential representation of what structural pieces are needed to bind the galanin receptor. In addition, the other half of galanin was shown to be relatively unstructured, leading to the hypothesis that this half plays a secondary or indirect role in galanin’s function in the body.
**Sulfidation of Silver Nanoparticles by Metal Sulfides**
Silver nanoparticles are among the most common nanoparticles in consumer products, raising concerns about the environmental implications of their widespread use because of silver's toxicity. Reactions of silver nanoparticles with sulfide result in the formation of a stable product that may diminish silver toxicity in natural waters. We investigated the reactions of zinc sulfide and cadmium sulfide with silver nanoparticles to assess the potential of these compounds to act as a source of sulfide capable of reacting with silver nanoparticles. Our measurement technique allows for rapid data collection and experiments at low, environmentally relevant concentrations. We studied the reaction of different sizes of silver nanoparticles with zinc and cadmium sulfide. Reaction of smaller silver nanoparticles occurred faster and more completely due to their larger relative surface areas. Sulfidation occurred more rapidly at higher pH and pH played a larger part in controlling the reaction rate than the metal sulfide type.

**Binding and crystallography studies of 4-methoxy-tetrahydrobiopterin bound to endothelial nitric oxide synthase heme domain in the presence of the intermediate substrate N-hydroxy-L-arginine**
Nitric oxide (NO) is exclusively made in the body by the enzyme nitric oxide synthase (NOS). There are several forms of NOS depending on where they are located in the body. Endothelial NOS (eNOS) is responsible for producing NO in endothelial cells for overall cardiovascular health including vasodilation and angiogenesis. The reaction catalyzed by eNOS converts the amino acid L-arginine into L-citrulline and NO. This reaction is dependent upon the cofactor 5,6,7,8-(R)-tetrahydrobiopterin (BH4) delivering one electron during catalysis. Herein, we have investigated by UV-Vis spectroscopy and crystallography the binding of BH4 to eNOS(HD) by using an analog, 4-methoxy-BH4. Binding studies were done in the presence of the substrate, L-arginine, as well as the intermediate substrate, N-hydroxy-L-Arginine, to better understand how BH4 facilitates this essential electron delivery.

**Chemical Interactions with Crumb Rubber**
Tire material is dispersed in the environment through road-wear or at end-of-life as crumb rubber (CR) in reuse applications. This material can carry potentially toxic chemicals. Measuring the abundance and behavior of CR is important for understanding potential environmental impact. This work i) applied different strengths of hydrogen peroxide to CR to assess compatibility with digestion used to clean samples for CR detection by microscopy, and ii) determined attraction to CR of a class of common, toxic pollutants in water. Results showed an increase in CR particle count related to hydrogen peroxide strength. The interactions measured between CR and chemicals showed strong attraction to CR, and it was found that these toxic chemicals were also present in CR. Together, these results imply issues with CR detection using common methods, and that further research is needed to improve monitoring methods and to assess the impact of associated chemicals to ecosystems.
Photocatalysis Approaches to Polyphenol Synthesis

Plant polyphenols are naturally occurring molecules found in teas (e.g. tannins) that have a plethora of biomedical applications. Polyphenols present a challenge to chemical synthesis because of their complex structures, which make their chemical reactions difficult to control using traditional methods. We are using photocatalysis, which uses visible light as a chemical reagent as a way to form bonds between atoms with a high degree of control. Our initial results revealed that compounds related to polyphenols have reactive states that interfere with our original synthetic strategies. However, they have allowed us to make use of a specific kind of photochemistry with visible light that had only previously been used with elaborate apparatus, making such methods very hard to use. We are currently exploring such “photoacid” reactions as a means of synthesizing polyphenols, and using model reactions to test whether this strategy, which would be new to organic chemistry, is feasible.

Microwave, Infrared Spectra, Structural Parameters, Ab Initio Calculations and Vibrational Assignment of 1,1-difluoro-1-silacyclopent-2-ene

Our laboratory has been involved in a research program investigating the structural preferences of cyclic organic compounds incorporating silicon atoms. Presently, we are researching silicon atoms in the unsaturated asymmetric five-membered rings. Five-membered rings composed only of carbon, nitrogen, and oxygen, have been fully studied from the aspects of biological activity and structure, previously. However, unsaturated five-membered rings incorporating silicon have never been experimentally investigated, due to difficulties inherent in their synthesis. Our knowledge of the synthetic routes, routine instrumental analyses and theoretical calculations for these compounds will help us to successfully explore the synthesis and characterization of these compounds. Additionally, our collaborations with laboratories at the University of Virginia, Missouri Kansas-City, and Eastern Illinois for specialized instrumentation has helped in interpreting the structure of these molecules. Finally, these prepared compounds may lead to collaborations with biology faculty at the College to investigate the bioactivity of these unique compounds.

Oxidation of Organic Compounds as a Model of Interactions between Silver Nanoparticles and Natural Organic Material

Silver nanoparticles are commonly used in consumer products, but concerns have been raised about their impact in the aquatic environment. Of all the potential effects, the interactions between silver nanoparticles and natural organic material (NOM) is largely unknown. Because true NOM is so complex, this study takes a “small molecule” approach to understand the functionalities of NOM that are likely to interact with silver nanoparticles. Our approach involves exposing organic compounds over time with silver nanoparticles and,
following removal of the nanoparticles, the composition of the remaining solution is analyzed. The results showed that silver nanoparticles had no effect on some compounds (phenol and aniline), but they catalyzed the oxidation of others (aminophenols). This decomposition only occurred in the presence of dissolved oxygen while light had no effect. Our future work seeks to identify degradants and study additional compounds to better understand interactions between nanoparticles and NOM in aquatic environments.

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Mentor: Dr. Frederick Heldrich
Department: Chemistry

Metal-catalyzed coupling between aryl bromides and di-substituted alkyl bromides in the synthesis of bis-para-anisyl alkanes

For this project, we wanted to run experiments using the Lipschutz and Wiex methods to test whether they could be used to create a series of desired compounds called bis-para-anisyl alkanes. It’s something that has been done before but these methods on paper should have provided a more efficient means of doing so. Although this experiment is only step one in a bigger project, these compounds could then be used in future experiments to create compounds that model compounds that are used as antibiotics and antiviral drugs. Our work could potentially contribute to finding the most efficient way to create these model compounds, and in doing so, help us understand why the biologically active compounds they model are so difficult to make in a lab setting. The work presented will be the current progress for creating the first series of compounds.

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Mentor: Dr. Katherine Mullaugh
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Influence of Ligands and pH on the Dissolution of Zinc Oxide Nanoparticles

The recent use of metal-containing engineered nanomaterials in consumer products has generated concern regarding their impact on the aquatic environment. Zinc oxide nanoparticles (ZnO NP), found in products such as sunscreen and textiles, may be leached into the surrounding environment. ZnO NPs have the potential to undergo dissolution, releasing zinc ions that are toxic to some organisms. To investigate how water chemistry can influence ZnO NP dissolution, an electrochemical technique was used to study the dissolution in various conditions. The dissolution of ZnO NPs was significantly faster and more complete in neutral conditions (pH = 7.0) compared to those that were slightly basic (pH = 7.9). It was also evident that molecules capable of binding zinc ions further enhanced the dissolution of ZnO NPs. These laboratory studies provide valuable insight into how conditions in the aquatic environment are important to consider when assessing the environmental impact of metal-containing nanomaterials.
**Reactivity of Homologous Sulfohydrolases**

We are studying a class of related enzymes found in a wide variety of organisms that have an unknown role in biology. One of these enzymes, called SdsA1, is found in a pathogenic bacterium. This enzyme breaks chemical bonds in the man-made detergent sodium dodecyl sulfate (SDS), which is found in shampoo. Since enzymes very similar to SdsA1 are found in organisms as diverse as cucumbers and antelope (which do not interact with shampoo), it is very likely that the true role of these enzymes is to break bonds within a different molecule than SDS. By examining SdsA1 and two other similar enzymes found in different organisms, we are defining the types of molecules they are capable of reacting with and attempting to determine the biological roles of these enzymes.

**Numerical Simulations of Black Hole Accretion Disk Precession**

Most black holes are believed to have a disk of gas and dust circling around them called an accretion disk. Material from this disk can fall towards the black hole and some is propelled away from the black hole by magnetic fields in “jets.” An interesting situation occurs when this disk is tilted with respect to the black hole, as the spin of the black hole can cause the disk to precess like a top. Using the computational code, Cosmos++, we ran three-dimensional simulations of a tilted accretion disks. We used a unique grid, called the cubed-sphere grid, which is more efficient for this problem than the standardly used grids. Our goal is to discover if the jets in our simulations precess with the disk or align with the black hole.

**A Reanalysis of Amphibian Response to Prescribed Fire Using a Multi-scale Approach**

Longleaf pine forests are biodiversity hotspots. Most of these habitats are managed with prescribed fire to restore longleaf pine plant communities. Little is known about how time since burn affects amphibians, which can be very sensitive to changes in their environment. An important study in the Francis Marion National Forest indicated that longer burn intervals would benefit amphibian species. We reanalyzed the data from this study using a new multi-scale approach that can unpack the components of biodiversity change. Our reanalysis indicates that time since fire is a poor correlate to amphibian biodiversity. We found an overall weak positive correlation between numbers of species and time since fire, but this relationship was only apparent at the coarsest spatial and temporal scale. Pond water chemistry was a better predictor of biodiversity than fire. Our results indicate that amphibian communities are relatively robust to variation in prescribed fire.
On and Off the Moral Path: Child Psychology and the Golden Age of Children's Literature

Prior to the late nineteenth century, children’s book writers often constrained child protagonists to pre-determined paths, limiting their chances for independent exploration. Alternative texts emerged during the Golden Age of children’s literature (1850 to 1920) involving dangerous journeys into unfamiliar worlds. Authors of these stories offered little to no guidance, forcing their child protagonists to navigate amoral realms using only their own judgements. Child psychology emerged as a discipline during this same period. Like their literary counterparts, psychologists like James Sully investigated children’s “mental whereabouts” as they traversed an unfamiliar adult world. This paper examines the relationships between child protagonists and the “off-road” settings in which they are placed - gardens, woods, and supernatural lands - to explore questions of child agency and moral development in the Victorian Era. By analyzing fictional and psychological texts together, this essay explores the ways in which Victorian maps of childhood overlap and crucially differ.

Quaternion-valued solutions to the Korteweg-deVries Equation

As part of a summer research project, we studied quaternion-valued solutions to one of the most famous and important wave equations in mathematical physics. The particular solution types that we studied (rational solutions, breather soliton solutions and periodic solutions) seem never to have been studied for this system before. The main results we found were (a) a theorem that identifies when the simple soliton and periodic solutions are singular and when they are nonsingular (b) a formula for the phase shift in the interaction of the 2-soliton interaction and (c) a characterization of a minimal collection of polynomials from which it is possible to produce all known rational solutions.

Study of Tap Dance Choreography

The piece I am choreographing is a tap solo. This solo explores the decision making process and the tendency of humans to make certain decisions over others. I plan to include my dancers (performer and understudy) in the creative process by sitting down together and discussing some tough decisions we have had to make across the course of our independent lives. We will then translate these excerpts into choreography by creating a movement vocabulary based on our individual steps in our decision making processes. In preparation for ACDA, I will hold two rehearsals each week that last two hours with the dancers, in addition to a minimum of three hours a week independently choreographing. This process will begin mid-November and continue until the conference. In rehearsals, I plan to engage and challenge dancers to explore the boundaries of tap choreography and create a technically and artistically strong performance.
Scenic design for "Marisol"
The presentation of this project includes a complete scenic design package for the play Marisol, a chronicle of a young Puerto Rican woman living in New York City who, when left to her own devices, comes to realize that her tidy world is not as it seems. This presentation includes image research, preliminary inspiration sketches, a complete package of scenic drafting, a painted model in ½" scale, production photos, and a design statement. The design for this show is derived from research completed by the student, and through a collaborative effort with the rest of the production team, which includes students and a guest director. The presentation of this work at the Southeastern Theatre Conference will allow the student the opportunity to not only share her designs with a greater community of theatre practitioners, but also receive critical feedback that will aid her in future designs.

A Study of Modern Dance Choreography
The piece I am choreographing is a modern dance duet. The duet explores the two hemispheres of the brain and their influence on each other. One dancer will represent the right brain by using rhythmic and imaginative movement; the choreography will stem from intuitive thinking. The second dancer will represent the left-brain using linear patterns and sequences; the choreography will be calculated movement. I plan on collaborating with my chosen dancers (performers and understudies) to represent their individualistic styles in this piece to present a raw, organic experience for the audience. In preparation for ACDA, I will be holding two rehearsals each week that will be two hours in length. Since this is a collaborative piece I will also be meeting with each dancer individually to fully represent their individual movement style. This choreographic process will begin in mid-November and continue until the ACDA conference in March. I am very excited to complete this piece because of its interdisciplinary exploration and representation of the hemispheres of the brain, their impact on thought, and connection to dance.

Attitudes, but not Knowledge, about Climate Change Influence Sea-Level Rise Maps
Attitudes toward and knowledge of climate change were examined as possible predictors of perceived impact of sea-level rise to humans, land, and infrastructure. A sample of 125 college students viewed animate maps depicting sea-level rise for 15 coastal cities and rated the amount of change in sea-level, the perceived impact to humans, land, and infrastructure, and their familiarity of each city. Participants also completed a survey measuring their climate change attitudes and knowledge of climate change. Analyses revealed attitudes toward climate change, but not climate change knowledge, significantly predicted one’s reported impact of sea-level rise to humans, land, and infrastructure. These results suggest that attitudes about climate change may increase awareness of climate change impacts more than knowledge of climate change.
Quaternion-valued solutions to the Korteweg-deVries Equation
As part of a summer research project, we studied quaternion-valued solutions to one of the most famous and important wave equations in mathematical physics. The particular solution types that we studied (rational solutions, breather soliton solutions and periodic solutions) seem never to have been studied for this system before. The main results we found were (a) a theorem that identifies when the simple soliton and periodic solutions are singular and when they are nonsingular (b) a formula for the phase shift in the interaction of the 2-soliton interaction and (c) a characterization of a minimal collection of polynomials from which it is possible to produce all known rational solutions.

Identification and Quantification of Degradant Products Present in Amoxicillin Capsules and Sertraline Stored Aboard the International Space Station
This study investigated sertraline tablets, an anti-depressant, and amoxicillin capsules, an antibiotic, that were stored aboard the International Space Station (ISS). These tablets were compared to tablets of the same drugs that were stored on Earth. All samples were analyzed using a Liquid Chromatography-Mass Spectrometer (LC-MS) machine. This machine forces the samples through a narrow, hollow column, which separates different compounds in the tablet from each other based on differences in structure of molecules. After each compound exits the column, it enters the mass spectrometer, which detects compounds based upon the mass of the molecule. From this mass value, we can deduce the chemical formula of the compound. This allows us to identify medications as well as any potentially harmful degradants - compounds that are similar to the drug but do not have its intended effect. This research will determine whether these compounds form due to conditions on the ISS.

A Simulated Indirect ACL Injury Mechanism Increased Biomechanical Risk Factors Associated with a Ligament Dominance Landing Pattern
Limited research exists examining the indirect contact anterior cruciate ligament (ACL) injury mechanism, defined as a physical disturbance to the body not directed at the knee joint during or immediately before the injury event. Understanding how an indirect contact mechanism influences ACL injury risk is relevant to developing injury prevention programs. The objective of this research is to compare the differences in lower extremity landing patterns during a jump between a control group and simulated indirect contact ACL injury mechanism task. It was concluded that the indirect mechanism task increased potentially injurious risk factors. These data suggest individuals may too heavily rely on the ACL during landing following an indirect contact mechanism as compared to a control landing, therefore producing greater risk for ACL injury.
injury prevention programs should emphasize landing strategies that focus on increasing the use of muscles to reduce stress placed on ACL during landing.

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A Simulated Indirect ACL Injury Mechanism Increased Biomechanical Risk Factors Associated with a Ligament Dominance Landing Pattern

Understanding the mechanism of anterior cruciate ligament (ACL) injuries is essential to prevention and rehabilitation. This experiment intended to mimic an indirect contact mechanism (force not directed at the knee), creating unanticipated movement patterns. Females have 4-6 times greater incidence of ACL injuries than males. The purpose of this study was to compare how unexpected, lateral forces applied to the participant’s torso impact jump landing patterns in females. The hypothesis was that females would demonstrate landing patterns associated with quadriceps dominance, the preferential use of the quadriceps muscles over the hip muscles to stabilize the knee during landing. Joint angle and force values during the landing phase at the hip and knee were recorded. Results indicate that a simulated indirect contact ACL injury mechanism increased knee joint loading associated with a quadriceps dominance-landing pattern thereby potentially leading to increased ACL injury risk.