

CAROLINA

# CROSSTALK

ISSUE 4, FALL 2021



**EDITOR IN CHIEF**

HENY PATEL

**SOCIAL MEDIA MANAGER**

ESHA HEGDE

**ASSOCIATE WRITERS**

MADelyn WESTON

RILEY WATSON

AUDREY GALIMBA

ISABELA VALENTA

HENY PATEL

**EDITORS**

CARLY LOVE

SAVANNAH KEATING

**PHOTOGRAPHER**

IMAGINE PATTERSON

**DESIGN EDITOR**

JUHI PATEL

COVER DESIGN BY JUHI PATEL  
PHOTO BY FREDSON SILVA ON PEXEL

**CAROLINA**  
**CROSSTALK**  
ISSUE 4, FALL 2021

# CONTENTS

## 1 LETTER FROM THE EDITOR

### RESEARCHING REMOTELY

CARBON POTENTIAL GENERATION THROUGH SYMBOLIC REGRESSION

## 2



**ANDREW ELDRIDGE**

## 5

### WANT TO GET INVOLVED?

MORE INFO ON CAROLINA CROSSTALK



**MARYAH NASIR**

6

**FAMILY & FILM**

FINDING THE PIECES

**WANT TO GET STARTED IN RESEARCH?**

MORE INFO FROM THE OFFICE OF UNDERGRADUATE RESEARCH

9

**UNDERSTANDING THE  
VALUE OF SMALL  
ORGANISMS**

EXPLORING HOW eDNA  
REVEALS HIDDEN  
BIODIVERSITY IN OYSTER  
REEFS

10



**IESHA WHITTAKER**

15

**WANT LEADERSHIP DISTINCTION FOR  
RESEARCH?**

MORE INFO ON THE GLD PATHWAY

16

**NATALIE BROWN**

**BARBERSHOPS, BEAUTY SALONS, AND BANKNOTES**

AN INVESTIGATION OF HOW COVID-19 HAS IMPACTED COMMUNITY ANCHORS



# 18

**SHUVANGEE DHAR, AUDREY GALIMBA, AVI PATEL**

## **DIFFERENT PARTS OF THE (RESEARCH) PUZZLE**

INSIGHTS FROM A RESEARCH TEAM

# CONTENTS

### **CONTRIBUTORS & RESEARCHERS FEATURED**

ANDREW ELDRIDGE  
MARYAH NASIR  
IESHA WHITTAKER  
NATALIE BROWN  
SHUVANGEE DHAR  
AUDREY GALIMBA  
AVI PATEL

## DIMENSIONS OF DIVERSITY IN RESEARCH

# LETTER FROM THE EDITOR

Simply put, the term “diversity” implies a variety of differences. However, in the world and communities we live in, “diversity” goes beyond such a simplified definition. Its many complex dimensions include, but of course not limited to, gender, religion, race, ethnicity, age, physical/mental ability, sexual orientation, family circumstances, education, socioeconomic background, nationality, and geographics. Some dimensions are seemingly apparent while other dimensions are more invisible and require more curiosity and empathy to uncover. Diversity of thought is one dimension that isn’t necessarily understood just by one glance; it requires conversations with a myriad of viewpoints and listening to them with respect and honesty. While diversity of thought is crucial for fostering creative environments and innovation, it is just as crucial to recognize that thoughts originate from people in the first place, so diversity of thought and diversity of people are not mutually exclusive. If you think about it, it’s astonishing how every person we have encountered and will encounter in our lives continue to bring the term “diversity” to life, creating a world teeming with countless vibrant stories. “Diversity” doesn’t define people; people define the term. The kaleidoscope of human diversity expresses so many shapes and colors, always morphing and in ceaseless motion. Though, it is important to be intentional when it comes to recognizing diversity because the danger of doing otherwise may reduce the term to a piece of aimless, meaningless jargon. To truly understand diversity is to acknowledge but also encourage the existence of an array of differences and to let yourself be transformed by those differences because at the end of the day, no one single person can ever be “diverse” alone.

This Carolina CrossTalk magazine issue intends to illuminate the diversity of people and diversity of thought within our UofSC research community. From unconventional modes of research to multifaceted inspirations for research to the convergence of various research areas to distinct life experiences to collaboration among researchers, the stories encompassed in the next few pages are living embodiments of “diversity.” Collectively, these individuals challenge the traditional borders of research and what it means to be an undergraduate researcher, indirectly empowering others to embrace their differences and pursue the intersections of different research fields. That being said, the narratives in this issue and the past issues are nowhere close to being representative of the diverse researchers and research fields we are surrounded by, so the CrossTalk team hopes to tell even more diverse stories in the next issues and give voice to those willing to share their own personalized research story—because we hold multitudes within us.

Henry  
Patel

**HENRY PATEL** EDITOR-IN-CHIEF

# RESEARCHING REMOTELY

## CARBON POTENTIAL GENERATION THROUGH SYMBOLIC REGRESSION

ANDREW ELDRIDGE COMPUTER SCIENCE, MATHEMATICS, CLASS OF 2023

WRITTEN BY ISABELA VALENTA ASSOCIATE WRITER AND ANDREW ELDRIDGE

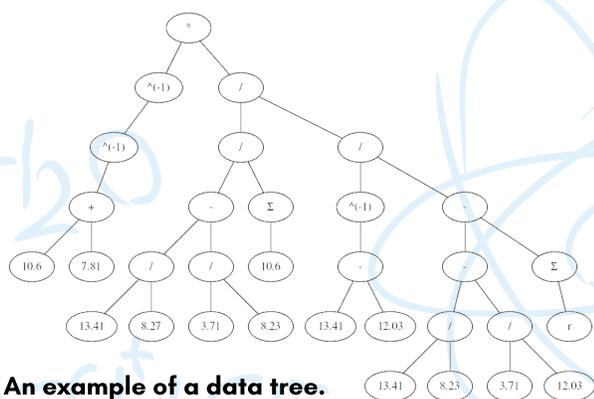
The word “research” often evokes images of a fancy laboratory and bubbling chemical beakers. Research, however, can take on many shapes and forms, allowing one to work completely remotely from one’s desk if necessary. This is the reality for Andrew Eldridge, a junior computer science and math major at the University of South Carolina, who is conducting his research project on carbon potential generation through symbolic regression. Although Andrew has been working in the The Machine Learning and Evolutionary laboratory since the beginning of last semester with Dr. Jianjun Hu of the computer science and engineering department and Dr. Ming Hu of the mechanical engineering department, he has never stepped foot in the lab in person because he works remotely. Andrew utilizes a computer tunneling protocol to access a remote lab server and complete tasks which would otherwise require presence in the lab. He is able to upload his work from his personal machine and run it on the lab’s server or the university’s Higher Performance Computing cluster, which contains thousands of nodes. Using this cluster, computations which would

take weeks on a personal computer can be completed in a matter of hours.

At the most basic level, the goal of Andrew’s research project is to generate a carbon potential function to be utilized for the discovery of atomically stable carbon allotropes (e.g. diamond, graphite, graphene, carbon nanotubes, and amorphous carbon) with desirable physical properties. A potential function is simply any mathematical expression which represents a physical potential - in this case the net energy of a carbon system, such as a diamond or graphite configuration. While many of these functions have already been created in the past for carbon allotropes, the lab’s goal is to try and create a more efficient and accurate function. Existing potentials have largely been generated in the form of neural networks, which are essentially computational models of the human brain and the neurons which compose it. The main problem posed by neural network-based carbon potentials is

their inability to extrapolate well beyond a training set. Andrew hopes to address this generalization issue by replacing the “black box” processes of a neural network with a well-defined mathematical expression.

The process used for this is genetic programming, where the genetic process of natural selection is modeled on a computer, and millions of iterations of a generate-and-test process are run on a program, similar to how desirable traits are generated and selected for across many generations in the biological process of natural selection. The genetic algorithm searches an extremely large solution space trying to get the optimal solution given the training data. Andrew uses what is called symbolic regression to generate data trees representing mathematical expressions in combination with the genetic algorithm to identify an optimal potential function. The process of symbolic regression can be thought of as similar to its more well-known counterpart, linear regression, except symbolic regression explores the space of all mathematical expressions rather than strictly linear solutions.



**An example of a data tree.**

Although the research process expects hard work and time commitment, Andrew finds enjoyment in the process. He states that “the moments that I enjoy the most are the “eureka” moments where you figure out something that you’ve been poring over for a long time, and I think that’s the entire research process for me.” For instance, he often finds himself in situations where he has been working on the same question for weeks and feels like he made no

progress on it, but then a slight change to the meta parameters makes everything work. It is often due to something as trivial as a missing negative sign and being able to figure that out can be incredibly gratifying in the research process. Another research tool that Andrew has enjoyed learning to work with is DEAP (Distributed Evolutionary Algorithms in Python), which is a python library with numerous genetic programming functionalities built into it. He notes that it is an important tool to learn because it has applications beyond just this project and that “being able to learn the intricacies of that specific library and seeing how to build other implementations such as symbolic regression off of it, it really helps me understand better how the genetic programming process works.” Being able to learn how to work with DEAP gives Andrew the research experience necessary for similar projects in the future. Through his extensive research so far, Andrew hopes to contribute to the scientific field and community by creating incremental improvements from the existing carbon potential functions. This would allow the discovery of new forms of stable carbon allotropes with a more efficient and accurate potential function. It also increases the likelihood of discovering new ways to create a variety of things that use carbon allotropes more efficiently. Due to their high tensile strength, they can be used in the production of lightweight materials and thus can create better variations of things that already exist.

As a recipient of the Magellan Scholar grant for his work, Andrew can enhance his undergraduate research experience further. He also hopes to push the limits of what has been done before by analyzing a much larger training data set than what his research is based on. The Machine Learning and Evolutionary laboratory collects numerous data of different carbon allotropes and the Density-functional theory (DFT) approximation of their net energy. Since Andrew is using a similar regression method as previous research with more training data, this theoretically means that his results would end up being more accurate than the pre-existing research. This would allow future researchers to identify stable carbon allotropes more efficiently and push the bounds further.

Beyond being an undergraduate researcher, Andrew's future specific research interests lie in being able to streamline the process of intelligence analysis. He is interested in being able to use machine learning processes to streamline the work that is done by intelligence analysts and make their job easier. This can help make more accurate assessments of geopolitical situations so that by extrapolation this means that intelligence analysts will have fewer missteps in their analysis.

# 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.

EMAIL

**CAROLINACROSSTALK@GMAIL.COM**

AND FOLLOW OUR IG

**@CAROLINACROSSTALK**

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?**



# family & film

## FINDING THE PIECES

MARYAH NASIR MEDIA ARTS, CLASS OF 2022  
WRITTEN BY RILEY WATSON ASSOCIATE WRITER

Life's toughest battles force us to look inward for strength, and oftentimes it is in these moments of self-reflection that we find the best inspiration. During the COVID-19 pandemic, we have seen this play out in not only our personal lives but also in the work of others around us. For Maryah Nasir, it was witnessing her grandmother's battle with Alzheimer's that gave her the inspiration to begin writing her first film, *Finding the Pieces*. Nasir is a senior studying media arts at the University of South Carolina and is originally from Columbia, South Carolina.

As you read the other articles in this issue, you will see the diversity that blooms in the different fields of research. Nasir's film is an example of several types of diversity in research. For one, when one thinks of research, images of sterile white labs and green test tubes come to mind. Nasir's work, however, shows us that research can often take unconventional and diverse forms. Nasir herself, as a woman of color, also embodies the spirit of diversity. Her work shows us that there is a place for everyone in every field of research.

During the summer of 2019, while taking care of her grandmother, Nasir found a story that needed to be told. "My grandmother was in the nursing home at the time," she recalled. "I just got this feeling that I wanted to write a script dedicated to her." The film tells a multigenerational story of hope, family, and the circular aspect of life itself. The film follows the story of three women: grandmother, mother, and daughter as they

17

17A

18

18A

19

19A

PREMIUM 200

17

PREMIUM 400

18

PREMIUM 400

19

navigate growing up, raising children, and the eventual Alzheimer's diagnosis of grandmother, Jenette.

The filming of *Finding the Pieces* began during the summer of 2021 with Patrick Rutledge as her mentor. Nasir led her team of camera operators, actors, and producers throughout downtown Columbia and the surrounding area, recognizing the beauty of Columbia. Filming a movie at any time is a challenge, but filming during a pandemic presents an entirely new set of obstacles. Nasir recalled that the biggest challenge of filming in the COVID-19 era was simply finding places that would allow an entire film crew to be present. Locations had to be altered from an indoor setting to an outdoor one, but Nasir explained that the "tone" of the scenes was more important than the scenery. For Nasir, it was most important to capture the emotional essence of a scene, whether that scene took place inside or outside did not matter. Of course, Nasir and her team followed COVID protocols: wearing masks and maintaining the standard six-foot distance between people. Despite these challenges, Nasir was able to create a film that she was happy with.



**Nasir with the script of her film.**

A great tool in Nasir's journey was the Magellan Mini-grant, awarded to her near the end of the filmmaking process. Nasir said the award came "just in time" to help her and her team.

Elaborating on the content of her film, the themes of connectedness and love are heightened by the main character's Alzheimer's diagnosis. Alzheimer's disease is a neurological disorder characterized by the loss of memory, lessened cognitive ability, and behavioral changes.

The characters learn to grapple with the preemptive grief that comes with such a grave illness. Jenette's daughter, Chyenne finds herself in the unique position of looking after the woman who raised her. For Chyenne and her daughter, the reality of Alzheimer's becomes painfully apparent. For those in the audience who may not be as familiar with the disease, Nasir hopes that the film will shed light on its effects. "I wanted to raise awareness regarding Alzheimer's disease and to encourage people to support organizations like the Alzheimer's Association that contribute in finding a cure," Nasir emphasized. However, Nasir is hopeful that her film will generate awareness and motivate viewers to learn more about what is being done to find a cure. This can be done by supporting the Alzheimer's Association, an organization dedicated to funding research and helping those currently battling the disease.

Just as the film aims to teach its audience something, Nasir found herself learning things on

set too. Since this was her first film, these fears and doubts were amplified for Nasir. Just as her characters were "finding the pieces," Nasir was also finding pieces of herself. As a first-time director, it was hard for Nasir to let herself be the assertive presence that needs to exist on a film set. "There were times when I thought, 'this isn't what I want; this needs to change,'" she recalled, "I had to tell myself, 'this is your film; say it.'" Nasir's film encompasses both her own deeply personal story and the essence of the human spirit that all research strives to capture.

# 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

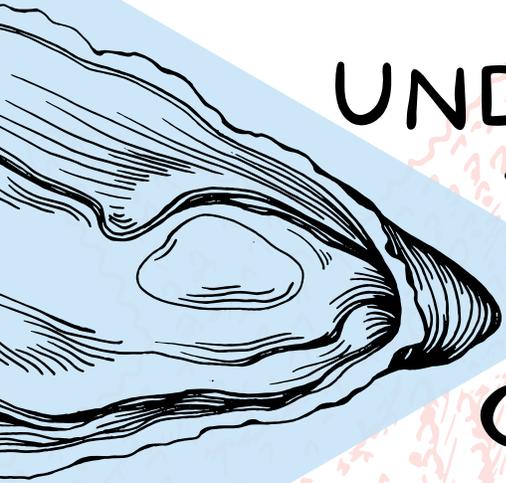
GETTING STARTED IN  
RESEARCH? ALL THE RESOURCES  
YOU NEED AND MORE:



ACCESS ALL THE OTHER  
OFFICE OF UNDERGRADUATE  
RESEARCH RESOURCES HERE:



# UNDERSTANDING THE VALUE OF SMALL ORGANISMS



EXPLORING HOW eDNA REVEALS HIDDEN BIODIVERSITY IN OYSTER REEFS

IESHA WHITTAKER BIOLOGY (BIOMEDICAL SCIENCES), CLASS OF 2022  
WRITTEN BY MADELYN WESTON ASSOCIATE WRITER

**F**ROM THE CARIBBEAN SEA TO SOUTH CAROLINA'S COAST, IESHA WHITTAKER APPRECIATED THE BEAUTY OF MARINE ECOSYSTEMS AS A CHILD, AND, AS AN ADULT, SHE IS LEARNING TO PROTECT THEM.

Whittaker grew up hearing stories about her mother's research experience in marine ecology as an undergraduate and recalls her own experiences with coral reefs in Jamaica. Inspired by her mother's passion and driven by her own curiosity, Whittaker decided to attend USC Beaufort to study biomedical sciences

and further her interest through research. "Being from an island, you are so close to the water and are naturally drawn to it," Whittaker explained. "You want to learn about the natural resources there."

In Beaufort, South Carolina, oyster reefs are plentiful and influential on their surrounding environment. Oyster reefs improve water quality by filtering water and function as a carbon sink. As a keystone species, oysters are essential to the health of their ecosystem; their shells are made of calcium carbonate, drawing carbon out of the ocean and atmosphere. Additionally, oyster reefs act



as a barrier by dissipating wave energy, thereby decreasing coastal erosion.

Learning about the complexity of aquatic ecosystems is a focus of Whittaker's undergraduate studies. She took the initiative to contact USCB's Chair of the Department of Natural Sciences, Dr. Joe Staton about research opportunities and was introduced to Dr. Mercer R. Brugler, who shares her enthusiasm for ecology and marine biology.

As an Associate Professor of Marine Biology at USC Beaufort, Dr. Brugler specializes in examining deep-sea black coral through DNA analysis and morphology. He leads the USCB's Tidal Marsh Task Force, a team of undergraduates and post baccalaureates. Their current project uses eDNA to assess the biodiversity of oyster reefs in the Port Royal Sound (PRS), a series of estuarine tidal inlets that are bordered by Hilton Head Island to the southwest and St. Helena Island to the north. A similar study on oyster reef biodiversity in the PRS was conducted in 1985 by Fox & Ruppert but was based on the anatomy (or morphology) of organisms alone. This makes Whittaker's research crucial to understanding how oyster reef biodiversity has evolved over the last thirty-seven years. Oysters in the PRS differ from those in the Gulf of



**An oyster reef.**

Mexico as their shells are elongated, which allows them to spend more time in the water as the tides ebb and flow (the average tidal range in the PRS is 8.5 feet) and provides more surface area for other organisms to inhabit.

Whittaker noted that eDNA (environmental DNA) is a relatively new research technique that has not previously been used to assess biodiversity in oyster reefs. DNA is found in cells released during fecal production, reproduction,

injury, the shedding of mucus and skin, etc. This technology can capture the genetic signature of organisms that currently inhabit, or recently inhabited, an aquatic environment. Depending on the water temperature and exposure to sunlight, eDNA can remain intact for approximately 21 days. The incredible number of DNA sequences that can be obtained using new sequencing technologies greatly increases the accuracy of the project. Whittaker's team may document undiscovered or newly invasive species. These organisms may currently inhabit the environment, but they may be too small or have cryptic (or parasitic) lifestyles that make it a challenge to detect using traditional visual surveys (i.e., human observation). Mobile animals may simply flee (or hide) from the intrusion of visual surveyors; however, with eDNA, there is little to no disturbance to the ecosystem.

During Summer 2021, Whittaker, in collaboration with fellow undergraduate Kristen Mullins,

reviewed Fox & Ruppert's 1985 research to compile a visual ID guide of local oyster reef community inhabitants. This visual ID is a list of the marine organisms found on oyster reefs across Beaufort's estuaries. To construct a reference database (to which eDNA sequences will be compared), they downloaded DNA sequences from GenBank, an online collection of publicly available DNA sequences. In doing so, they quickly realized that available DNA sequence data for marine organisms in the Port Royal Sound is largely incomplete. This complicates matters when newly-obtained gene sequences do not match known sequences. The genes they targeted in GenBank to build their reference database were 18S, 28S, *cox1* and 16S, which are all commonly sequenced gene regions.

Whittaker's wet lab work includes filtering water, extracting DNA, and setting up the polymerase chain reaction (PCR) to obtain many copies of the gene regions of interest. However, due to COVID-19 restrictions, her team has not extracted as many DNA samples as planned and the project is still in its preliminary stages with no biodiversity data yet. The USCB team has optimized the PCR to allow amplification of the genes of interest, built a reference database, collected seawater and started constructing artificial growth platforms (to monitor how biodiversity changes as an oyster reef ages) which will be deployed soon. Whittaker is optimistic about the success of the project since they "honed in on the background research" before conducting their eDNA surveys.

In addition to elucidating the true biodiversity of an oyster reef, Whittaker's goals include identifying an indicator species that demonstrates the overall health of the reef, documenting community succession over time, analyzing the impact of stormwater runoff (which changes



**Ilesha and her team at work.**

the salinity and nutrient load) on biodiversity, and comparing eDNA to the visual surveys.

More specifically, collecting and analyzing eDNA entails collecting a liter of water upstream of an oyster reef, filtering the water using 0.45, 1.0, and 3.0  $\mu\text{m}$  filters, storing the filters in Longmire's Buffer, then extracting DNA, amplifying specific gene regions via PCR and lastly sending those PCR products for amplicon-EZ sequencing at Genewiz. To reduce background noise (i.e., DNA sequences from organisms that are inhabiting the marsh outside of the oyster reef), the Tidal Marsh Task Force collects water from the middle of the waterway and the waters immediately surrounding the oyster reef. Strict protocols are followed to avoid contamination in the laboratory.

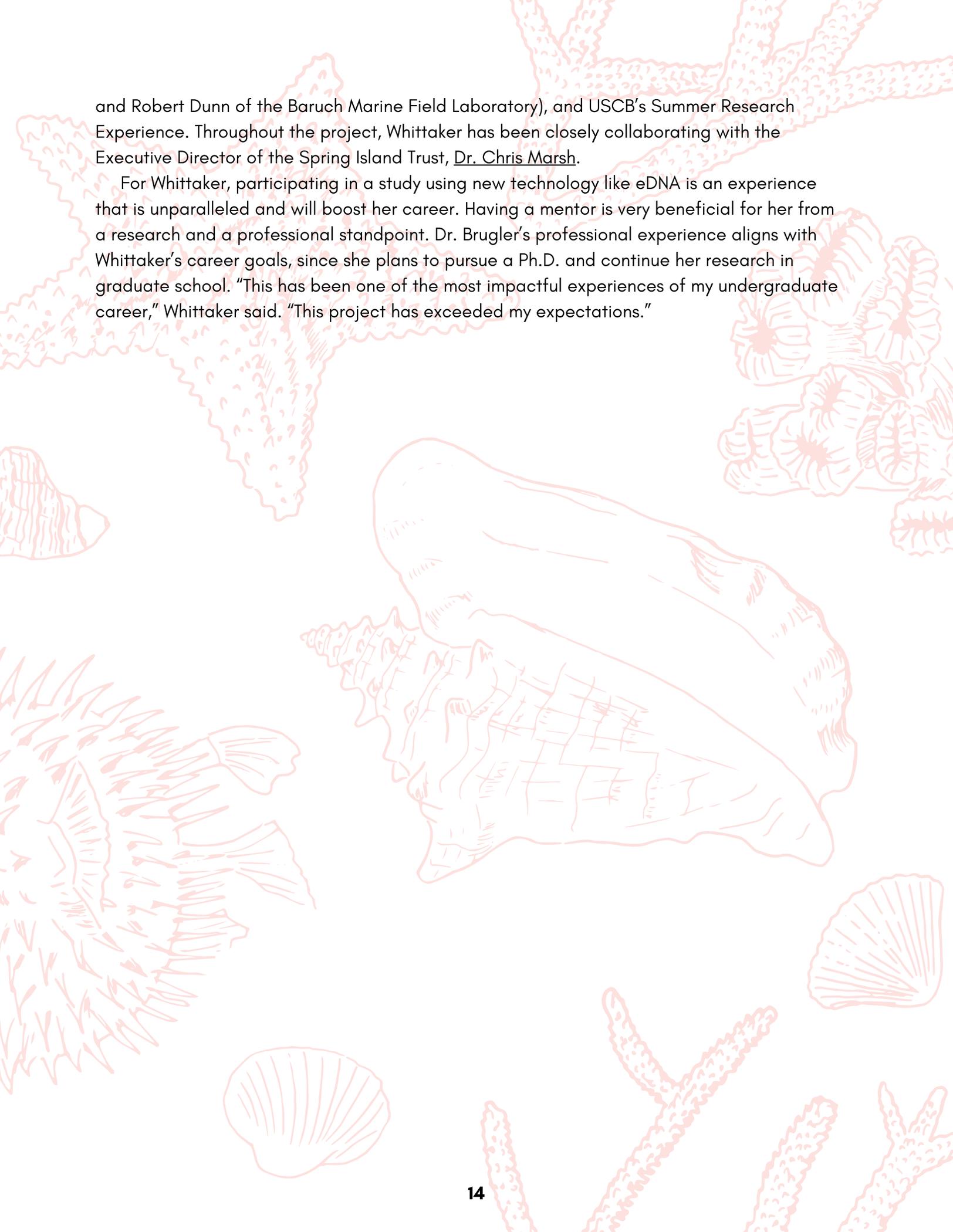
As Whittaker employs eDNA as her method of study for oyster reef biodiversity, other local groups are using visual surveys. For example, Dr. Robert Dunn and undergraduate Maggie Pelton of the Belle W. Baruch Institute for Marine and Coastal Sciences are deploying oyster shell baskets (a 5-gallon bucket filled with sterilized oyster shells) in the center of living oyster reefs in the North Inlet - Winyah Bay National Estuarine Research Reserve and leaving them for four weeks to allow organisms to settle. Upon retrieval of the baskets, Dr. Dunn and Maggie soak the baskets in seawater for 30 minutes to collect eDNA and subsequently conduct a visual survey of the inhabitants. Whittaker will compare the results of these visual surveys with her eDNA findings.

All newly-obtained DNA sequences will be compared to the sequence databases of known organisms that Whittaker and Mullins compiled during Summer 2021. Any sequences that do not match the local database will be compared to publicly available sequence data on GenBank using BLAST. There is an assortment of animals expected to be identified within the Port Royal Sound such as a spotted crab that burrows in the sand in oyster reefs. Different types of coral, shrimp, worms, sea slugs and fish are predicted to be present. In addition, predators such as small mammals and birds may leave traces of DNA as they feed on oyster reef inhabitants during low tide.

The South Carolina Department of Natural Resources in Charleston gave the USCB team a tour of their facility. "A lot of research is important to society," Whittaker said. "However, if you're not involved in the management or political side of it, nothing really gets done." Her biggest takeaway is the importance of seemingly simple organisms such as oysters. Whittaker knew little about oysters' impact on the environment, our shores, and the ecosystem prior to this project.

Whittaker appreciates guidance from scientists such as Dr. Peter Kingsley Smith, Gary Sundin, and Graham Wagner from the Shellfish Research Section of the SCDNR Marine Resources Research Institute. They shared information on their Living Shorelines project and delineated how to build recruitment surfaces for oysters. These are necessary in understanding community succession. Assistant Director Dr. Tanya Darden of SCDNR MRRI provided information about best practices when filtering water to collect eDNA from salt marshes.

Generous funding for the oyster reef eDNA project was provided by the Spring Island Trust, the Office of Coastal Management/NOAA/DOC (subaward provided by Drs. Erik Smith



and Robert Dunn of the Baruch Marine Field Laboratory), and USCB's Summer Research Experience. Throughout the project, Whittaker has been closely collaborating with the Executive Director of the Spring Island Trust, [Dr. Chris Marsh](#).

For Whittaker, participating in a study using new technology like eDNA is an experience that is unparalleled and will boost her career. Having a mentor is very beneficial for her from a research and a professional standpoint. Dr. Brugler's professional experience aligns with Whittaker's career goals, since she plans to pursue a Ph.D. and continue her research in graduate school. "This has been one of the most impactful experiences of my undergraduate career," Whittaker said. "This project has exceeded my expectations."

# WANT TO GET LEADERSHIP DISTINCTION IN RESEARCH?

You can get it through the Center for Integrative and Experiential Learning and their Graduation with Leadership Distinction program!

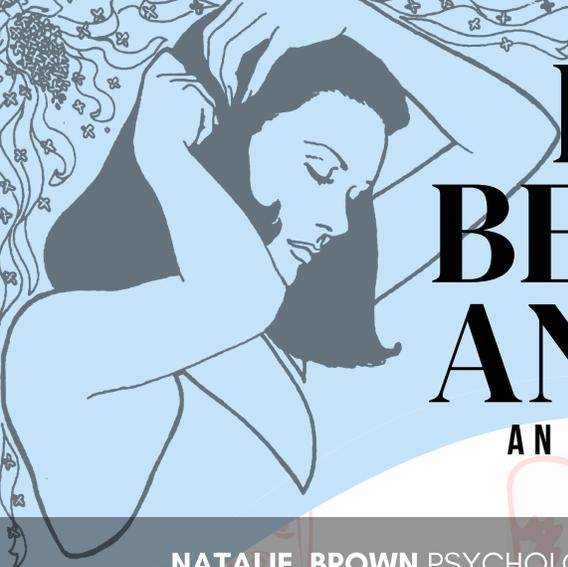
GLD ORIENTATION  
RECOMMENDATIONS BY MAJOR  
MAKE AN APPOINTMENT WITH ONE OF THE GLD ADVISORS  
DISTINCTION ON DIPLOMA & CORD AT GRADUATION

CHECK OUT THE GLD RESEARCH  
PATHWAY & MORE RESOURCES  
HERE:



WANT TO LEARN MORE ABOUT GLD  
IN GENERAL? CHECK OUT THE PAGE  
AND OTHER PATHWAYS HERE:





# BARBERSHOPS, BEAUTY SALONS, AND BANKNOTES

AN INVESTIGATION OF HOW COVID-19 HAS IMPACTED  
COMMUNITY ANCHORS

NATALIE BROWN PSYCHOLOGY, CLASS OF 2021

WRITTEN BY AUDREY GALIMBA ASSOCIATE WRITER

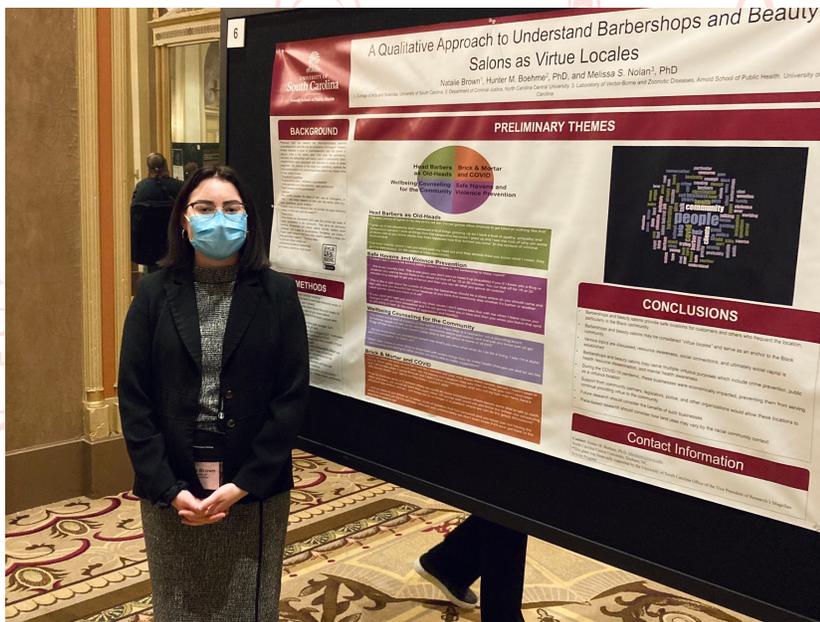
**M**anaging a business is difficult. Add in a pandemic, and streams of income are disrupted, further revealing the financial fragility of many small businesses. In particular, businesses such as barbershops and beauty salons play a role in anchoring communities and preventing crime. In light of the unprecedented pandemic, Natalie Brown explores the impact of COVID-19 on businesses like these—introducing public health to her community-based research.

Natalie is a senior psychology major from Austin, Texas. In her sophomore year, Natalie wanted to get involved in research and began by reaching out to the Office of Undergraduate Research. To students interested in getting started, Natalie recommends connecting with professors and building on existing relationships. She had more success getting in contact with professors of classes she had already taken than with cold-emailing. Natalie reconnected with Dr. Hunter Boehme, one of her former criminal justice professors. The summer after her sophomore year, Natalie started working with Dr. Boehme and professor of public health Dr. Melissa Nolan on a joint project.

There is a stereotype surrounding research—to be a researcher one must don a white lab coat and work with mice and various chemicals. However, throughout her undergraduate journey, Natalie has learned that research takes many forms. At the intersection of public health and criminology, Natalie's project is community-based. Community-based research depends on community leaders and, at its core, demonstrates respect for the contributions of community partners. In particular, Natalie's research group focuses on community anchors, which are organizations and agencies that provide community support via outreach, equipment, and services. They are particularly important to vulnerable populations such as low-income residents, the unemployed, and the elderly, and Natalie's project serves as an example of research supporting diversity.



Natalie is a 2021 recipient of the Magellan Scholar Award, a scholarship that funds materials, travel, and stipends related to her research project. However, it is important to note that this award does not require that you design your own research question. Natalie's current project, titled "The Effects of COVID-19 on Barbershops and Beauty Salons as Community Anchors for Crime Prevention and Public Health," is based on Dr. Boehme's graduate school dissertation. However, Natalie's work takes on a different perspective and may have critical implications. Her project is the first to focus specifically on the impact of COVID-19 on barbershops and beauty salons. As an undergraduate researcher, Natalie collaborates with other assistants in her research group to interview local businesses. She is also tasked with transcribing interviews and organizing the data into broad categories such as "community," "business," and "violence prevention." Her research team aims to highlight the importance of these businesses in maintaining not only physical health of their clients but also community health. Socially vulnerable populations are more likely to have adverse health reactions to



**Natalie presenting her work.**

supporting diverse communities and demographic minorities.

As an undergraduate researcher, Natalie continues to gain a deeper understanding of the research process and how academia works. While she does not have plans to continue research after graduation, Natalie can say that she has a deeper understanding of the research that may affect her field as she plans to pursue her MBA to study marketing and consumer behavior. Furthermore, she views research as a tool for the greater good. While government funding is critical to the survival of local businesses, Natalie emphasizes the need for community support. "That's what they need to get back on their feet." COVID-19 affected almost every facet of life in the world of a new normal. No one was prepared for this pandemic, so to maintain our community's social health, we need to do our part to help our community anchors.

COVID-19, but the impact of the pandemic may be intensified by the harm to community anchors, as many of their services support these vulnerable demographics. Natalie's work aims to provide evidence of community anchors' importance, which may eventually be expanded to advise on how local businesses can be helped through local and federal policy. This way, Natalie's work may advocate for the distribution of funds toward local businesses with an eye for

# DIFFERENT PIECES OF THE (RESEARCH) PUZZLE

## INSIGHTS FROM A RESEARCH TEAM

**SHUVANGEE DHAR** BIOLOGY, CHEMISTRY MINOR, CLASS OF 2022

**AUDREY GALIMBA** BIOMEDICAL ENGINEERING, BIOLOGY MINOR, CLASS OF 2023

**AVI PATEL** BIOMEDICAL ENGINEERING, CLASS OF 2023

**WRITTEN BY HENY PATEL** EDITOR IN CHIEF

### EXPLAIN HOW YOU GOT INVOLVED IN RESEARCH. WHAT STARTED YOUR RESEARCH JOURNEY?

**AVI:** Biomedical Engineering is a major that is very application-based, so I wanted to apply concepts that I learned in class and optimize my understanding of them. Being fascinated with cardiology and cardiovascular disease as a pre-med student, I typed the keywords “biomedical engineering” and “cardiology” into the [OUR Faculty Research Database](#) and, during the second semester of my sophomore year, [Dr. Susan Lessner](#) allowed me to join her lab. Dr. Lessner is a Professor of Cell Biology and Anatomy in the Department of Cell Biology and Anatomy in the School of Medicine (Columbia).

**AUDREY:** In my BMEN 101 course (an introduction to biomedical engineering), one of the assignments entailed picking a faculty mentor, reading about their research, and

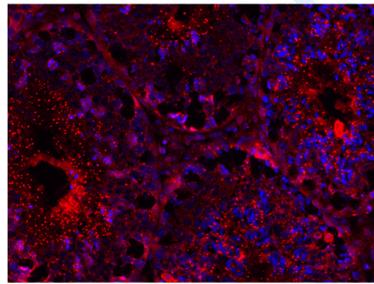
summarizing one of their publications. Interestingly enough, I chose Dr. Susan Lessner and learned a bit about her research. Because I was already familiar with some of her research and was intrigued by it, I reached out to her in the second semester of my freshman year after going to OUR’s “Getting Started in Research” workshop, starting in Dr. Lessner’s lab that spring.

**SHUVANGEE:** I was interested in research related to cardiology and cardiovascular health as a pre-med student, so I got involved with research as soon I entered college in the first semester of my freshman year. My Honors Peer Mentor and a couple of my other researcher friends encouraged me to look into the possibilities of research. I looked through the [OUR Faculty Research Database](#) and was interested in Dr. Lessner’s research when I learned that her lab mainly focused on vascular diseases.

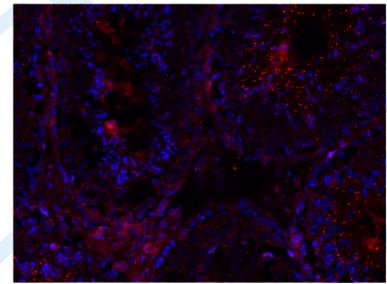
## WHAT IS YOUR RESEARCH PROJECT ON?

**AVI:** Overall, the Lessner Lab focuses on cardiovascular disease and vasculature (a circulatory network that connects the heart with other organs and tissues). There are a variety of projects going on simultaneously. Currently, I am assisting on a project that studies the effects of two independent driving factors, diet and endothelial dysfunction, on the collagen fiber organization in the apoE mice prior to the development of atherosclerosis. ApoE is involved in creating molecules called lipoproteins that are responsible for transporting lipids like cholesterol throughout the bloodstream. ApoE knockout (KO) mouse is a widely used model to study the progression of atherosclerosis (deposition of plaque in or on artery walls, leading to narrow and often blocked arteries that can restrict blood flow to organs and tissues). Endothelial dysfunction is defined as a reduction in the bioavailability of nitric oxide (NO), the main vasodilator and mediator of platelet aggregation on vascular tissue. By genetic deletion of endothelial nitric oxide synthase (eNOS), endothelial dysfunction is recreated in the mouse model. Thus, the project involves crossbreeding the apoE knockout (KO) with eNOS KO mice to create a double KO strain to combine endothelial dysfunction in the background of apoE mice. I am mainly responsible for conducting genotyping and classification of mice colonies. Essentially, sorting out single and double knockouts of apoE and eNOS by genotyping will allow us to further investigate the roles of various driving factors in the progression of cardiovascular disease.

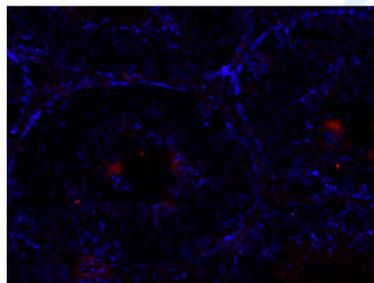
**AUDREY:** My research project studies the development of aneurysms by using Marfan syndrome as a model. An aortic aneurysm is a localized weakening and bulge in an artery's wall that can increase in size and may rupture, leading to fatal internal bleeding. Marfan syndrome is an inherited disorder that impacts connective tissue and most commonly affects the heart, blood vessels, bones, ligaments,



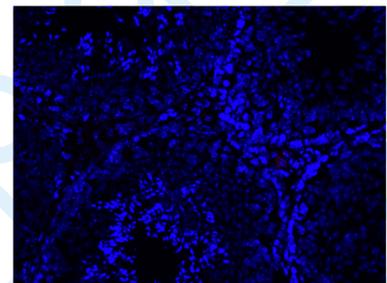
1:50



1:100



1:200

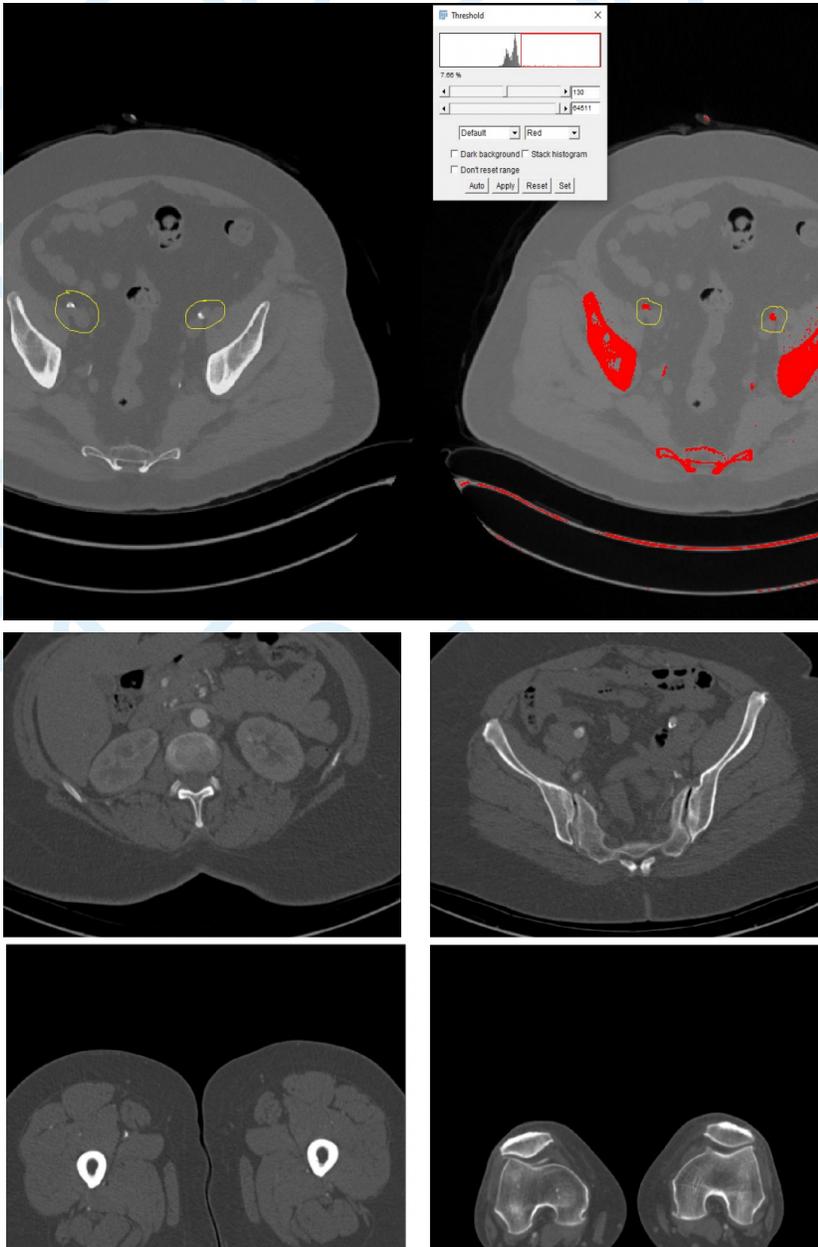


Control

**Images from an immunohistochemistry titration provided by Audrey.**

and muscles. Aortic aneurysms are a complication of Marfan syndrome. We observe mice with Marfan syndrome that have developed aneurysms and look at their aorta at different ages to track the development of the aneurysm and quantify different cell measures, such as proliferation. Over the summer, we looked at the CDK8 (cyclin-dependent kinase 8) enzyme from the CDK family. We are trying to determine (1) whether the protein is mechanosensitive (meaning that the production of the protein is affected by mechanical stresses) and (2) how physical stress affects the levels of CDK8 in the cells of the ascending aorta. We compared the

vascular cells of healthy control mice and mice affected by aneurysms. By observing how cells respond to mechanical stress in an aneurysm and correlating it to the levels of CDK8, we hope to understand the pathways that regulate CDK8, such as whether the protein promotes or inhibits aneurysms, and if therapies can target CDK8 to prevent aneurysms.



**Some sample CT-scans provided by Shuvangee.**

treatment often requires amputation of the affected limb). We are quantifying levels of calcification in arteries and investigating whether serum protein biomarkers (such as osteocalcin and osteoprotegerin) can predict PAD and its severity. We are doing this through calcification scoring of CT-scans and ELISA assays to quantify levels of protein biomarkers.

**SHUVANGEE:** My project assesses the progression of PAD (peripheral arterial disease), which is characterized by narrowing of blood vessels and consequently a reduction in blood flow to the peripheries or the limbs of the body. Arteries in the legs are affected and intermittent claudication occurs so that the muscles do not get enough oxygen, which can lead to severe complications. Currently, diagnosis is mostly via evaluation of symptoms and exercise testing. However, by the time PAD is diagnosed the disease has usually progressed quite far. Treatments are limited to surgical operations such as femoral endarterectomies, where plaque is removed from the femoral artery to try to increase blood flow to the lower extremities. We want to understand the progression of PAD to explore ways we can prevent the culmination of severe endpoints like gangrene and focal tissue necrosis (where

## WHAT ARE SOME OF YOUR DAY-TO-DAY ACTIVITIES AS AN UNDERGRADUATE RESEARCHER?

**AVI:** Right now, I am genotyping mice. We collect samples from mice (by clipping tissue from the ear or tail), digest the DNA, purify the DNA, amplify the DNA via PCR (polymerase chain reaction), and perform gel electrophoresis.

**AUDREY:** I am currently using a machine called a cryosectioner to section the tissue very thinly to make slides of tissue samples and visualize the vascular cells of an aneurysm. Specifically, we first collect samples of the ascending aorta, freeze them using OCT (optimal cutting temperature) compound, and then use the cryosectioner to look at the vascular cells under the microscope. To look at specific proteins, we use special antibodies to visualize cells via fluoroscopy.

**SHUVANGEE:** I am generating a calcification score for each patient by analyzing the CT scans of ischemic patients and determining the amount of calcification present in the peripheral arteries. I often observe surgical procedures that involve physicians obtaining plaque samples from the femoral artery and carotid artery. I also perform ELISA assays on the plasma samples of these patients to determine if a certain serum protein biomarker is present at a significantly higher or lower level compared to the control samples.

## WHAT ARE THE POTENTIAL IMPLICATIONS OF YOUR RESEARCH? WHAT MAKES YOUR RESEARCH PROJECT DISTINCT FROM OTHER RESEARCH PROJECTS?

**AVI:** Cardiovascular disease is the leading cause of death in the United States, so my research project contributes to the pool of information we have on cardiovascular by studying the structure of collagen in relation to atherosclerosis.

**AUDREY:** There are about 200,000 cases of Marfan syndrome every year in the U.S. and aortic aneurysms are the 13th leading cause of death in the U.S. The distinctiveness of this project lies in the specificity of the question we are asking, especially because there does not seem to be a lot of literature around CDK8 and whether it is mechanosensitive. Additionally, aneurysms characterize many forms of cardiovascular disease, so the results of our research can potentially be extrapolated to other causes of aneurysms.

**SHUVANGEE:** Abundant research literature explores PAD at the molecular level, but my project is more clinical, more patient-focused because it examines artery calcification with arterial plaque samples from patients who have undergone a femoral endarterectomy surgery. Additionally, amputations have been increasing in SC since 2013, so our research attempts to predict who would benefit from such surgeries and therefore reducing such an invasive intervention would significantly improve quality-of-life for patients and reduce the economic burden of the surgery. At Prisma Health, we previously collaborated with Dr. Daniel Clair and our current PI is Dr. Kathryn Fong.

## WHAT EXPERIENCES HAVE ALLOWED YOU TO EXPAND YOUR RESEARCH PROJECT?

**AUDREY:** I was recently awarded the Magellan Grant and previously, I was awarded the Honors College Research Grant. Both really support and incentivize my commitment to research.

**SHUVANGEE:** My Honors Senior Thesis is centered around a branch of research from the Lessner Lab that focuses on analyzing the progression of PAD and identifying patients who might be at a higher risk of developing severe outcomes. The main purpose is to use calcification scoring and protein biomarker levels to predict PAD severity and to determine the prognosis of each patient in the case of undergoing femoral endarterectomy surgery.

## HOW HAS RESEARCH PUSHED YOU OUT OF YOUR COMFORT ZONE? WHAT HAS RESEARCH TAUGHT YOU?

**AVI:** When I was first interested in getting involved with research, I had a fear factor and 'imposter syndrome' going in. I procrastinated reaching out to professors for a while, but looking back now, I realized that every answer is no until you ask it. To those interested in research, a piece of advice: hit send on that email. When I joined the lab, all the projects basically flew over my head, but the graduate students and Dr. Lessner really enhanced my understanding of the concepts. I appreciate the extent of collaboration in research.

**AUDREY:** There was definitely a learning curve when I first joined the lab, but Dr. Lessner and the other researchers were extremely supportive in helping me get where I needed to be because they truly believe in the work they do. I enjoy collaborating with other researchers because we all are in different stages of our research careers and it's nice how the subprojects of the Lessner Lab are not clear-cut where the divisions lie. As a biomedical engineering student on the pre-med track, I became more meticulous when it comes to lab documentation and became more familiar with mammalian anatomy. Additionally, the

techniques we use in the lab sometimes gave me an edge in labs associated with the courses I have to take for my major.

**SHUVANGEE:** Reflecting on the amount of collaboration in our lab, I've realized that research is mostly teamwork; it's not just you. You have to get help from someone that has skills that you don't have in order to where you collectively want to be. Also, I'm more accepting of the failures that come with research. For example, I was using osteoactivin as a protein biomarker for my Honors Senior Thesis and after spending a considerable amount of time and resources on the protein, we determined that osteoactivin was not a viable serum protein biomarker for calcification. It was disheartening at first, but I learned that failures come hand-in-hand with the successes of research. I also became more familiar with different software (like ImageJ and Image Pro) and how to perform data analysis with raw data, which supplemented the analytical techniques I learned in lecture.

## WHAT IS ONE OF YOUR FAVORITE MOMENTS FROM THE RESEARCH PROCESS? AN EXPECTED DISCOVERY? A SURPRISING SETBACK? A QUIRKY RESULT?

**AVI:** I had the opportunity to go see a femoral endarterectomy: a surgical procedure performed to remove plaque from the femoral artery.

**AUDREY:** It was a very subtle moment when research finally clicked for me. I intuitively understood what was going on in the lab and was not just mixing random solutions because I was told to do so. I could put the pieces together better as I was seeing the research process from start to end (from collecting tissue samples to data analysis).

**SHUVANGEE:** One moment I will always remember is the first time I was prepping a mouse to collect a tissue sample and I accidentally let go of the mouse on the table! Luckily, a graduate student in the lab had quick reflexes and caught the mouse. I also really enjoy observing surgeries and how the implications of research can be clinical.

## FUN QUESTION: IF YOU HAD AN UNLIMITED AMOUNT OF RESOURCES, WHERE WOULD YOU TAKE YOUR RESEARCH?

**AVI:** I would want to try and pose a therapeutic treatment for atherosclerosis because the only treatment right now involves preventative lifestyle changes through regular exercise and a healthy diet or invasive surgery.

**AUDREY:** I would ideally work toward a computerized model of all the information we obtain from the levels of CDK8 in aneurysms and use those trends to track the development of aneurysms in real-time. Essentially, we could make a predictive model that can be applied to clinical cases.

**SHUVANGEE:** I would like to investigate pre-surgery treatment options or other preventive methods that would prevent the culmination of severe outcomes such as the development of gangrene in patients with critical limb-threatening ischemia or recalcitrant intermittent claudication.

**CROSSTALK**  
BIT.LY/CARLINACROSSTALK

