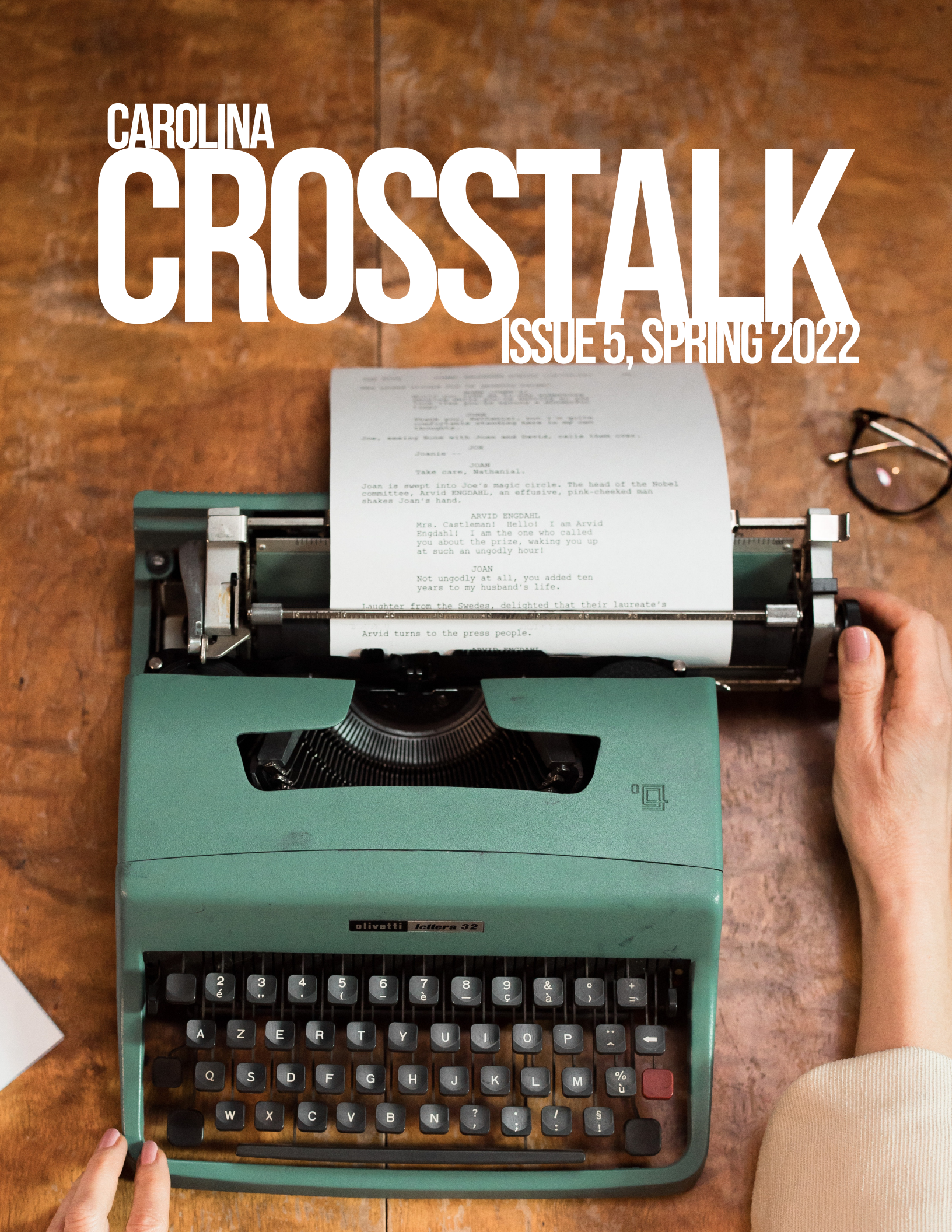
CAROLINA CROSSTALK

ISSUE 5, SPRING 2022



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TELL ME A (RESEARCH) STORY

LETTER FROM THE EDITOR

Storytelling is innate to humans. We are naturally drawn to stories. From the first cave paintings and oral storytelling to modern mediums and advanced technology, storytelling seems to have been a part of human civilization since the beginning of life. Some evolutionary psychologists suggest that storytelling is an adaption that allows us to keep our ancestors alive in memory, pass down valuable information, and imagine alternatives when faced with obstacles. There is also neuroscientific reasoning behind our affinity to stories because when we hear stories, we tend to release hormones like cortisol, dopamine, and oxytocin and activate the sensory centers in our brains. There is also a phenomenon called brain mirroring, where the brain activity of the listener mirrors the brain activity of the storyteller. It's incredible how stories bring our society to life and conversely, society brings stories to life. Contrary to common perception, stories aren't just contained within novels and films; they are found in everything and anything if you actively look for them.

While sharing stories is crucial, telling stories is only one part of its significance – the other part is listening to stories. The act of storylistening involves viewing something or someone with curiosity, respect, and empathy. Sometimes, it takes only a curious question, respectful silence, and empathetic interest to create space for someone's story. Let's ask ourselves: how can we engage in more storylistening? In fact, that is the purpose of our Spring 2022 issue—it aims to amplify the voices of researchers in our UofSC community through both a storytelling and a storylistening lens. The stories of researchers bring research to life by contextualizing and humanizing it because research is more than the literature, methods, results, and conclusions. Research is about communicating research findings and stories because, at its core, research is a human endeavor (for and by humans). Whether it's writing a research grant, a journal article, or an oral presentation, research is intertwined with the elements of a story: setting, characters, plot, conflicts, resolutions, and themes. In the next few pages, you will hear stories about butterflies, birds, manufacturing, dance, stem cells, sports, viruses, bones, and, most importantly, the researchers themselves. Nevertheless, these stories are only a fraction of the multitude of stories that exist in research, so for the next issue, the CrossTalk team implores you: tell us your research story.

Heny Patel

HENY PATEL EDITOR-IN-CHIEF

A STORY ABOUT CHASING BUTTERFLIES

WRITTEN BY HANNAH WALTON BIOLOGICAL SCIENCES, MATHEMATICS, AND GEOGRAPHY, CLASS OF 2022
EDITED BY HENY PATEL EDITOR-IN-CHIEF

As a freshman walking into the Coker Life Sciences building for my Ecology and Evolution lab, I was nervous, and frankly, more unprepared than I thought. I came from a rigorous high school where I had taken many AP courses and had weekends swamped with homework. I thought for sure I would be ready for anything that came my way. Then I got my first grade on my Ecology and Evolution lab report: a B-. My world was crushed - was my writing that bad? Then, I got to know my graduate Teaching Assistant a little more. My TA, Rachel Steward, was a Ph.D. student in her last year here at UofSC under the advisement of Dr. Carol Boggs. Rachel was a tough TA - she expected you to quickly learn and demonstrate understanding of concepts - and after re-reading my lab report, it became clear that I was going to have to step it up to meet her standards. Looking back, these expectations challenged me for the better. I found myself paying more attention to the clarity and conciseness of my writing, and by the end of the course, I had earned an A. But this is just where my journey into research really got started.

In the middle of my first semester, Rachel mentioned an opportunity to work for Dr. Boggs. She was looking for students to help with a joint project with Congaree National Park - the job required students to catalog citizen science sightings from CNP, meaning I would be recording sightings of birds, feral hogs, etc. So, I went in, quickly interviewed, got the job, and started working. Weeks later, I was getting into the groove of this project, typing out many sightings of the "prothonotary warbler," and still so unsure of how to say that tongue twister out loud. In the lab, I overheard lots of conversations concerning butterflies - can people really study butterflies? The short answer is: yes! Shortly after joining Dr. Boggs' lab, I began attending the biology department lectures, surprised by the breadth of topics and organisms that researchers around the country studied - you can really study nearly anything.

In the spring semester, I started running triglyceride analysis of butterfly eggs using a mass spectrometer - essentially, I was helping Dr. Boggs determine how much of this fatty nutrient the butterflies were allocating to their eggs. Dr. Boggs is interested in quite a few things, one being the life history of the Mormon fritillary (*Speyeria mormonia*), a montane butterfly species, and how they're affected by nutritional constraints. Towards the middle of the spring semester, I learned more about Dr. Boggs' work on butterflies at the Rocky Mountain Biological Laboratory (RMBL), where she has been going nearly every summer since the early 1980s. Lucky for me, she

was hiring a Research Assistant for that summer – someone to catch butterflies and help people with their projects. I gladly accepted the position and began counting down the days until my flight to Colorado.

The car ride from the Gunnison airport to Gothic, Colorado (where RMBL is based) was about 40 minutes, and I grasped the change in the landscape quickly. I had to nurse a little bit of a headache due to the extreme increase in elevation – I'm from Myrtle Beach, so I went from sea level to 9,500 feet, and I was feeling it. But, as we passed by the mountains that were, yes, you guessed it, rocky, I was excited to have the privilege of working in this montane area. Throughout the summer, I learned how to perform my day-to-day tasks, including catching butterflies and performing mark, release, and recapture (MRR) on two species of butterflies. Additionally, I would mark egg masses, help rear caterpillars, and feed adults. *Side note: I'd be lying if I said catching butterflies looked different than Spongebob catching jellyfish*. Beyond the fieldwork, I hiked mountains and took in views beyond what I could have ever pictured. Members of the lab and I often ventured into Crested Butte, a nearby ski town that harbors unique restaurants and shops, and soon I began to call my lab mates my good friends. After a few weeks, Gothic started feeling like my home (away from home).

While at RMBL this summer, I learned two things: 1) butterflies can be *fast* and 2) Dr. Boggs is a renowned woman in her field. I didn't realize I was living and working alongside a historical figure of entomology research, and during this summer I grasped the real fortune of being able to work for Dr. Boggs. Additionally, legend has it that her husband, Dr. Ward Watt (also a professor at UofSC) helped establish RMBL and did so by riding in on a donkey. As the summer went on, the magic of this field station started making sense. Meanwhile, in the field, I was catching *Euphydryas gillettii* as part of a nearly month-long MRR project, which is a much slower butterfly compared to *S. mormonia*. I was also helping Nitin Ravikanthachari catch *Pieris macdunoughii* as part of a project for his Ph.D. research. *Pieris macdunoughii* is a butterfly found in RMBL and surrounding areas, and it appears to have fallen into an evolutionary trap where they occasionally lay their eggs on a non-native host plant that is too toxic for caterpillars, causing these caterpillars to die. Nitin is studying how this evolutionary trap continues to persist in this butterfly.

Thankfully, when *S. mormonia* MRR rolled around, I was adjusted to the altitude, yet I was surprised by their speed. These are fast little guys, making for an intense 2 days of MRR. But, fortunately, one of the greatest discoveries during this field season was that butterflies are really only active from 10 am-4 pm. What does this mean? It means that unlike my cabin mates who rolled out of bed at 5:30 am or 6:00 am to hike to their field sites, I could go into the lab around 8:00 am, feed our lovely butterflies, and prepare for the day ahead with lab mates.

If you happen to join a fantastic lab like I did, you realize that you learn skills beyond lab or fieldwork. For example, Nitin taught me how to pin butterflies, meaning I learned how to use tiny pins and a pinning board to properly preserve butterflies for museum and personal collections. I became better at asking and articulating questions, communicating with others, and identifying the flora and fauna of the area. Throughout the summer, I learned about a butterfly behavior called mud puddling, where male butterflies will sip nutrients with their proboscis (tongue) from mud puddles. Typically, they're after sodium, which is used for both personal nutrition and transferred to females when they mate. I was intrigued by the behavior, and at the end of the summer, Dr. Boggs and I sat down and discussed my time at Gothic and what kind of projects I could pursue during the next field season.

In the fall of 2019, Dr. Boggs and I began drafting ideas for a Magellan Scholar grant application, which is funding available through the Office of Undergraduate Research. I knew I'd like to study mud puddling, and after brainstorming, we decided that I would explore the kinds of visual cues that draw a butterfly to a mud puddling site. Mud puddling is a well-documented but under-studied behavior, and we are unsure of what motivates the first butterfly to begin puddling at a site. I was awarded the Magellan grant in the spring of 2020, and I planned to uncover some of this mystery that summer. Unfortunately, the COVID-19 pandemic hit, and my project was immediately put on hold. Dr. Boggs was not going to RMBL that summer, which meant I wasn't either, so I was sort of at a stand-still in my research. Fortunately, I found a job in my hometown, and worked as an accounting clerk for a small business, gaining skills that would prove to be more useful than I thought. But, I missed field work and hoped to return to RMBL during the summer of 2021.

Fast-forward to spring 2021, and there I was, thankful to be ramping up for the summer field-season. My Magellan funding was still in place, but we had to reevaluate what kind of methods I'd be using in order to get the information I wanted. Luckily, we have a vision specialist in the Biology department, Dr. Dan Speiser, who helped me refine my methods and is now my second reader on my Honors thesis. When I got to Gothic this field season, it was nerve-wracking to be in charge of my own project, but I was excited about the independence. You learn a lot about yourself and how you work when you take on a project of your own. With the help of Nitin (photographer extraordinaire), I took lots of photos with Ultraviolet filters and polarizing filters. I began to understand more about the puddling behavior simply because I was paying more and more attention, and I think this is a critical part of being a student researcher - you notice something you're interested in and ask a question because questions are just as exciting as answers. Additionally, I was still able to catch butterflies for Dr. Boggs this summer and partake in MRR surveys, and I expanded my pinned butterfly collection. This summer proved to be one of growth, and for that, I am grateful. But, one of the biggest highlights of the summer was winning the annual *E. gillettii* MRR ice-cream contest. Each summer, Dr. Boggs uses a model to estimate what the population of *E. gillettii* will be and at the end of the summer, each lab member makes a guess as to what they think the population will be. Then, Dr. Boggs takes the MRR data and runs it through another model to get a final population estimate. Whoever's guess was the closest wins Third Bowl Ice Cream from the visitor's center! Fortunately, this year, my guess was the closest, so I indulged in some mint-chocolate-chip ice cream courtesy of Dr. Boggs! It was the perfect end to a great summer of fieldwork.

Little did I know that walking into Dr. Boggs office during the fall of my freshman year would change the trajectory of my life. This coming fall, I'll be pursuing a Ph.D. at Auburn University under the advisement of Dr. Brian Counterman, where I'll be switching my focus to understanding the evolution and development of butterfly wing patterns. I strongly believe my training under Dr. Boggs has more than prepared me to undertake this pursuit.

Partaking in undergraduate research significantly enhanced my experience at UofSC, and I couldn't have asked for a better lab to have been a part of. My advice to you: take the leap. You never know - you may end up at 9,500 feet above sea level catching butterflies in a meadow, and you'll never look back!

A STORY ABOUT TRACKING BIRDS

WRITTEN BY RILEY WATSON ASSOCIATE WRITER
EDITED BY SARA PADULA BIOLOGY, PSYCHOLOGY AND COMP SCIENCE, CLASS OF 2023

Research often conjures up images of laboratories, scientists in crisp white coats, and test tubes full of mysterious green sludge. This idea is often what keeps people away from the study and pursuit of research-based knowledge. However, the work of researcher Sara Padula may challenge your preconceived notions of what research should look like. "I don't really like working in a lab with chemicals," she explained during our interview, "I would get literal chemical burns. It was not fun." It was this distaste for traditional laboratory work that drove Padula to contact Dr. Nathan Senner, a migratory shorebird expert, who was studying shorebirds in Charleston, South Carolina.

At first, Padula wasn't sure if Dr. Senner's research would be her cup of tea. "I never was into birds, but maybe I could be into birds!" she joked, recalling her apprehension when she first applied to work with Dr. Senner. She was assigned to work with the grapefruit-sized, cinnamon-colored *rufa* Red Knot, which is a long-distance migratory shorebird that breeds in the central Canadian Arctic and spends its winters anywhere between the gulf coast of the United States and Tierra del Fuego. *Rufa* Red Knots are migratory, which means they live in one climate during cold months and another during warm ones. Padula and Senner's research focused on these migratory patterns. Specifically, the utilization of a stopover site on the coast of South Carolina -- Seabrook and Kiawah Islands, South Carolina.

During the hands-on portion of researching this, Padula would walk a 20-mile stretch of beach in search of Red Knot flocks. The birds travel in groups of "two to five hundred", which can make them a bit hard to distinguish, especially since they look so similar to other shorebirds. With practice, however, Padula developed a knack for identifying them, and more importantly, spotting the colored flags on their legs that denoted where each bird came from. The Red Knots are safely netted and marked by other research groups all over the world. Many of the birds donned lime and dark green flags, which meant they came from the United States, but Padula's group was lucky enough to spot a few red and yellow flags, meaning the Red Knots had traveled to Charleston all the way from Chile and Peru! The flags didn't just tell Padula where the birds had been, but also had an alphanumeric code specific to that bird, so if that same bird was spotted multiple times a year, they could get a good gauge on the status of the rest of the rufa Red Knot population.

Explaining the core concept of her research, Padula said: "If you capture a group of organisms, and you mark all of them, and you release them back into the population, if you go back and re-capture a group of, like, salamanders or something, you might capture three marked and five not marked ones. You can put that into an equation and find out the population size." Researchers like Padula and her team need to know the number of Red Knots in Charleston because Charleston is what's known as a "stopover site" where the birds stop to rest, eat, and gain enough energy for their next migratory flight. Charleston is one of the few known stopover sites for red knots because of its high horseshoe crab population, whose eggs are a main source of the rufa Red Knot's diet. In addition to the crab eggs, the birds eat a lot of coquina clams, which can also be found in Charleston.

Padula fell in love with the red knots and their temporary habitat in Charleston. The sand-dune beaches boasted gorgeous sunsets and the occasional dolphin sighting, as well as a few locals who were able to join the conservation efforts. Two older men from the Charleston community—Mark Andrews, a retired doctor, and Bob Mercer, a bird biologist—took notice of what Padula and her research partner were up to. The two pairs become fast friends, and eventually, they were invited to join the research team. Padula and Senner's team are still in touch with the two men, and even had them revise and co-author their research paper. The pair continue to birdwatch and upload their findings to eBird. It is these stories of community involvement that drives not only Padula's passion for research, but Carolina Crosstalk's mission as well.

WANT TO GET INVOLVED WITH US?

We are a student-run research magazine at UofSC that features the stories of undergraduate researchers in all the diverse disciplines. We aim to communicate student research in an engaging manner to encourage conversation and inspire others to pursue their own research interests.

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IF YOU HAVE QUESTIONS OR WANT UPDATES ON THE MAGAZINE!

WE ARE LOOKING FOR:
WRITERS
EDITORS
GRAPHIC DESIGNERS
PHOTOGRAPHERS
& RESEARCHERS

INTERESTED IN SHARING YOUR RESEARCH OR IN NOMINATING A RESEARCHER?

INTERESTED IN JOINING THE TEAM?

BENEFITS OF RESEARCH IN GRADUATION WITH LEADERSHIP DISTINCTION

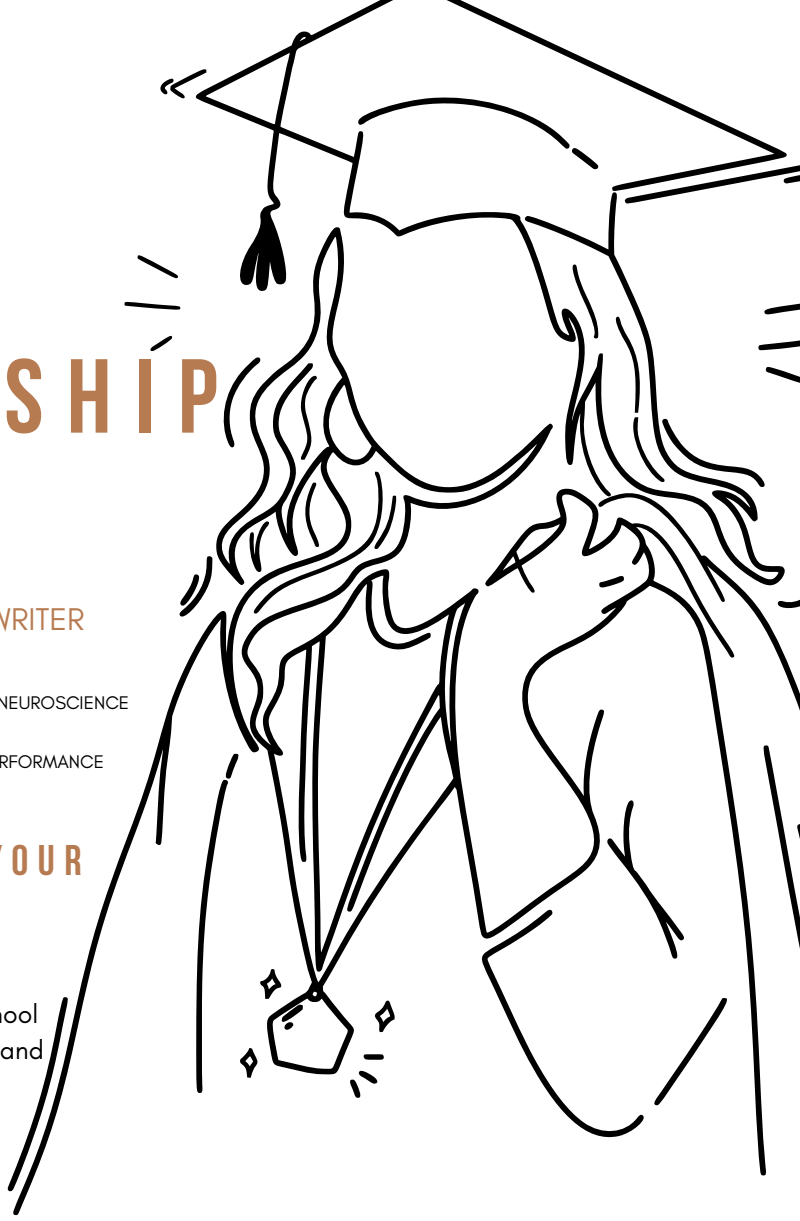
INSIGHTS FROM RECENT ALUMNI

WRITTEN BY MADELYN WESTON ASSOCIATE WRITER
EDITED BY SILVI PATEL ASSOCIATE EDITOR

MADISON E. PATTERSON DANCE PERFORMANCE AND CHOREOGRAPHY MAJOR, NEUROSCIENCE MINOR, MAY 2020

SYDNEY WOMACK BIOMEDICAL ENGINEERING MAJOR, MATHEMATICS MINOR, PERFORMANCE CERTIFICATE IN BASSOON, MAY 2021

FAITH SCHROERS EXERCISE SCIENCE MAJOR, MAY 2021



HOW DID YOU GET INVOLVED IN YOUR RESEARCH AND WITH THE GRADUATION WITH LEADERSHIP DISTINCTION PROGRAM?

Madison: I knew I wanted to apply to physical therapy school and get started in research. I used the research database and emailed a few faculty members in the School of Public Health that had projects that I'd be interested in. Then I was able to meet with Dr. Troy Herter from the School of Public Health and got that set up first. After getting into research, I spoke with Dr. Stephanie Milling, who is a part of the dance faculty and does a lot with GLD. I was a dance major and she encouraged me to pursue GLD as well.

Sydney: My freshman year, I was a biomedical engineering (BME) major, and my dad was a field service engineer for GE Healthcare. One of the locations where he did maintenance work on ultrasounds and MRIs was at the University of South Carolina Graduate Science Research Center. He introduced me to the lab animal technician that worked there under a research principal investigator (PI), Dr. Francis Spinale. After I was introduced to the technician, I reached out to Dr. Spinale, scheduled an interview with him, and then started working in his lab at the beginning of my sophomore year. Later, in my junior year, I found out about GLD through my BME Professional Development and Ethics course with Dr. Melissa Moss, who is absolutely amazing. One of the professional development activities for the course was to meet with a GLD advisor. I'd already completed a lot of the requirements for GLD by that point, so I decided to finish it.

Faith: I transferred to USC in the spring of my sophomore year, planning on a dance minor, but I realized that the requirements for an exercise science student meant that I couldn't complete both on time. I was going to the public health building to talk to my advisor when I saw a pamphlet for the GLD program. I thought this could be a really good replacement for a minor to put on an application for graduate school. It was May of 2019, so I researched GLD over the summer, got a plan for the fall, then talked with one of my professors, Dr. Troy Herter. He's the Motor Skills professor in the Exercise Science department. He connected me with the department chair, Dr. Shawn Arent and his postdoc, Dr. Bridget McFadden. They were doing something new in the exercise department, which was performance-based research. At the time, a lot of the research was more clinically-based, and I was more interested in the performance side of exercise science. They interviewed me and told me about their upcoming studies/projects. I officially got started with the UofSC Sports Science Research team in January 2020.

WHAT WAS THE PROCESS OF JOINING AN IN-PROGRESS PROJECT OR TRANSITIONING TO A DIFFERENT RESEARCH ENVIRONMENT?

Madison: It was kind of a mix. When I started, I joined an in-progress project that interested me. As a sophomore, I got to work with juniors, seniors, and grad students who were working on the project. Then in my junior and senior year, for the second half of my research, I planned out my senior thesis and worked on my own study.
Sydney: Dr. Spinale does cardiovascular translational research, which I enjoyed, even though I didn't know much about it at first. The lab manager gave me a couple of tasks related to microscopy, and analyzing histological samples. I looked at slides of hearts for measures of collagen, which we were using as a marker of heart failure. That work contributed to a publication. By my junior year, I was ready to reach out to Dr. Spinale and the lab manager that I felt prepared to work on my own project or have a larger role. Knowing my love for data analysis and my background in engineering, my PI gave me part of a project that was very data-analysis heavy. Through that, I explored more about heart failure, but also created an original code that analyzed something new. Even if I did have a clear idea of what I thought I wanted to do when I first started, it's really good to begin on an ongoing project first and then learn the ropes of research. I would not have been successful if I had tried to jump in starting a research project with no prior knowledge of research.
Faith: I attended Shenandoah University in Winchester, Virginia my freshman year of college, did a semester at my local community college in Maryland, then transferred to USC. It was the most life-changing experience coming to USC. I don't think that I would have gotten the same opportunities with research at Shenandoah that I have with USC because Shenandoah was a much, much smaller school. I was interested in research at the start of my freshman year, but Shenandoah just didn't have the faculty that you would find at USC. If a student is really interested in their studies, USC professors are going to invest in them. That's what my professors did with me, and I have been so happy that I had the opportunity to attend this university. USC has thousands of students, but I never felt like a number with my faculty.

BRIEFLY SPEAKING, WHAT IS YOUR RESEARCH PROJECT ON?

Madison: I did a literature search on how dance can help patients with Parkinson's disease. There are still a lot of specifics to figure out, like what kind of dance, for how long, and what intensity helps. One big gap in research is what neural mechanisms in the brain or in the motor system make dance effective for Parkinson's patients. Our study was preliminary to see if having music that matches helps to improve motor learning for patients with Parkinson's. The public health building has a KINARM (Kinesiological Instrument for Normal and Altered Reaching Movement). It's a robot that looks like a videogame and aligns with your eyes to track your eye movement. My pilot study with the KINARM robot looked similar to a video game, so it would look like obstacles were falling, and participants would use hand paddles to hit the objects before they reached the bottom of the screen. One group had the music matched, where you would hear a music beat every time an object fell, and the other group had white noise.
Sydney: I worked a little bit on a lot of different projects in Dr. Spinale's lab, and on one main project at the University of Rochester, which was my first experience doing research full-time. I also designed a project with a lab animal veterinarian whom I met through work with Dr. Spinale for my senior thesis. Many universities have government funded programs called "Research Experiences for Undergraduates," or REUs, that allow undergraduate students to do research full-time for a summer and receive free housing and a stipend. The University of Rochester had an REU during the summer of 2019, which is what I participated in. My project was about endothelial differentiation of mesenchymal stem cells, which means that we were extracting stem cells from the bone marrow of mice. Then we added growth factors to the cells to encourage them to differentiate into a particular cell type, which is used for vascularization, making blood vessels. The idea behind that project was to create an animal model that could be used for personalized medicine. For example, future studies might extract stem cells from a person, then differentiate them for the purpose of biotechnology or therapeutic development.
Faith: The focus of the Sports Science Lab's research was sports performance. I gathered fitness data on the women's volleyball, men's and women's tennis, and men's and women's soccer teams at USC. There was a mutual

providing of data, which benefited the coaches and allowed us to see how the athletes were doing. The biggest study was with the ROTC cadets at USC. It focused on comparing blood flow restriction (BFR) for resistance training using minimal equipment to current resistance training methods. The hope was that the BFR training would speed up the building of muscle, thus speeding up the building of strength and the neural adaptations needed to be stronger and have more power. The BFR cuffs on the cadets maintained a certain amount of pressure to induce hypoxia in the muscles, which would lead to the increase of growth hormones in the muscles via physiological pathways. For six weeks, the team and I trained the cadets multiple times a week using a structured resistance training program that got progressively more challenging. One condition was training some cadets with traditional resistance equipment, which included dumbbells, bench presses, squat stands and other heavy equipment pieces. The second condition was minimal equipment which consisted of resistance bands, sandbags and body weight exercises. The third condition used the same minimal equipment with the blood flow restriction cuffs.

WHAT WAS YOUR SPECIFIC ROLE WITHIN THE PROJECT?

Madison: It changed with the progression of the research. When I began, I was getting used to the lab. I looked at previous data collection and ensured that it was organized and easy to access, so that our principal investigator and all of our grad students had everything ready to write and publish from. Then I had an extensive literature review, but it was really helpful to have that background information. For the second half, I helped more with other people's studies as well. I learned how to use an EEG cap. Using those tools, I prepared patients for other studies, while working more hands-on with the pilot study for my thesis, applying for grants, and getting IRB approval.

Sydney: I was an undergraduate student through a summer research experience for undergraduates, so when I first showed up in the lab, I was introduced to a post-doctorate. She was my mentor for the majority of the project. I did have a PI, Dr. Danielle Benoit, who I met with, but most of my in-person interactions were with the post-doctorate. I learned how to independently run RT-qPCR, which is a polymerase chain reaction, a method for quantifying mRNA. I watched my post-doctorate do flow cytometry, which is another method for looking at certain markers in cells. I also cared for and maintained different cell lines independently, worked on different projects, and created a poster based on my results.

Faith: The volleyball collection data piece was one of my smaller roles, but it was definitely more frequent. We had equipment called the Polar Team Pro system, so I attended the team volleyball practices and used a program on an iPad that connected to heart monitors that the athletes wore. It would collect data on their heart rate and workload. Based on the program's data, we could evaluate each athlete's physical condition during the practice. Additionally, I was more involved in the ROTC cadet study from when it started in March 2021 until the end of May. We looked comparatively at traditional resistance training, minimal equipment resistance training and minimal equipment with blood flow restriction resistance training using various fitness measurements-body composition, muscular endurance and strength, and muscular power. Similar to a fitness trainer, I would lead athletes through a two-hour session based on the condition that they were assigned, teaching them how to properly execute each exercise. A two-hour resistance training session can be physically grueling and mentally challenging, so I provided guidance and encouragement throughout to help keep the cadets motivated.

WHAT DID YOUR DAILY ACTIVITIES AS A RESEARCHER LOOK LIKE?

Madison: It depended on where it was in the project. I tried to make a concrete written literature review by reading a little bit of literature every day, then writing about it once in a while. Towards the end of the project, it definitely was hands-on, and included performing phone screens to recruit participants and learning how to use the KINARM machine and EGG cap. There was more focus towards getting the study started, checking our boxes, writing grants and getting IRB approval.

Sydney: I would go into the lab once every two days or so, and I would take out my cells in their culture media,

and count their viability. If they were at a pretty high viability, then they were doing good. I would split the cells by taking some of the cells out and throwing them away, so that the other ones can grow with more resources and room. I would replace their media by taking the cells out and putting them in a centrifugal tube, then spinning them down to a little cell pellet at the bottom. Then I removed the media on top, which has the waste products. I replaced them with new media, put them back into their dish or flask, then returned them to the incubator. Cells can be grown for maintenance by keeping them in the same size container or for expansion by moving the cells to another container to grow more cells for experiments. When I wasn't working with the cells, I was doing data analysis, reading literature to learn more about research in the area of my project, or attending seminars.
Faith: I worked with the collegiate teams. I did a lot of fitness measurements with the men's and women's tennis, the men's soccer, and the women's indoor volleyball teams. So, with the tennis athletes, we did TRAZER-a reaction time test, BOD POD, VO2max, and vertical jump testing. For the men's soccer team, I helped collect vertical jump data from the players. This data was used in a study in the lab that looked at asymmetry in vertical jumping heights and hip injury. Based on the heart rate and workload data collection for the women's volleyball team, we hypothesized about each athlete's physical condition. This included potential injury or dietary concerns such as not eating sufficient amounts of food or staying hydrated. In the blood flow restriction study with the ROTC cadets, I did the training sessions and fitness testing measurements. We had a team of about 14-15 with 15 cadets total, and 3-5 athletes in training sessions at a time, and with eight hours of training a week per cadet, I trained the same ROTC cadets regularly. I made it my goal to build a good working relationship with each person, so they felt comfortable with me instructing and giving exercise guidance. They got excited about coming to the lab and exercising. Being able to perform fitness tests for several weeks in the lab was something that helped me develop all of my research skills.

TELL US HOW YOUR RESEARCH HAS PUSHED THE LIMITS OF WHAT HAS BEEN DONE BEFORE.

Madison: It was breaking it down into little pieces. We knew that dance is helpful, but is it the music that makes it helpful? Is it having a partner in the dance? Is it a combination of all of the different things together? We made sure that we had a realistic scope for what we could do with our time, breaking it down into much smaller parts.
Sydney: For the University of Rochester project, we were trying to see if we could use this particular cocktail of growth factors to cause the mesenchymal stem cells to differentiate into another cell type that could then be used for future research. So, it was definitely looking into the personalized medicine aspect and trying to see if this could be a viable animal model for something that could be applied in human medicine.
Faith: The ROTC study pushed the bounds of physical training on a biological level within the human body so that we can achieve peak levels of physical fitness quicker. It was a grant-funded research project aiming to support this resistance training method for the U.S. military to officially integrate into military channels as a way to save money and shorten training time. A method like minimal equipment and BFR is safer because it negates the necessity of heavy, traditional equipment that can put someone at high risk for injury if used improperly or overloaded. With the BFR and minimal equipment, equipment is reduced down to some cuffs that go around the arms and legs, essentially like blood pressure cuffs. It could include sand bags, and maybe a mat for you to do your body weight exercises on and maybe a pull-up bar. It's much more portable, it's safer, it's less expensive. It just makes exercise more efficient.

WHAT WAS YOUR FAVORITE ASPECT ABOUT RESEARCH? WHAT WAS YOUR LEAST FAVORITE ASPECT?

Madison: I'm really interested in clinical practice and I'm hoping to be a physical therapist, so my least favorite aspect was how research felt very slow. Getting IRB approval and getting grants takes a lot of writing and time. It took some adjusting because I didn't realize how much time and intentionality it took to get the study started. The best part was that we were able to recruit one participant and see his perspective. He didn't finish the whole study, but it was cool to see him. Our participants were going to be compensated for travel time and different

hings. He was so sweet. He said, "I don't want to be compensated. You are trying to see about a disease that I have that I would like to know more about." It was amazing to see how thankful and grateful he was for the fact that research was being done.

Sydney: Research to me is so incredible because you are looking at a particular research question, investigating something that no one in the world knows. It's so exciting because you get to work with people from all over the world (if you want to), who are also interested in this research question. My least favorite part about research is that you fail. A lot. It's also hard to fight for grant money. You might think that a research question is really interesting, but if you cannot convince the people that could fund you that your research project is really interesting, then sometimes you can't afford to do it.

Faith: My most favorite part was definitely the training and the lab tests because I loved hearing about it in class and learning about it. Doing it in an official capacity for data studies that professionals use is the exciting part where you feel like you've finally hopped into the real world. It provides some form of external validity that what you're doing matters and it's important to people. Having the human interaction aspect in the research lab was one of my most favorite parts with training and guiding people, developing those communication and leadership skills that you need when you have a job. My least favorite part was when it was over. I realized that especially during my senior year, I just wanted to be at the research lab and doing something that's like a job.

HOW DID PURSUING RESEARCH STRENGTHEN YOUR UNDERSTANDING OF YOUR UNDERGRADUATE STUDIES AND BEYOND?

Madison: I knew that I'd like to use dance as a mode of therapy for patients. Also, I grew up dancing and trained pre-professionally. I was really thankful that I majored in dance and was able to hold onto that. A typical path would be to do biology or exercise science because the curriculum will definitely prepare you for PT school. Having a multidisciplinary course of study was very enriching, even though I may not have had the curriculum for physical therapy at the very beginning. I enjoyed the different modes and types of learning. It's been so helpful to have been a dance major because I work with the intellectual, educational, kinesthetic, and body awareness parts of physical therapy. When I'm working in a clinic, I know how it feels because I know how my body moves.

Sydney: I was doing research in heart failure for two years before I took a class in undergrad that was called Human Anatomy and Physiology. Through that class, I had a lecture from one of my PI's collaborators, and he would ask me questions in class that related to my research. Research definitely gave me these connections with professors in my major and I gained confidence around approaching them to ask questions. It is definitely good to practice being able to return to old research ideas or even just have that knowledge stored somewhere in the back of your head. For my first PhD rotation in graduate school, I did a project in equine and canine orthopedics with a comparative aspect. This was a proteomics project and it really made me want to explore other areas of data analysis in veterinary medicine.

Faith: Research took everything I learned in the class and put it on a real-world application. In exercise science courses, you'll find that anything you learn at first seems so complicated, but as soon as you are able to apply it, it makes sense and is not too hard. My career goal is to be a physical therapist. I got accepted for USC's DPT program in the fall. That was my main goal, but after being with the research lab, I decided that I need to figure out a way to make research the other half of my career. So, after I finish DPT school, I'm going to stay at USC and complete their accelerated exercise science Ph.D. program in rehabilitation sciences or applied physiology. Research opened my eyes to how fascinating and exciting that can be. Not only will I have a different setting, but also potentially be on the edge of something that leads you to a bigger improvement or change. I want to be on the team when it happens. Interestingly, at the same time as the blood flow restriction study, I was completing my EXSC practicum at a physical therapy office that used the blood flow restriction to speed up healing time. It was fascinating to learn and see this method in action not only for performance purposes, but also for injury rehabilitation–the focus of my career.

HOW HAS YOUR RESEARCH FURTHERED YOUR INTEREST IN YOUR CHOSEN FUTURE CAREER?

Madison: I've been surprised about how well it fits into our curriculum now. A big tenant of the APTA, which is the American Physical Therapy Association, is practicing evidence based medicine. So, it's important that even as an in-person, in-clinic physical therapist, you have the skills to read about the research, then figure out how you want to apply or modify it. It's gratifying to see in PT school the different study types that I was able to learn about in undergrad. I feel very privileged and so thankful that I had the opportunity to pursue research in undergrad. It makes understanding these classes easier. Even more, it has facilitated a greater appreciation and interest in evidence based medicine, which is going to be so important for me to be a clinician.

Sydney: In some ways, research has helped me narrow down my interest, but in other ways, I have more interests because of the many opportunities. Seeing how engineering can be used in biology and with animals is something that I found amazing and intriguing. Through that, I realized that I want to do veterinary research and apply engineering to it. Combining those topics to help humans and animals was my big aspiration for going to veterinary school. What really ties everything together was starting in undergrad with the enzyme activity analysis project that I did in Dr. Spinale's lab. I like data and working on computers, then taking large data sets and turning them into something usable for research. Once I started research, I realized that research was a way for me to have that variety that I crave in a career.

Faith: I knew that I wanted to become a physical therapist since high school. Research refined that purpose in a way that as a physical therapist, I wanted to define standard practices for treating dance-related injuries. There's a ton of scientific literature on how dancers respond to sports medicine doctors compared to dance medicine doctors. Dancers are much more likely to listen to the advice of dance medicine doctors. It's a pioneering field that I'm passionate about. Research will allow me to develop standard practices for treating dance injuries. Treating an ankle sprain for a runner is different from treating an ankle sprain from a dancer because of the different ranges of motion and muscle groups used. So, it's all getting down to the specifics to make it a better experience for the athlete.

WHAT ENHANCEMENT ACTIVITIES DID YOU PARTICIPATE IN? FEEL FREE TO GO IN-DEPTH OR SPEAK BROADLY.

Madison: The basis of my GLD and research was how to highlight the importance of multidisciplinary work and really bridge gaps between different areas and studies of expertise that may not seem connected, but can inform each other. It was interesting to highlight the integration of how research practice and clinical practice can work together. I did observations at a clinical practice in West Columbia for a neurology and orthopedics rehabilitation. It was the most gratifying experience. It was really cool to appreciate and integrate the research that we were doing in the research pathway in the School of Public Health while thinking about the clinical work.

Sydney: I've been riding horses since I was a young child and I volunteered at a therapeutic riding center. That was one of my inspirations for attending veterinary school and I ended up using these experiences as an enhancement activity. I found out about this therapeutic riding center (hippotherapy) near my hometown of Lexington, South Carolina while I was transitioning from high school to college. I volunteered with them weekly for one semester. The summer following that experience, in 2020, I reached out to the director of the program to help design a pair of reins for one of the students to ride more effectively. She had been practicing riding one-handed, but the reins would help her steer using both of her shoulders and upper arms. That used concepts in project design from my introductory years of biomedical engineering classes. They used some ideas from my prototype in the final apparatus. I also served as a Magellan Ambassador during my senior year where I gave research presentations to University 101 classes and student organizations and I was inspired to do this for the GLD.

Faith: For my key insights, my main enhancement activities were my exercise science courses. Exercise Science (EXSC) 330 was a muscular physiology class with a lab component where I learned to do the vertical jump and VO2 max testing. There was also EXSC 355, which was a special topics class titled Motor Behavior and Everyday

Activities taught by Dr. Herter. In that class, I was looking at current literature, finding a knowledge gap, and writing a plausible research proposal. I learned about resiliency in research. That class allowed me to develop the skills in writing a research proposal. My Epidemiology (EPID) 410 class, connected to my third key insight about presenting research and engaging an audience with a leading message that leaves people with a lasting impression and spurs them to action. That class I did a semester-long infographic project on the prevalence of major depression in the college-aged group, so 18 to 25-year-olds. Also, I had a research intern position at a health economics company. My role was to look through present research literature to find data that would eventually get based onto a litigation team that would present the data in court. During that internship, I became skilled at reading research that was filled with jargon or hard to follow.

WHAT WAS YOUR EXPERIENCE WITH PRESENTING YOUR RESEARCH AT DISCOVER USC OR ANOTHER CONFERENCE?

Madison: It was a little different because of COVID. I translated it into a PowerPoint and did a voiceover, so that was my mode of presentation. It was very encouraging to reframe my perspective for presenting research as a chance to share that love and passion for having those experiences. Look at it less as "I have to know everything" and "I have to perform" and everything has to be right. Be able to say, "I put hard work into this. My team worked so hard. They were all helpful and this is an opportunity to share what I know. If I don't know, that's okay. That's another starting point to learn more and research." Look at presenting at Discover USC as not just an opportunity to perform and check all of the boxes, but an opportunity to really share what you've done and what your team has done.

Sydney: The Biomedical Engineering Society (BMES) annual conference in Philadelphia was where I presented on the endothelial differentiation of mesenchymal stem cells in 2019 and I used this as my presentation experience for GLD. Even though I wasn't presenting research from USC, I still connected with people in the biomedical engineering department at USC. As an undergraduate, you can definitely look at other posters, go to research talks, and learn more about the research, but one of the most beneficial parts of the conference is definitely the networking opportunities that it gives you. At that point, I had already decided to go to grad school, and I knew that I wanted to do veterinary school as well, so I had a list of schools that I wanted to apply for. I went to all of their tables and I said, "Hey, I'm really interested in this particular program. Do you know anything about it?" I made a connection there with someone from Cornell who introduced me to another professor there, who was my first rotation professor. I made a connection at this very first conference that is helping me now and this person has the potential to be my PI for my Ph.D.

Faith: When I presented at Discover USC, it was completely virtual. It was very underwhelming compared to what I think the real experience in-person would be. I think if it was in-person, maybe I would have had an easier time. The whole idea was that you're supposed to be in this virtual room with people and they're "walking" around clicking posters. It was very confusing, and I remember having a hard time explaining my poster to the person I talked to because we couldn't see each other.

WHAT DID YOU FOCUS ON IN YOUR EPORTFOLIO AND HOW DID YOU PREPARE FOR IT?

Madison: My ePortfolio focused on being a dance major, working clinically at a PT clinic, and researching and trying to articulate overall how all of those experiences are meaningful to me and how they connected to create a broader and richer understanding of my experiences. I did the UNIV 401 course because I was taking 21 credit hours and working a few different jobs, so I needed that extra structure. It was the push I needed to stay on track and not get behind. That's just how I work and I know myself that I needed the extra structure. I was also so thankful to have Dr. Milling's help, who is part of the dance program and on GLD faculty.

Sydney: For my ePortfolio, I wanted to learn how to incorporate all my various experiences into a cohesive idea. I struggled with this at first and really leaned on my GLD advisers to help me. I decided to try to focus on how to make research more accessible to everyone and also explain my path to graduate and professional school, since

it's an unusual route to take and I have really had to learn along the way. I worked a little bit on a lot of different projects so it was fun to tie everything together in a creative way.

Faith: I broke out from the typical mold of a GLD Research candidate. Doing the ePortfolio was difficult because I spoke about a whole host of experiences that I had as a research intern instead of a singular study. On the GLD page, they post examples of five-star portfolios and in all of the research ones, the student had completed their own research study. My professor for UNIV 401, Dr. Marketa Kubickova, was utterly fantastic. She was really open to what I had as a GLD candidate and was encouraging about being broader. She provided excellent advice on how to approach the writing of my key insights and how to tell a story with my portfolio.

WHAT ADVICE WOULD YOU GIVE TO A STUDENT CONSIDERING GLD IN RESEARCH?

Madison: As an undergrad student, I don't think I realized all of the resources that were available to me. Definitely do research. There are so many people that want you to succeed, and they want to provide you with as many opportunities as they can. With GLD, there are grants, research opportunities, basically everything. Know that opportunities are out there. I would encourage people to take hold of it. I'm still trying to figure out how to both take advantage of the many resources and opportunities offered me, while figuring out my own boundaries. Know yourself and what you can handle. Humble yourself and know that you can't do everything and that's okay. Have open communication with a research team or a research professor. Understand that the faculty wants you to succeed just as much as you do. Communicate with them, say what you are available for and what you're interested in, then work with them to create a plan.

Sydney: Don't be afraid to write about negative results, or to talk about something that didn't work because there's not enough of that in research. Unfortunately, things that don't work aren't what people want to read about, so it's not what people talk about. In order for people to avoid making the same mistakes, it's important to continue discussing what didn't work. In terms of recovering from failure, I've been pretty blessed in my research career and haven't had to recover from too many massive failures. But I also love troubleshooting, so when things did go wrong I really enjoyed trying to figure out what was wrong. Sometimes it was frustrating, but the process itself is something that you can learn to like. It's like solving a puzzle. In light of failure, know that the more things that you keep working towards, the more things you will eventually get. Keep your mind open to new experiences, any ways that you can learn more. Ask questions and be upfront when you don't know something because I've had professors tell me that they really appreciate that I do that. Don't be afraid to reach out to the GLD advisers if you find yourself struggling.

Faith: My biggest advice would be to get started as soon as possible. Don't procrastinate. If you have absolutely no idea where to start, either go to the GLD office or go to a trusted professor. I promise you that they've had a student who is interested in GLD come to them before and they can be your greatest resource, especially if they're a professor within your department. You don't even have to have the whole thing planned out either. If you had asked me what I had planned to do in order to complete my portfolio on day 1, I would have told you I have no idea. I found that it was all about the baby steps I took to build up my GLD experience along the way. Opportunities will come if you seek them out. I'm so thankful that I went to Dr. Troy Herter about GLD because he was able to point me to Dr. Arent and Dr. McFadden, who gave me the opportunity to be a part of their amazing lab. It was an invaluable experience, and I only wish I had more time with them. My lab team was like a family and that's something that I was very grateful for.

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A STORY ABOUT A VIRUS

HOW A FEW KEYWORDS CAN SHAPE YOUR CAREER

DARBY PORTER CHEMISTRY, CLASS OF 2023
WRITTEN BY AUDREY GALIMBA ASSOCIATE WRITER

Darby Porter's journey with research is a bit of a love story.

Even as a first-year student at the University of South Carolina, Porter knew she wanted to get involved with research. She started her search by attending a Getting Started in Research workshop through the Office of Undergraduate Research. They directed Porter to the Faculty Research Database. While many research biographies may seem overwhelming at first, a few words caught Porter's eye: "HIV" (human immunodeficiency virus) and "dopamine". These keywords introduced Porter to her current mentor, Dr. Jun Zhu, a professor of drug discovery and biomedical sciences. Dr. Zhu's work—developing drugs to treat neurodegenerative disorders—piqued Porter's interest, so she decided to cold email him. Porter's enthusiastic approach worked. "I started working in Dr. Zhu's lab in the first semester of my freshman year, and I loved it!"

When Porter was first introduced to the lab, she was really excited. However, Porter notes that she was scared to make mistakes in the laboratory. For example, contaminating any of the materials used for cell culture Porter works with may result in the infection of all of their cells. After training, Porter became familiar with the laboratory techniques, and she got to know the other members of the lab through lab meetings and shadowing graduate students.

HIGHLIGHTING HIV

HIV weakens the immune system by destroying the cells that fight infections. While there is no cure for the virus, it can be controlled with proper care. Untreated HIV can lead to AIDS (acquired immunodeficiency syndrome).

Porter's work focuses on neuronal HIV infections and drug addiction.

Fifty to seventy percent of all HIV-positive individuals experience some level of neurocognitive deficit related to HIV. This happens even if patients use medications to suppress the infection. These neurocognitive deficits are called HIV-1 Associated Neurocognitive Disorders (HAND). Symptoms include lack of muscle control, behavioral changes, and memory impairment. There is strong evidence that dopamine pathways—which affect processes ranging from movement to motivation—are the main neurotransmitter systems dysregulated in HAND. Porter's project aims to develop a drug that reduces the effect of HAND. There are currently no FDA-approved drugs for the treatment of neuronal HIV infections, and Porter's group is trying to specifically remedy this by developing a compound that could act as a therapeutic. Because HAND is exacerbated by cocaine use—and many HIV-positive individuals suffer from drug abuse disorder—Dr. Zhu's group hopes to find a potential treatment for HAND and cocaine addiction.

Porter's research project has the potential to impact millions of people around the world. There are about 38 million people living with HIV globally, and the majority of them will develop HAND. South Carolina ranks high nationally for HIV transmission, and the midlands are a hotspot for new HIV cases. Thus, this project has the potential to impact numerous people locally and nationally.

In the spring of Porter's freshman year, COVID-19 hit, and everyone was forced out of the lab. Thankfully, her research mentor was able to let Porter come back to the lab the following summer. Most days, Porter performs cell culture. The Zhu lab uses cells that are fairly fast-growing, so they need to be taken care of every day so they have enough space to grow and enough nutrients to grow correctly. Porter runs between 2-3 experiments per week, and these take about 5 hours from start to finish with two preparatory days before she runs the actual assay.

Porter tries to work the classes she takes around her experiment schedule in the lab. "Research is something that really reflects the time and effort you put in. I really enjoy my project, and it is something that I have become passionate about. Because of this, I dedicate as much time as I can to it."

Porter also volunteers at CAN Community Health, a nonprofit community health organization that offers full panel sexually-transmitted infection and disease testing with a large focus on making HIV testing available across the Columbia area. As a pre-medical student, Porter got involved because she wanted to find an intersection between patient interactions and her research project. Porter is certified to test for HIV, and she enjoys educating people about transmission, prevention, and treatment. She has found herself passionate about the social issues surrounding neuronal HIV infections, especially as this condition is particularly prevalent in South Carolina.

Porter is currently working on a peer-reviewed manuscript, and once she collects an additional set of data and writes the protocol, she hopes to submit the paper for publication by early May!

When asked about her expectations about research, "I think all of my expectations have been exceeded," Porter says. Conducting research has opened up many opportunities for her, from conference presentations to national fellowships.

Getting involved in undergraduate research has actually changed what Porter plans to do after graduation. "Before starting research, I wanted to pursue an MD, but now I want to complete an MD-PhD program focusing on developing therapeutics for transmissible neurodegenerative disorders." Her long-term goal is to conduct clinical trial research.

For anyone interested in research, Porter says that "growing cells in a dish is pretty cool." She encourages anyone who is interested in research in any field—from science to the performing arts—to give it a shot, because you may just fall in love with a project.

A STORY ABOUT EMPOWERING DATA-DRIVEN MANUFACTURING

MATTHEW GODBOLD MECHANICAL ENGINEERING, CLASS OF 2022
WRITTEN BY NICOLE HAMNER ASSOCIATE WRITER

Matthew Godbold has worked in undergraduate research for the past three years but getting involved was just the beginning of his journey. As a freshman Mechanical Engineering major, he had already heard of the research the university had to offer. The following semester, Matthew asked about available opportunities and soon began working on data collection and processing for Dr. Wehbe as part of the neXt research team under Dr. Harik. From the very beginning, he saw the camaraderie within the lab. Although the learning curve was steep and often overwhelming, everyone in the lab was welcoming, understanding, and willing to help you learn.

These were his fondest memories of research in his undergraduate years. One example that Matthew mentioned, was that on Friday afternoons, everyone would gather in the office and conjure up ideas, many of which ended up influencing the direction of research. Matthew's strongest piece of advice is to inquire about anything that interests or perplexes you; no one expects you to be an expert when you first join a lab. His research has allowed him to gain invaluable experience with concepts not only learned in the classroom, but industry-demanding skills. He was able to foster life-long friendships, develop soft skills, and establish professional connections with industry and research leaders, such as NASA, Boeing, Toray, VERICUT, and NIAR.

His research accomplishments did not come without hard work. Matthew applied for the Undergraduate NASA SC Space Grant, along with the McNair Junior Fellow Scholarship his sophomore year and was awarded both the assistantship and scholarship his junior year, which allowed him to work on his undergraduate research topic. His project had three goals: (1) find the effect of Automated Fiber Placement process parameters on defect

formation during manufacturing by quantifying the number of defects that occur in each course, (2) obtain an optimized set of process parameters, and (3) use these optimized process parameters to reduce the number of defects when steering tows over a cylindrical tool for future manufacturing programming. In summary, Matthew is working to create an optimized manufacturing process that will eliminate mistakes, or defects, from being repeated.

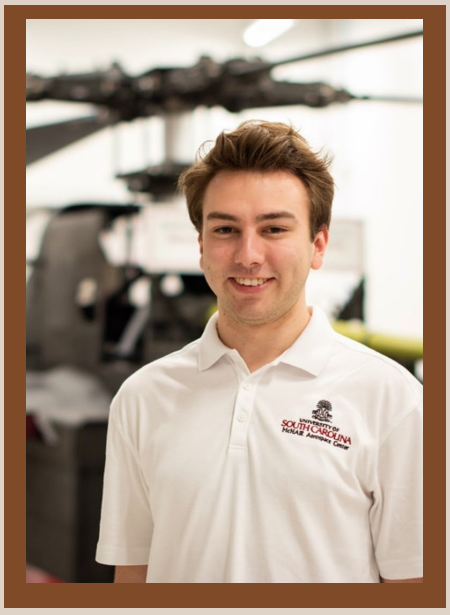
While working on his undergraduate research topic, he was able to correlate defect production to process parameters and determine not only the dominant feature but rank all relevant processing parameters on their influence of defect formation. From the analysis, Matthew determined that curvature of the surface's path was the most important feature in the production of defects.

Three years later, Matthew is working to integrate artificial intelligence (AI) into automated fiber placement (AFP) to permit a closed-loop AFP system. It will allow for design parameters to be adjusted based on defect production from previously manufactured parts. An AFP system is an additive manufacturing process and an advanced method to manufacture composite materials. The AFP process starts with strands of carbon fiber, that are thinner than hair, collected into quarter inch strips called tows. The machine then applies heat and pressure to form courses, with the final product being laminates that comprise aerospace structures. Matthew is working to optimize this multivariable process through artificial intelligence.

From this, a cyber infrastructure can be established ultimately developing a smart digital avatar empowered by data-driven manufacturing events. So, when manufacturing future structures, the smart avatar will be capable of predicting issues, and suggesting a solution, without the researcher or engineer having to manufacture the part. This allows for high-rate minimal defect manufacturing with rapid and optimized process planning. Who might benefit from this? Any composite manufacturing company utilizing the AFP process; however, if applied to other manufacturing processes, the opportunities are endless.

Matthew is currently working on obtaining his Master of Science in Mechanical Engineering from the University of South Carolina. First he must perform a literature review on the topic. The literature review will help him determine the research already performed and identify what is unknown in his topic. He is trying to find where people have implemented data-driven models within composites, manufacturing in general, and abroad such as the medical field.

Just like sharing knowledge within his own research lab influenced the direction of research for Matthew, it is equally important to share research further to gain more knowledge and spark more ideas. After three years, his research is still building, evolving, and attracting attention from industry leaders. He was recently awarded the Graduate NASA SC Space Grant Assistantship for his master's research. Matthew's future is bright with an extensive research-based foundation towards reaching his goal of working for an aerospace startup.



A STORY ABOUT NONLINEAR PATHS AND CURIOUS QUESTIONS

JULIE MORRIS DIRECTOR OF THE OUR
WRITTEN BY HENY PATEL EDITOR-IN-CHIEF

Julie Morris is the founding director of the University of South Carolina Office of Undergraduate Research and she served as the director for 18 years. She retired from the position in spring 2022. Furthermore, she contributed to Carolina CrossTalk as the faculty advisor from summer 2021 to spring 2022. Special thanks to Julie for supporting our magazine and for fostering a partnership between the Office of Undergraduate Research and Carolina CrossTalk!

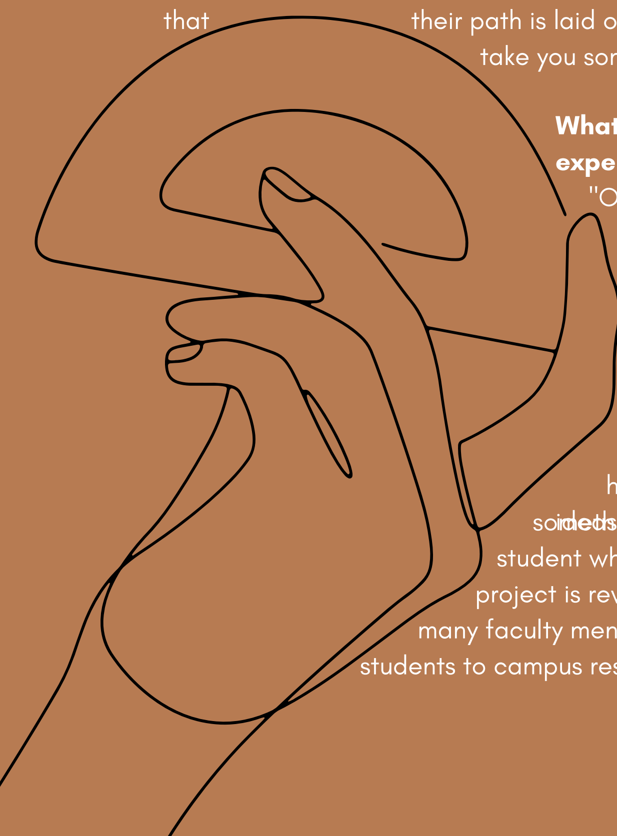
Explain how you got involved with research and the OUR. What were your pathways and connections to research?

"I came to the University of South Carolina as a graduate student for my master's program in genetic counseling and I've been here ever since—25 years! I love that the Fall 2021 Issue is about different research stories because I think it's such an important way to look at research experiences. So many pathways don't go straight and you may end up in places you would never expect. Take mine, for instance. My undergraduate years were at Michigan State, where I was a biochemistry/biotechnology major and I had planned to go into genetic research. I was first exposed to genetics in 5th grade and I completely fell in love with it. Since I wanted to do genetic research, you would think I would actively seek research at university. However, at the time, research wasn't as common as it is at UofSC. But, it was a requirement for my major, so I was directed to a faculty member doing genetic research. My faculty research mentor had never mentored an undergraduate student researcher before, so neither of us had any clue what to do. The funny thing is that one of the reasons why I'm so passionate about the undergraduate research experience is because mine was not great; not what it could be: I was all alone in the lab in a basement and I had no idea if I was doing anything right. This made me go: well, if this is what genetics research is about, then it's not for me. I was a second-semester junior at that point and I was supposed to be applying to graduate school, but I made the decision to change my entire career trajectory and came down to UofSC for the master's program in genetic counseling. This is a fantastic program, but again not the right fit for me. However, my experiences from the master's program enhanced my science background with a curriculum in social sciences. Shortly after I got my master's, I started working in a research lab, followed by experiences as a research coordinator in the College of Pharmacy and a program manager in the College of Engineering and Computing. Then, my current position as the founding director of the Office of Undergraduate Research became available. A friend

encouraged me to apply because I had experience with both social sciences and sciences, plus a love of theater and history. The exposure to different disciplines made this position the perfect fit for me. On top of that, I was extremely passionate about making sure students did not go through the awkward experiences I had in undergraduate research. Because of my zigzag pathway to my present position, I can identify with both types of students seeking research: those that know what they want to do and those that have no idea. I think that being able to see both sides and being able to help students through the transition is the most rewarding part of my job."

As the director of the OUR, what is your approach to guiding undergraduate student researchers?
"I believe that, even though every student is different and has a unique mindset and unique goals, research is universal in that research is about asking questions. Many students, myself included, are intimidated by research, so I try to take it down to one simple but important question: what are you curious about? Research is about trying new experiences and exploring different experiences. It's about figuring out what you think you want to do and, equally important, figuring out what you don't want to do. One of the first students I worked with was extremely fascinated by physics—she was a physics major and got involved in physics-centered research. But she then ended up as a Media Arts student. A complete turnaround. Physics was not a fit for her journey. It's okay to not know what you want to do and to take a moment to ask yourself what makes you curious. My favorite pieces of CrossTalk have been reading about those moments when students transform their journey—when they're going through this "hey, I don't know what to do" phase and their curiosities progressively get clearer once they get deeper and deeper into research. It's also a joy to see a student researcher and their faculty mentor talk about their shared curiosities."

What are some of your favorite aspects of your position?
"It always comes back to you, the student, and seeing the moment of transformation. I hear this sentiment so often from the faculty that the best part of working with undergraduates is the 'aha' moment where students realize 'I love this' or 'I don't love this.' Finding that place in their journey. I also love getting to hear about what students are learning. Learning things I didn't even know existed. I see the projects that come in for Discover UofSC (we get to skim over the abstracts and walk through the presentations) and, every year, the topics never cease to amaze me. The excitement that gets generated at the event is inspiring! I love that for this CrossTalk issue, you're getting perspectives of faculty mentors that have gone down the path and students that are tracing their path. Because I think the research journey is about seeing where things take you. So many people I've talked to think that their path is laid out straight ahead for them. But more often, a conversation or meeting can take you somewhere you never expect."



What might students look for or expect with a faculty-mentored research experience?
"One is to dismiss the misconception that students have to know a lot before they get started in research. Our faculty mentors know that students don't have a deep level of knowledge yet. Research experiences are another form of teaching and learning where knowledge and skills are taught. Faculty are there as a support structure and to give students a glimpse into the life of a professional in the field. And then, in the process, the relationship advances, and students and mentors begin working hand in hand. A lot of faculty like this stage, where students bring up their own ideas and perspectives for the project—"hey, I thought about this" or "let's try something else." That progression in knowledge and being able to support a student when they take on their question or get to take ownership of a piece of the project is rewarding. But that's not the only part of a mentored research experience, many faculty mentors also help in terms of academics, balancing personal life, or guiding students to campus resources. We all go through struggles, life happens, navigating this is

important and requires open and honest communication. Don't be afraid to share your struggles, challenges, and successes, because you are not just a researcher, you're an entire person. We want, and expect, to help each other."

What is your advice for an undergraduate student looking to get started in research?
"I desperately try to share that research isn't scary. It's about asking questions. What are you excited/motivated about? What do you want to learn more about? And that faculty aren't scary. The best thing to remember when you approach a faculty mentor and ask them about their research is that you're asking them about something they LOVE to talk about. When you have a conversation with them about their research, you're gonna open the floodgates. It's not scary. You're asking them about something they want to talk about. You're gonna have an amazing conversation by asking a faculty "so you're interested in such and such; tell me a little about it. I want to learn more." Just take that step and try it. It's also okay to not like the research you are working on If that isn't the right fit for you, then you should try something else. Many students have come to me over the years expressing hesitation and doubts about what to do when the project isn't the right fit. Your mentor cares about you and wants you to love what you're doing. It's okay to go to your mentor and talk it through. "This isn't the right fit for me and I'm kinda curious about this topic." Mentors want you to find what you will love to do and help you succeed."

What are some qualities you value in an undergraduate student researcher? What are some of your expectations?
"When I first got involved in research as an undergraduate student, I had the same mindset that a lot of students initially have: "the faculty member is going to expect me to be proficient and experienced in certain topics and skills." Over the years, I've asked faculty mentors for their expectations of students and I've found some similarities: "Motivated to learn. Excited about a topic." That's it. So simple. If you can check off those prerequisites, then the mentor is there to teach you everything else. You have classes that cover broad topics but a research project tends to be focused on a specific topic and unless you dive deep into the subject, you're not gonna have much background on it. I will add "willingness to ask questions" to those prerequisites too. That's one reason I had a bad research experience: I was afraid to ask questions and wasn't sure what questions to ask. I encourage you to overcome that fear and go up to your professor or a potential mentor—and simply ask a question. They want you to ask. Putting it into perspective: we can't read each other's minds so it's important to communicate your questions. They want to help you. And take the opportunity to have different conversations with different people. You never know what questions may lead you onto a whole new exciting path."

Photo taken by Forrest Clonts, Public Information Director, Office of Research
Taken at Discover UofSC, April 22, 2022.

WANT TO GET STARTED IN RESEARCH?

Make an appointment with the Office of Undergraduate Research or attend one of their workshops! They are dedicated to making sure that every student in every discipline has the chance to ask questions in research and pursue the answers!

REGISTER YOUR PROJECT
GET FUNDING FOR YOUR WORK
CONNECT WITH FACULTY
GET STARTED

GETTING STARTED IN RESEARCH? ALL THE RESOURCES YOU NEED AND MORE:

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A STORY ABOUT BONES AND DISEASE

WRITTEN BY SAVANNAH KEATING BIOLOGICAL SCIENCES AND ANTHROPOLOGY, CLASS OF 2023
EDITED BY HENY PATEL EDITOR-IN-CHIEF

University students, especially those within STEM fields, are encouraged to get involved in research. We often hear about the numerous opportunities, how good the experience will look on our curriculum vitaes, and the ease of getting involved in the plethora of diverse labs available at our Tier 1 Research university. However, many undergraduate students, including me, find it difficult to obtain a position within a lab, yet alone a lab that aligns with their interests in their respective field. From cold emails to interviews with research faculty, the process can seem daunting even with incredible resources, such as the Office of Undergraduate Research at UofSC, that lay out the process through numerous workshops and online resources. Through my story I hope to share that the process of getting involved with research as an undergraduate student is rarely linear and that as long as you are working hard to find your passion or exploring something you are curious about - you can't go wrong.

The beginning of my sophomore year, I was ready to get started in research. I attended a "Getting Started in Research" workshop at the OUR and sat down with an OUR staff member for an advising appointment, where I began sorting through the faculty research database. With most of my classes still online due to the COVID-19 pandemic, I had not made many strong connections with faculty yet. So, even with all the preparation provided by OUR, when the time came to begin cold emailing, I was terrified. After sending one email to a faculty researcher I was interested in speaking with and then not getting a response back, I was too scared to email anyone else, yet alone email that same faculty member again because of the fear of bothering already busy and overworked people. As undergraduate students, we are taught to be assertive and put ourselves out there, especially when it comes to opportunities, but the fear of rejection can really hold us back.

For the rest of fall semester, I concentrated on my coursework, organizations, and job with the hope that by staying involved, I could strengthen my experiences within relevant activities such as leadership roles in organizations I was passionate about and classes pertaining to my research interests. As for getting involved with research again, I decided to pick that interest up the spring semester of my sophomore year instead which took some of the pressure off. By the spring, I was feeling hopeful because my biological sciences advisor, noting my double major in biology and anthropology, mentioned that I should get in contact with McKissick Museum's Natural History department. I jumped at this suggestion as natural history was one of my main research interests. I sent an email to the faculty contact my advisor gave me. I simply introduced myself and my interests with the hope of the museum's natural history curator having a volunteer position available for me. A week later I heard back from the head curator, Christian Cicimurri, to schedule a chat concerning the types of projects I would be interested in.

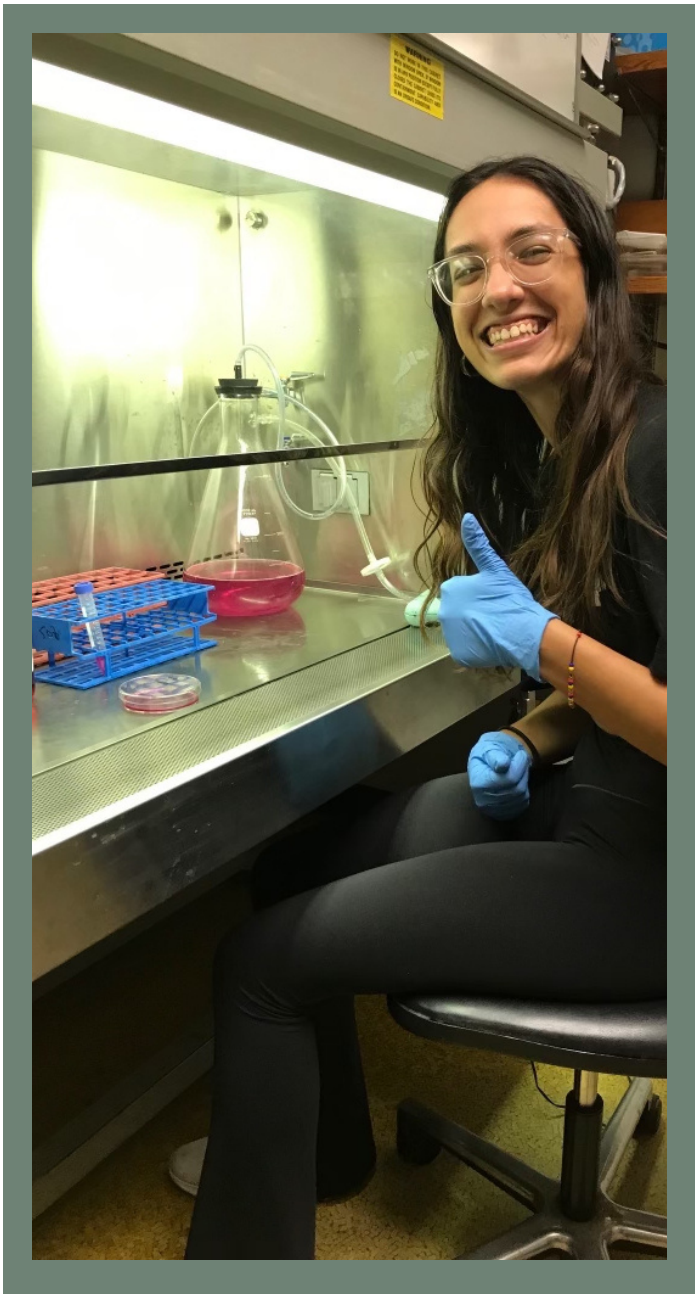
After a successful chat, I began volunteering and within a month, I was offered a position working on the natural history department's current grant funded project. Christian Cicimurri took a chance on me—an inexperienced sophomore whose sole criteria was that she loved museums, science, and fossils—and has taught me so many things since January 2021. I never would have found this opportunity in a faculty research database or without being in the right place at the right time (i.e., my biological sciences advising meeting) and without, to put it in colloquial terms, 'shooting my shot.'

My work on McKissick Museum's natural history project, *Historic Southern Naturalists: Bringing USC's History & Natural History Together Online*, continued throughout my sophomore year summer and into junior year. This project allowed me to learn about McKissick Museum's extensive natural history collection as I worked hands-on with the collection. I have loved working on the project and am still actively working to finish it up by this coming May 2022. However, I knew that it was not the area of research that I was truly passionate about continuing into my graduate education. During my sophomore year, I began to read about various research areas that overlapped with natural history. I became very interested in biological anthropology research, specifically the spread of diseases and how they interact with different populations in different ways due to a population's demographics, historic events, and societal factors. I was aware of a faculty member within the anthropology department that conducted research on topics within these very areas, but fear of being an annoyance or worse - not getting a response - kept me from contacting her, Dr. Sharon DeWitte, initially. Instead, I looked to see what courses she would be teaching in the fall semester of my junior year, and when it came time to register, I enrolled in her course: Plagues - Past and Present. Enrolling in a course with a professor actively involved in research can allow you to not only get to know the professor in a less intimidating setting but can also allow you to learn more about your own areas of interest since often they will be teaching courses that align with their research! This was a good way for me, someone that was involved in research but still doubting herself, to learn more about what I was interested in a setting I was comfortable in.

During the fall semester, I quickly fell in love with the content of Dr. DeWitte's course, and the course's readings, assignments, and lectures all allowed me to learn more and delve into the field I was interested in doing research within. Evidentially, my passion for the course content was evident in my assignment responses and one day Dr. DeWitte left a comment on my paper to talk about doing research with her the following semester - I did shriek a little from happiness when I saw the comment. Finding a research mentor semi-organically in my wanted area of research made it a less stressful process for me as I wasn't even thinking about getting involved in her research at that point. Instead, I was focused on learning more about what I was passionate about - which is what university is all about at the end of the day. As students we can get really wrapped up in where we 'should' be in our journey and what things we should be checking off such as involvement in research, pre-health/graduate school exams, and how far along we are in our coursework. Although these things are important, school is first and foremost about learning about what you are passionate about, and when we invest in it, often other opportunities that align with our goals materialize.

I am now working with Dr. DeWitte on a project entitled Temporal Trends in Health in the Context of Plague, Famine, and Urbanization in Medieval England. It focuses on the analysis of data obtained by Dr. DeWitte from human skeletal remains excavated from medieval and post-medieval cemeteries (c. 1000 – 1739 CE) in/near London, England to identify how health at the individual and population levels changed over time in the context of mortality crises such as periods of famine and plague. Specifically, I am analyzing data on the presence of skeletal pathologies to observe if trends exist between the presence of these stress indicators and survivorship in medieval and post-medieval London. This project will hopefully be informative about the effects of famine, produced by climate change, the introduction of novel diseases such as plague, and urbanization on the presence and type of skeletal lesions indicative of stress.

My story of getting involved in both of my research projects with McKissick Museum and Dr. DeWitte is the result of delving into what I was interested in and talking about it to my advisors, reading about it in academic journals, and taking classes relevant to my interests. It shows that there is no 'right' way to get involved with research. No matter how many cold emails one sends or getting started in research workshops one attends - sometimes it just takes talking to the right person whether that person is your advisor, a student in one of your classes, or your professors. It's easy to get discouraged and even easier to not feel qualified to even send an email to a professor but at the end of the day, taking chances will one day pan out, often in unforeseen ways.



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