COLLEGE of CHARLESTON
UNDERGRADUATE RESEARCH AND CREATIVE ACTIVITIES

2018 SURF AWARD RECIPIENTS

The office of Undergraduate Research and Creative Activities is pleased to announce the Summer Undergraduate Research with Faculty (SURF) award recipients for summer 2018. Please join us in congratulating these students and their faculty mentors.

Summer Undergraduate Research with Faculty (SURF)

1. Student: Emily Anderson **Major: English**
Mentor: Dr. Tim Carens **Department: English**
Title: *Darkness in Wonderland: Child Psychology and the Golden Age of Children's Literature*

The "Golden Age" of British children's literature (1850 to 1920) witnessed the emergence of texts such as *Alice's Adventures in Wonderland, Peter Pan*, and many other forgotten or lesser-known narratives involving dangerous quests into unknown realms. Significantly, the publication of such texts coincided with emergence of developmental psychology as a discipline. Although literary critics have studied individual texts through psychological frameworks, work on a broader scale remains to be done. This project will advance scholarship in the field by treating the evolution of children's literature and the emergence of psychology as twin parts of a broad-based cultural phenomenon: a fundamental reappraisal of the child mind. Late-Victorian culture enacted this reappraisal by assuming that child readers would derive a benefit by vicariously exploring the "darkness in wonderland." This project will base its argument on a broad analysis of popular children's literature and psychological theory published 1850-1920. While literary criticism on this subject has for the most part focused on a handful of well-known stories, I aim to determine the extent to which the British public embraced the "darkness in wonderland" in myriad forms. I will spend the grant period identifying, discovering, reading, and interpreting as many relevant texts as I can find. This work will provide the basis for my Bachelor's Essay, during which I plan to present my research at one or more professional conferences and begin to develop an essay that will eventually be published in an academic journal.

2. Student: Jordan Bralley **Major: Biology**
Mentor: Dr. Allison Welch **Department: Biology**
Title: *Effects of sertraline pollution on tadpole behavior*

Pharmaceuticals frequently enter the environment through our waste water systems, which aren't designed to remove pharmacological compounds. Once in the environment, these compounds can be transformed into related compounds through various methods like UV

exposure. This pharmaceutical pollution may pose a threat to the environment as the effects of these compounds on aquatic life are not well-tested. Pharmaceuticals like antidepressants have cause for study because many of them are taken daily and pass through the body, exiting unchanged in human urine. The antidepressant sertraline (brand-named Zoloft) has been chosen for this study. Sertraline and other related antidepressants have been shown to cause a variety of behavioral changes in organisms ranging from molluscs to fish to tadpoles. With exposure to UV radiation from the sun, sertraline transforms into a related compound, norsertraline, the effects of which are even less understood than sertraline itself. 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 will be examined. Observed behaviors will include startle response, aggregation behavior, and refuge use, which are all important to the tadpole's survival by helping it avoid predators. When tadpoles are exposed to low levels of sertraline, it is predicted that they will experience changes to their behavior that may increase their vulnerability to predation. The results from this experiment will help us understand the level of threat that pharmaceuticals like sertraline pose to the aquatic environment.

3. Student: Katherine Bruce Major: Astrophysics
Mentor: Dr. Ashley Pagnotta Department: Physics and Astronomy
Title: *Long-Term Evolution of Classical Novae*

Novae are eruptions that occur on the surface of a white dwarf star that has stolen hydrogen gas from a companion star. The gas builds up in a layer on the surface of the white dwarf until the pressure at the base is so intense that the hydrogen atoms fuse together, creating a nuclear eruption similar to that which powers a hydrogen bomb. Astronomers are keen to observe novae during their eruptions but tend to move on to other objects when the eruption starts to fade. Because of this, little is known about the long-term behavior of novae, despite the fact that there are potential implications for topics such as our measurements of the expansion of the Universe. We propose to combine more than a century's worth of observations of novae to understand their long-term behavior. The Harvard Observatory has ~500,000 observations of the entire sky, dating from the late 1890s to the 1980s. The observations were recorded on glass plates that were exposed and developed in much the same way that camera film was. These plates are able to tell us about the behavior of our novae. We can combine our measurements from the archives with the modern telescopic survey that Dr. Pagnotta has been conducting to get the full picture of what our novae have done since their eruptions. This will allow us to test the main prediction of the current theory, which says that novae should steadily decrease in brightness in the decades following the eruption.

4. Student: Reagen Desilets Major: Geology
Mentor: Dr. Steven Jaume Department: Geology and Environmental Geosciences
Title: *The Subsurface Distribution of Geological Formations of the Charleston Peninsula, South Carolina*

Ever since the 1886 Charleston earthquake it has become apparent that there exists variation in the strength of ground shaking across the Charleston Peninsula. Thanks to advances in technology and the growth of the City of Charleston there is considerable information about the subsurface available that can help decipher why these variations in

earthquake ground shaking exist. This project will import the subsurface information into GIS maps and cross sections of the Charleston Peninsula to better understand these seismic risks.

5. Student: Mikayla Drost **Majors: Marine Biology and Geology**
Mentor: Dr. Allison Welch **Department: Biology**
Title: *Amphibian community composition along coastal salinity gradients*

Freshwater salinization is becoming a widespread issue for a variety of reasons including coastal storm surge and flooding, which are amplified by the effects of climate change. Since many amphibians rely on freshwater sources for reproduction and early development, changes in salinity can impact their life cycles and thus impact the overall community composition. While some species can tolerate higher salinities, sensitive species are vulnerable to even slight changes. Over several trips to four locations representative of coastal Charleston County, we will record salinity levels of a range of habitats and sample the amphibian species present in each. Through use of minnow traps and dip netting for larvae and juveniles, and call surveys for adults, we will identify the amphibian species composition across habitats that vary in salinity. We expect to find species with higher salinity tolerances present in more habitats across a range of salinity levels, while finding less salinity tolerant species to be comparatively rare across these areas. We also predict that habitats with higher salinities will be associated with simpler amphibian communities containing fewer species than habitats with lower salinity levels. By examining the relationship between site salinity and amphibian communities, we hope to assess the vulnerability of these populations and communities.

6. Student: Mary Scott Gilbert **Major: History**
Mentor: Dr. Julia Eichelberger **Department: English**
Title: *Eudora Welty-Frank Lyell Correspondence, 1931-1977*

Two undergraduate students will work with faculty mentor Dr. Julia Eichelberger over the course of a 10-week period during the summer in order to produce a manuscript of as-yet-unpublished letters between writer Eudora Welty and one of her close friends and correspondents, Frank Lyell. Familiarity with Welty's work will be required to accurately read, transcribe, and organize the letters, taking them from a loose collection to a curated manuscript which can be more easily accessed by scholars and interested readers. The letters, which were written and shared throughout the mid-20th century, contain previously unpublished information revealing not only facets of Welty's life, but also information about everyday life and events of the time. Personal anecdotes and casual conversation between friends proves to be invaluable information for scholars of Welty as well as fans of her work who simply wish to learn more about her life. The letters also present an important potential source for historians, who will be able to make use of these primary sources, contextual information and footnotes, all of which will be organized and produced over the summer.

7. Student: Samara Grimes **Major: Public Health**
Mentor: Dr. Brian Bossak **Department: Health and Human Performance**
Title: *Impact of the 1918 Spanish Flu on Charleston: A Centennial Retrospective Study*

The Spanish flu was a remarkable pandemic that brought death and despair to the 1918 world. The purpose of this study is to further explore the dynamics of this disease in the Charleston area. Statistics of the impact on Charleston have been documented, but there is little research on the transmission patterns and environmental associations. Data will be collected from a

historical account of Spanish Flu cases in Charleston documented by the health officer of the time, Dr. J. Mercier Green, to analyze these parameters. Case information such as date and location will be collected from this archive to map the outbreak in Charleston. This will lead to tracing the transmission of the disease and determining associations with environmental factors (such as temperature) through statistical analysis. The results will be compared to documentations of other cities during the spread of the pandemic. It is expected that this research project will successfully find transmission patterns and statistically significant environmental associations. The results are envisioned to be submitted to a scholarly journal and potentially lead to further research studies.

8. Student: Ceili Hesselgrave Major: Theatre
Mentor: Dr. Charles Calvert Department: Theatre and Dance
Title: *Developing the Design Process*

Development as a theatre artist cannot be fully achieved strictly in a classroom setting. The nature of this collaborative art form requires immersion in realized production work that takes ideas learned in the coursework and puts them into practice - resulting in a far more in-depth understanding. "Developing the Scene Design Process" allows for an intensive look into the day-to-day work and research involved for the Scenic Designer on a variety of professional theatrical productions. Using the creation of a of original set designs for producing theatre organizations as the framework, this project will allow for the student to gain an understanding of the processes of theatrical design and to be exposed to professional theatres with high production values. The project requires in-depth analysis of the scripts, the time period and location of the plays, and the logistical challenges unique to each of the performance spaces. The student will develop communication and problem-solving skills in a collaborative atmosphere while interacting with the faculty mentor and the members of the productions' creative teams - hired by the theatre companies. While the faculty mentor will serve as the lead designer on the productions, the student participant will serve as a collaborator and participate in every aspect of the design process and execution of the designs, ultimately leading to a portfolio of professional work produced on the stages of these two critically acclaimed theatre companies.

9. Student: Michael Lanier Major: Mathematics
Mentor: Dr. Mukesh Kumar Department: Mathematics
Title: *An Automated System for Polyp Detection in Wireless Capsule Endoscopy Images based on Deep Learning*

Colorectal cancer is the third most common cancer diagnosed in both men and women. As estimated by American Cancer Society, there were 132,700 new colorectal cancer cases in United States in 2015. Colorectal polyps are important precursors to the cancers, which may develop if the polyps are left untreated. In order to detect polyps in their early stage and remove them before they deteriorate to cancer cells, doctors need to visualize the gastrointestinal (GI) tract directly. Wireless capsule endoscopy (WCE) enables physicians to examine the digestive tract without any surgical operations, at the cost of a large volume of images to be analyzed. In the computer aided diagnosis of WCE images, the main challenge arises from the difficulty of robust characterization of images. This study aims to provide discriminative description of WCE images and assist physicians to recognize polyp images automatically. In this project, we develop an automated system for polyp detection in WCE images based on deep learning which

is an improvement to the neural network that contain more computational layers that allow for higher levels of abstraction and prediction in the data.

10. Student: Matthew Magee **Major: Biology**
Mentor: Dr. Agnes Ayme-Southgate **Department: Biology**
Title: *Splicing factors in honeybee nurse-forager transition*

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

11. Student: Alexandra Mielcarek **Major: Public Health**
Mentors: Dr. Cara Delay and Dr. Beth Sundstrom **Departments: History (Delay) and Communication (Sundstrom)**
Title: *LGBTQ Oral Histories in the Lowcountry*

Resources documenting the history of the lesbian, gay, bisexual, and transgender (LGBTQ) community in the Lowcountry are largely lacking. Due to a long history of stigmatization that this population has survived, available archival materials are at risk of being hidden or otherwise neglected and are often destroyed during the LGBTQ person's life or by their embarrassed family after their death. Without a documented history, the segment of culture contributed by peoples under this identity becomes muddled. Unlike other marginalized peoples, the LGBTQ community has not had the opportunity to undergo intensive documentation that would aid in filling this gap in knowledge. In order to remedy this, the research team will collect and make accessible at-risk materials on the local undocumented LGBTQ community through an oral history collection program. According to Ramierz and Boyd, "queer oral histories have an overtly political function and a liberating quality..."[10] This research and methodology provides LGBTQ individuals with a means of vocalizing their roles in South Carolina's history in the twentieth and twenty-first centuries. This project also will create a publicly accessible database (via the Lowcountry Digital History Initiative http://ldhi.library.cofc.edu/) from which information can be gathered. This research will thus assist in correcting common misunderstandings and aid in reducing stigma and discrimination.

12. Student: Anastasia Miletich **Major: Exercise Science**
Mentor: Dr. Kate Pfile **Department: Health and Human Performance**
Title: *Lateral Trunk Perturbation as a Potential Indirect ACL Injury Mechanism in Healthy Adults*

Understanding the mechanism of anterior cruciate ligament (ACL) injuries is essential to injury prevention and rehabilitation. Noncontact injuries have been studied, however, this experiment intends to mimic an indirect contact mechanism (force applied to the body but not directed at the knee)[1], creating unanticipated movement patterns. Females are at 3-6 times greater risk for ACL injuries than males.[2] Core muscle control[3] and lower extremity movements[4] during sport-specific tasks may account for this difference. The purpose of this study is to compare how unexpected, lateral forces applied to the participant's torso impact jump landing patterns between males and females. The hypothesis is that the unexpected lateral force will create greater movement and forces at the knees and hips, resulting in high risk ACL injury positions with greater differences anticipated in females. Forty active males and females with 3 years of experience in jumping-intensive activities will participate. Participants will wear a chest harness and motion analysis markers to collect motion and force measurements. They will perform 15 jump landings off a 30cm box onto force plates. During the landing, a force set at 15% of the participant's mass[5] will be applied in the right or left direction for 10 of the 15 experimental condition trials. The control condition consists of no applied force and the participant performing a natural landing. Joint angle and force values during the landing phase at the torso, hip and knee will be recorded. Microsoft Excel and SPSS will be used for data reduction and analysis, respectively.

13. Student: Trisani Mukhopadhyay **Major: Biology**
Mentor: Dr. Gamil Guirgis **Department: Chemistry and Biochemistry**
Title: *Preparation, characterization and conformational analysis of sila- and germacyclopent-2-ene and their haloderivatives.*

Carbon atoms can bond with other atoms to form linear and cyclic structures. Our laboratory at the College of Charleston has been involved in a longstanding research program investigating the structural preferences of cyclic organic (i.e., carbon-containing) compounds incorporating silicon and germanium atoms. From these studies, we have published 85 papers in international journals, demonstrating the capability of College of Charleston to produce world-class research on silicon- and germanium-containing organic compounds. Our previous studies examined cyclic compounds composed of three to six members (i.e., the atoms constituting the ring "skeleton"). Our attention is presently directed towards novel research on unsaturated (compound with double bond) five-membered rings incorporating silicon or germanium atoms within the ring structure. For five-membered rings composed only of carbon, nitrogen, and oxygen, their biological activity and structure is fully elucidated in chemical literature. However, unsaturated five-membered rings incorporating silicon or germanium have never been experimentally investigated—possibly due to difficulties inherent in their synthesis. Our technical knowledge of the synthetic routes to these compounds, as well as our experience with the routine instrumental analyses and theoretical calculations, will help us to successfully explore the synthesis and characterization of these compounds. Our longstanding collaborations with laboratories at the University of Virginia at Charlottesville, the University of Missouri Kansas-City, and the University of Eastern Illinois at Charleston, Illinois for highly specialized instrumentation will help in interpreting the structure of these molecules. Finally,

the newly prepared compounds may lead to collaborations with biology faculty at the College of Charleston to investigate the bioactivity of these unique compounds.

14. Student: Lilyana Newman **Major:**
Mentor: Dr. Moshe Rhodes **Department: Biology**
Title: *tRNA profiles of the Haloarchaea as a function of salinity*

To be able to thrive in environments with high levels of salt, halophiles, or salt loving organisms, have developed several methods to balance the osmotic inequalities placed on them by these hypersaline conditions. One of these methods is the "Salt-In" method. Salt-In halophiles maintain high concentrations of salt internally in order to balance the amount of salt within their cells with that of their surroundings. Although this Salt-In method efficiently balances the salt gradient, it severely alters the internal chemistry of the cell. In short, it alters the way proteins fold. This in turn necessitates halophiles to compensate by altering their own proteins. Halophiles accomplish this by using specific amino acids more than other organisms. tRNA is the RNA molecule responsible for transporting individual amino acids to a protein under construction. As tRNA is a pivotal component of protein building, changing amino acid requirements should be reflected in tRNA profiles as well. In this study we will be growing and culturing the Salt-In haloarchaeon, *Haloferax sulfurifontis*, in medias with differing salinity levels. We will then extract the tRNA in order to investigate how the tRNA profile and usage changes based on salinity. It is expected we will see one of two results. It is either predicted that we will see a change in how many of each tRNA are produced in a cell or an increase of specific tRNA molecules with no amino acid attached. In so doing we will gain insight into how extremophiles respond to changing environmental pressures.

15. Student: Bach Nguyen **Major: Biochemistry**
Mentor: Dr. Katherine Mullaugh **Department: Chemistry and Biochemistry**
Title: *Role of the Chelate Effect in the Affinity of Natural Organic Material for Silver Nanoparticle Surfaces*

The widespread use of nanoparticles in consumer goods had led to concerns about environmental harm from their use, especially silver nanoparticles that are common and contain a metal that can negatively impact the health of aquatic systems. The unique properties that make nanomaterials valuable for various applications also make their behavior in natural waters difficult to predict, especially given the diversity of conditions possible. It is therefore imperative that controlled laboratory-based studies are conducted to determine the likelihood of possible chemical and physical transformations that engineered nanomaterials may undergo so their environmental impact can be accurately assessed. The chemistry that occurs on the surface of nanoparticles is likely a controlling factor in their behavior, but this aspect of nanoparticle behavior is one of the least understood and further complicated by the inherent complexity of large molecules common in natural waters. This project proposes a series of experiments that determines what characteristics of organic compounds can be used to predict their affinity for nanoparticle surfaces. Specifically, we are interested if large compounds that have multiple potential attachment sites for a nanoparticle surface demonstrate stronger binding than small compounds. This "chelate" effect is analogous to Velcro® forming a strong overall attachment to a surface through the combination of numerous weak interactions. Results from this work would be of interest to our field because it would provide insight into what water quality parameters are important to consider when predictions about the behavior of this emerging class of contaminants is considered.

16. Student: Andrew Pampu Major: Biology
Mentor: Dr. Rick Heldrich Department: Chemistry and Biochemistry
Title: *Preparation of bis anisyl alkanes*

One area of study in organic chemistry is known as methods development. In a methods development project the goal is to find new ways to make organic compounds. These new methods can be based on theoretical predictions, they can be logical extensions of known methods, or they can be the result of serendipity. In most methods development research there needs to be a perceived need for a new or improved method. The need for the methods development that is described in this project is to find a better way to make a set of molecules known as [n.o]-*meta*-cyclophanes. We need to find a facile pathway to the [n.o]-*meta*-cyclophanes so that we can use them as model compounds to learn how to make the herquiline natural products: herquline A and B. Herquline A has the ability to be used as an anti-influenza virus antibiotic.[1] The compound inhibits replication of the influenza virus and has been proven to work effectively inside human cells without being toxic to them. Herquline B has the ability to inhibit platelet aggregation, meaning it can help individuals who have conditions in which their blood fails to clot.[2] Both applications are important to society. The herquline compounds exists naturally in a genus of fungi called *Penicillium*, and how they are created in that organism[3] differs in how it would be made in a chemistry lab.

17. Student: Nisarg Patel Major: Biology
Mentor: Dr. Heather Fullerton Department: Biology
Title: *Distribution of Iron-Oxidizing Marine Microbes in the Charleston Area*

In recent years, advancing technologies have revealed that microbes play a significant role in all environments and biological nutrient cycles. Iron is one of the most abundant elements in the world, and as such represents a vast energy source for many microbes through the oxidization of iron. The recently discovered bacterial class, Zetaproteobacteria, were found to be abundant at marine sites high in iron such as hydrothermal vents. More recently these organisms were also found in more estuarine environments like the Chesapeake Bay. These results indicate that Zetaproteobacteria can be found in environments that have low levels of iron and a wider range of salinity. Sediment samples will be collected at near shore sites and salt marshes where depth and salinity will be recorded. From these samples, the total population of Zetaproteobacteria will be analyzed to see if Zetaproteobacteria are present and if their population levels correspond to the measured environmental gradients. Statistical analysis will be conducted on this information to ensure validity and accuracy of results.

18. Student: Kyleigh Petersen Major: Biology
Mentor: Dr. Agnes Ayme-Southgate Department: Biology
Title: *Splicing factors and their RNA targets in honeybees*

Living creatures have the great ability to adapt to changes in their environments. However, how organisms manage to modify their behaviors, metabolism, and physiology is still in many cases a mystery. One striking example is the ability of the honeybee workers in a colony to change their behaviors and activities during their life time (a process known as polyethism) to accomplish very diverse tasks, such as protect the queen, feed the colony, and gather pollen and other nutrients. The polyethism process requires the workers in a colony to transition from nurse bees with jobs inside the hive to forager bees with tasks outside the hive. This transition requires many changes, including a remodeling of the flight muscle system to make it more

efficient and capable of sustaining long flights with heavy load (imagine a bee loaded with nectar going back to the hive from the field). One molecular process implicated in muscle remodeling is alternative splicing, which requires special proteins known as splicing regulators. These proteins interact with the nascent RNA molecules and lead to modification of the mRNA information molecules, which in turn result in creating slightly different muscle proteins. Kyleigh's project is to investigate one of these regulators, known as Muscleblind and its interactions with known RNA targets. She will investigate whether this interaction is altered during the nurse-forager transition. She will use several molecular biology techniques to purify the Muscleblind protein and create RNA molecules *in vitro*. Their interaction will then be studied in an *in vitro* assay. These data will be presented at several conferences, included in a future peer-reviewed manuscript, and serve as preliminary data for a NIH grant in September 2018.

19. Student: Maxwell Rabe **Major: Physics**
Mentor: Dr. Joe Carson **Department: Physics and Astronomy**
Title: *A Novel 3D Imaging Technique for Screening Pre-Cancers of the Cervix*

Currently, the research project is continuing its development of a 3D medical imaging tool that will be a simple-to-use diagnostic device for pre-cancer and early stage cancer detection, with its primary focus being cervical cancer. The device's power lies in its ability to quantitatively measure the overall 3D shape of a cervix, or other biological object, including potential surface growths, while also being able to resolve individual surface cells. Dangerous growths may be evaluated either by an on-site or remote expert viewing the data, or else through Artificial Intelligence algorithms. The device's primary target demographic is populations in developing countries, specifically sub-Saharan Africa, where around 50,000 deaths occur from the cancer each year (Mboumba Bouassa, 2017). The device is designed to be relatively low cost
(less than a few dollars per use), allowing for accessibility in regions where alternative 3D biomedical imaging, such as MRI or 3D Ultrasound, is vastly too expensive and/or non-existent (Joseph Carson, 2018). The device is simple to use by a non-expert as well as portable; an inexpensive laptop, which controls the device and stores the data, is currently the largest component. A probabilistic diagnosis is envisioned in a single patient visit, unlike conventional cervical pre-cancer screening methods, which typically require multiple visits (e.g. Pap Smear + colposcopy). This is important since patients in these countries often do not return after the initial visit (Martin et al. 2014).

20. Student: Abigail Reeves **Majors: Biochemistry and Biology**
Mentors: Dr. Jennifer Fox and Dr. Marcello Forconi **Department: Chemistry and Biochemistry**
Title: *Biological Roles of Homologous Sulfohydrolases*

Enzymes are proteins that have a specific shape and chemical composition, which correspond to a specific function. To increase the rate of a chemical reaction, enzymes interact with a molecule called a substrate that complements its shape and composition within a binding pocket. Some species of organism have very specialized and unique enzymes, whereas other enzymes can be found in nearly all living things. We are studying a group of structurally similar enzymes that can be found in animals, fungi, bacteria, and plants. Since these enzymes are found in a wide variety of living things, we can expect them to serve an important role. Currently, these enzymes are known to be able to break down a type of man-made chemical found in products like detergent and shampoo. However, it is unlikely that breaking down these

man-made chemicals is the original purpose of the enzymes since the organisms that possess them were not exposed to such chemicals historically and since many organisms do not even encounter them in modern times. Therefore, it is likely that these enzymes became prevalent due to their ability to break down a natural substrate that is similar in shape and composition to the man-made chemicals. By studying three different organisms and their respective enzymes, we hope to use their similarities and differences to determine what the natural substrate could be. This information will ultimately be used to determine the enzymes' function, which is a very important aspect of the biological and chemical understanding of living things.

21. Student: Harper Richards Major: Psychology
Mentor: Dr. Jen Wright Department: Psychology
Title: *Conceptions of Altruism Across Western and Non-Western Countries*

Why do people help one another, when they do? This question, which has sparked debates across academic fields, has repeatedly been given two contradicting answers. The first answer is that people always help others, ultimately, for "egoistic" reasons—i.e., to benefit themselves. This is true even when the benefit to themselves is fairly small, such as decreasing the distress they experience when seeing someone else in need. The second answer is that, at least sometimes, people help others solely for the benefit, or to alleviate the suffering, of others, even when there is no benefit to themselves. In other words, they can behave "altruistically". For my study, I want to explore what people think about altruism—whether they value it, what they cite as examples of it, and whether it is something that is actively promoted in their communities. Since people's understanding and expression of altruism is likely to be powerfully influenced by cultural and situational factors, I would like to explore this across both western (US) and non-western (Cambodia & Vietnam) countries. Through interviews conducted in multiple (one large and one small) cities within three countries, the degree to which people in these countries help others even when it does not benefit themselves —and/or view such forms of helping as valuable and appropriate—will be determined. Ultimately, the study aims to determine how western vs. non-western countries incorporate the notion of altruism into their cultural world-views, and the degree to which this actually impacts people's daily lives.

22. Student: Estelle Rounsefell Major: English
Mentor: Dr. Julia Eichelberger Department: English
Title: *Eudora Welty-Frank Lyell Correspondence, 1931-1977*

Over the summer, Dr. Eichelberger and two undergraduate students will be transcribing the letters of Eudora Welty in order to create a preliminary manuscript. The letters span from the 1930s to the 1970s, and they are correspondence between Welty and Frank Lyell, a friend from Jackson who became a college professor. Lyell closely followed Welty's career, and the two often discussed her work in progress. The letters contain witty banter, and comments on fads, events, and other details from their daily lives. The letters provide ample historical information, as well as a deeper understanding of Welty's creative process. To begin the project, undergraduates will read Welty's entire body of work in order to become acquainted with her life and her writings. Then the undergraduates will begin transcribing the un-transcribed letters. These primary source documents will be typed up electronically, sorted, and documented. The remaining letters that have already been transcribed need to be proofed. Simultaneously, undergraduates will read all the letters as whole, and aid the mentor in deciding which letters will be put into the final manuscript. Additionally, the research team will look for patterns and connections between the transcribed letters, in order to begin to organize the work in a creative literary manner, keeping in mind that it will be presented to the public in its final form. Undergraduates will research references and articles mentioned in the letters in order to create

footnotes. Mentor and undergraduates will be working collaboratively in order to accomplish these goals.

23. Student: Michael Schwartz **Major: Geology**
Mentor: Dr. John Chadwick **Department: Geology and Environmental Geosciences**

Title: *Holocene Snake River Plain Lavas and the Yellowstone Hotspot: A Geochemical Study*

Yellowstone National Park is famous for its dramatic hot-water geysers, and many people know that the heat for those geysers is provided by an immense body of magma just a few miles beneath the surface of the Earth. Known as the Yellowstone "hotspot," a plume of hot mantle rises beneath the continental crust and melts, periodically producing "supervolcano" eruptions in the area of Yellowstone National Park. To the west of Yellowstone in southern Idaho, numerous smaller volcanoes have erupted consistently over the past 15,000 years on the eastern Snake River Plain. Although these eruptions have occurred over 100 miles away from the Yellowstone hotspot, many scientists think they are derived from this same plume of hot mantle. The magma that produces the young lavas may be left over from a time when the hotspot was directly under Idaho or may be the result of the deflection of the hotspot beneath the Snake River Plain. The crust is under extension, which allows magma to travel to the surface. The purpose of this research will be to analyze the chemistry of lava samples from these Snake River Plain volcanoes, to evaluate their connection to the hotspot and to understand the processes that can change their compositions, including melting of the overlying continental crust. The results will help to explain the source of these unusual young volcanoes and allow us to better understand how hotspots like Yellowstone interact with continental crust.

24. Student: Payden Shaw **Major: Astrophysics**
Mentor: Dr. Chris Fragile **Department: Physics and Astronomy**

Title: *Numerical Simulations of Black Hole Jet Precession*

Black holes are the remains of the most massive stars in the universe. Many black holes are believed to have a disk of gas and dust around them that is called an accretion disk. Material from this disk can fall towards the black hole and be propelled along magnetic field lines. This propelled material can be launched at near light speed and can be observed as "jets" being emitted away at the poles of the black holes. The relationship between the accretion disk and the jets are a source of many questions and much research. An interesting situation occurs when the accretion disk is tilted with respect to the black hole. In this scenario, the disk will precess about the spin axis of the black hole, like a spinning top. The question is, do the jets also undergo precession and sweep in circular arcs through the sky or do they align with the steady spin axis of the black hole.

25. Student: Tess Shymanski **Major: Psychology**
Mentor: Dr. Gabrielle Principe **Department: Psychology**

Title: *An Exploration of Maternal Factors Affecting Children's Memory*

In everyday life, young children and their mothers frequently discuss memories of past events. A substantial body of research has shown that these discussions provide children with several benefits. On one level, they help children learn how to formulate and recount a coherent story that fits within social and cultural norms. Yet they also provide children with guidance on how to evaluate and interpret their experiences. This benefit arises because mothers and children do

not simply reminisce about the facts of what happened; they also discuss their own and others' thoughts and emotions. Therefore, these reflections help teach children how to interpret, manage, and respond to emotional experiences. The proposed study investigates whether mothers' styles of talking about the past influence the ways in which children interpret the emotions involved in personally-experienced events. In previous work (Principe, Cibischino, & Greenberg, 2017), we used a similar method to examine the ways in which children completed and remembered ambiguous stories. We found that when mothers were more negative, their children tended to misinterpret and misremember these stories negatively. The proposed study aims to replicate and extend these initial findings to determine if this relation remains when children are asked to recall personal experiences. This is an important extension because studies of adults demonstrate that negative interpretation and memory biases contribute to emotional disorders such as depression and anxiety (Hertel & Mathews, 2011), but little is known about what sorts of early experiences might contribute to the development of these cognitive biases.

26. Student: Monique Sparkman Major: Mathematics
Mentor: Dr. Alex Kasman Department: Mathematics
Title: *Quaternionic KdV Solitons*

The KdV equation is one of the most important wave equations of mathematical physics. Among its many remarkable properties are that we can find exact formulas for its solutions and that some of those solutions are so-called "solitons" with particle-like properties. The study of those solutions over the last 50 years has provided a deeper understanding both of what is possible in wave phenomena and in quantum physics. Although the numbers that most people are familiar with satisfy the *commutative property* (e.g. $2 \times 7 = 7 \times 2$), *non*-commutative algebra is of great importance in many areas of math and physics. One of the most famous examples is the numbers called "quaternions", a non- commutative generalization of the real numbers that was developed in the 19^{th} century. There has been much interest lately in non-commutative solitons. Interestingly, although the KdV equation is the most famous soliton equation and the quaternions are one of the most famous non-commutative algebras, there is only one paper published so far about quaternionic solitons of the KdV equation (Huang, 2003). The goal of this paper is to further investigate the quaternionic KdV solitons, to develop new techniques for producing the solutions, to verify (or correct) the conclusions of the one previous paper on this subject, and to provide the first visualizations of quaternionic solitons.

27. Student: Briana Taormina Major: Biochemistry
Mentor: Dr. Marcello Forconi Department: Chemistry and Biochemistry
Title: *Isotope effects in the Kemp elimination*

Catalysts are substances that make chemical reaction go faster. One of the most efficient class of catalysts are enzymes, which are macromolecules used by living organisms to accelerate chemical reaction and make their rates compatible with life. These rate accelerations can be astonishing – enzymatic reactions can easily be trillions of times faster than the same reactions in the absence of enzymes. When the rates of the enzymatic and non-enzymatic reactions are determined, it is crucial to ensure that these two reactions have the same characteristics (i.e., that they proceed through the same mechanistic pathway). Whereas we cannot look at a chemical reaction with our eyes at an atomic scale, we can use reporters to investigate the properties of the reaction. Among the various reporters that we can use, stable isotopes (i.e., versions of the same atom that have different masses) are the ones that do not usually alter the overall characteristics of the reaction. The most common

isotope of the simplest chemical element (hydrogen) is called deuterium. In this project, we will measure the effect of substituting a native hydrogen atom for deuterium in a particular reaction. This measurement will be done with different catalysts, and the value of these effects will be used to compare the mechanisms of the reaction in the different conditions.

28. Student: Grace Anne West **Major: Psychology**
Mentor: Dr. Daniel Greenberg **Department: Psychology**
Title: *Maternal Influences on Child Memory*

In everyday life, young children and their mothers frequently discuss memories of past events. A substantial body of research has shown that these discussions provide children with several benefits. On one level, they help children learn how to formulate and recount a coherent story that fits within social and cultural norms. Yet they also provide children with guidance on how to evaluate and interpret their experiences. This benefit arises because mothers and children do not simply reminisce about the facts of what happened; they also discuss their own and others' thoughts and emotions. Therefore, these reflections help teach children how to interpret, manage, and respond to emotional experiences. The proposed study investigates whether mothers' styles of talking about the past influence the ways in which children interpret the emotions involved in personally-experienced events. In previous work (Principe, Cibischino, & Greenberg, 2017), we used a similar method to examine the ways in which children completed and remembered ambiguous stories. We found that when mothers were more negative, their children tended to misinterpret and misremember these stories negatively. The proposed study aims to replicate and extend these initial findings to determine if this relation remains when children are asked to recall personal experiences. This is an important extension because studies of adults demonstrate that negative interpretation and memory biases contribute to emotional disorders such as depression and anxiety (Hertel & Mathews, 2011), but little is known about what sorts of early experiences might contribute to the development of these cognitive biases.

29. Student: Lucille Williamson **Major: Astrophysics**
Mentor: Dr. Joe Carson **Department: Physics and Astronomy**
Title: *Investigating the Impact of Episodic Stellar Activity on Planet Formation and Evolution*

The formation of planets in a protoplanetary disk has been researched with respect to a variety of constraints. Studying the formation of planets allows us to learn more about our own origins, as well as trends that appear in other planetary systems. This information allows scientists to look for potentially habitable planets in other systems. The proposed project is unique in its approach to the study. Early stellar activity of the star over a short period of time will be studied to investigate how the flux of stellar activity impacts the early formation of planets around the parent star. Photometric and spectroscopic methods will both be utilized in the implementation of the project. Photometry is the measurement of the overall large-scale radiation of the star, while spectroscopy is measuring the relative brightness of radiation at a specific wavelength. Both are integral to the project, but photometry will be my main focus.