DECIPHER

CREATIVE INQUIRY MAGAZINE | VOL. 12

Coral reefs serve as habitat for countless ocean species and researchers in Clemson's Department of Biological Sciences intend to find out what makes a healthy reef. Page 27

ABOUT DECIPHER | Volume 12

Decipher magazine is produced by a team of Clemson University's undergraduate students to highlight the accomplishments of their peers in Creative Inquiry (CI), Clemson's unique brand of undergraduate research. Creative Inquiry is Clemson's campus-wide experiential learning program which provides students with opportunities to participate in research topics they find interesting, in their own, other or cross-disciplinary fields of study.

Each year, more than 4,000 CI students investigate topics ranging from establishing Clemson as an official campus refuge to investigating new methods for cancer drug delivery. Creative Inquiry projects provide students with the tools they need to explore diverse problems and issues in our community and beyond, and to propose possible solutions. Students value these opportunities to apply the skills they learn in the classroom to solve real-world problems.

From the 391 current CI projects, we selected 26 projects to feature in this magazine. The team interviewed faculty, graduate students and undergraduate students involved with each of these projects in order to write these articles and produce photographs and illustrations. *Decipher* is printed and distributed to students, faculty, alumni and friends of Clemson so that they are aware of the many accomplishments of students and faculty in the Creative Inquiry program. Though this magazine can feature only a few projects, CI accomplishments are considerable, including more than 1,947 presentations at professional conferences, more than 519 professional publications and over 540 awards.

Decipher is also available digitally as an interactive blog on the Creative Inquiry website (clemson.edu/ci). Visit our blog for more information and to see more project highlights.

CREATIVE INQUIRY STAFF

Barbara J. Speziale | Director
Cora Allard-Keese | Associate Director
Tullen Burns | Project Coordinator
Julie DuBose | Fiscal Analyst
Lindsay Hobbs | Administrative Coordinator
Sagar Thakur | Database/Web Manager
Ben Wyland | Graphics Manager

DECIPHER STUDENT STAFF

Katherine Sahd | Editor
Kyle Wilson | Chief Graphic Designer
Nathan Beaver | Marketing
Hailey Blackwelder | Photographer
Kennedy Cope | Graphic Designer
Annabella Cotugno | Writer
Lauren Ferguson | Photographer
Kelsey Harris | Writer
William Isreal | Graphic Designer
JB Rehrig | Assistant Editor
Brielle Reynolds | Marketing

CONTACT CREATIVE INQUIRY

The Office of Creative Inquiry + Undergraduate Research
Watt Family Innovation Center
405 S. Palmetto Blvd., Suite 303
Clemson, SC 29634 | 864.656.9497
ciinfo@clemson.edu | clemson.edu/ci

Decipher (verb)

To succeed in understanding, interpreting or identifying

A LETTER FROM **CREATIVE INQUIRY**

These are exciting times for Creative Inquiry.

Over the past year, two major initiatives at Clemson University have affirmed the Creative Inquiry approach to learning, both pledging to enhance experiential learning at Clemson University.

What is experiential learning?

In experiential learning, students "learn by doing," by engaging in a topic beyond a typical classroom. But students need more than to just 'do.' To gain real benefits from the experience, students must reflect on what they are doing and use that knowledge to push forward with experimentation, analyses and discovery. Sound familiar? That's what Creative Inquiry students have been doing for many years.

Clemson's new Quality Enhancement Plan (QEP) will devote the next five years to "improving students' academic experience through access to quality experiential learning opportunities," including Creative Inquiry. The QEP will particularly target first- and second-year students and those in majors that are currently less represented in experiential learning activities.

The new ClemsonElevate strategic plan has three main pillars and Creative Inquiry supports all three. The first is to "Deliver the No. 1 Student Experience," largely by involving all students in experiential learning activities, such as Creative Inquiry. CI also supports the second pillar, to double institutional research, as evidenced by the many research publications, presentations, grants and awards produced by CI projects. The third, to "transform lives statewide and beyond" is another natural opportunity for CI projects.

Thus, Creative Inquiry continues to be a fundamental part of the Clemson Experience and Clemson's priorities. CI started offering experiential learning opportunities to students long before that term became popular. Just as importantly, we developed a strategy to support, track and promote those activities and their impressive student and faculty teams.

Decipher is one part of the promotion strategy. The magazine annually highlights just some of the hundreds of active CI projects. But many projects have their own blogs, websites and social media feeds, products that contribute to students' analytical and communication skills.

To see a wider field of CI projects, browse previous *Decipher* magazines or peruse project descriptions on the Current Projects page—all on the CI website. And join us in congratulating the CI teams for their many accomplishments.

Cora Allard-Keese
Associate Director, Creative Inquiry + Undergraduate Research

Dr. Barbara J. Speziale
Director, Creative Inquiry + Undergraduate Research

THE **DECIPHER TEAM**

Katherine 'Kat' Sahd - Editor

Kat is a junior marketing major with a minor in creative writing from Lancaster, PA. She is the Director of Ethics and Compliance for Delta Sigma Pi and a member of the Consulting Club. She enjoys going to concerts, reading and writing.

JB Rehrig - Assistant Editor

JB is a sophomore environmental science and natural resources major with a minor in entomology and concentration in conservation biology. They are from Summerville, SC. Along with working for *Decipher*, they are also involved in the Restoration Ecology CI (look for their interview on page 8). In their free time, they enjoy walking their dog, listening to music and climbing trees.

Kelsey Harris - Writer

Kelsey is a junior psychology major with minors in sociology and youth development studies. She is from Spartanburg, SC, and is in the Clemson Honors College. She is President of the Piano Club, a member of the Clemson University Symphony Orchaestra and plays intramural soccer.

Annabella Cotugno - Writer

Annabella is a sophomore marketing major with a psychology minor. She is from Marvin, NC. She is the Diversity, Equity and Inclusion (DEI) Chair of Zeta Tau Alpha, and a member of Clemson's Women in Business Club. She enjoys cooking, doing her nails and painting in her free time.

Kyle Wilson - Graphic Designer

Kyle is a landscape architecture major with a music minor. He is from Greenville. He loves playing piano (he is Vice President of the Piano Club), playing intramural soccer, reading and eating strawberry Eggo waffles.

William ‘Trey’ Israel - Graphic Designer

Trey is a computer science major from Greenville. Outside of class and *Decipher*, you can find him playing the guitar, soccer or disc golf and listening to his favorite band, *The Strokes*.

Kennedy Cope - Graphic Designer

Kennedy is a junior marketing major with a minor in brand communications. She is from Fort Mill, SC. She is a member of Delta Sigma Pi, Cadency and the College of Business Recruitment Ambassadors. In her free time she enjoys trying out new coffee shops around Clemson and listening to Taylor Swift.

Hailey Blackwelder - Photographer

Hailey is a junior fine arts major with a dance concentration. She is a member of Alpha Delta Pi, the Sculpture Club and the Ceramics Association. In her free time she enjoys cooking, walking her dog, and of course, photography—she has over 63,000 pictures on her phone!

Nathan Beaver - Marketing Intern

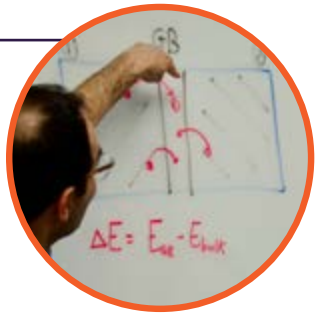
Nathan is a senior marketing major from Pittsburgh, Pennsylvania. He is in the FIRST program and the Minority Business Student Association. A fun fact about Nathan—he was an extra in the movie, *The Dark Knight Rises*.

Brielle Reynolds - Marketing Intern

Brielle is a sophomore marketing major with a brand communications minor from Brooklyn, NY. She is a member of Delta Delta Delta and loves to meet new people. She enjoys traveling, learning new things and hanging out with her friends.

TABLE OF

CONTENTS



Andrew Peel, a senior environmental and natural resources major, processes root ball samples in the greenhouse.

RESTORATION ECOLOGY

By KELSEY HARRIS

Lost, but not forgotten. This is the sentiment of the Restoration Ecology: From Coastal Wetlands to the Appalachian Mountains and Back Creative Inquiry team. This project, mentored by Dr. Althea Hagan from the Department of Forestry and Environmental Conservation, focuses on the restoration of Piedmont prairies and coastal wetlands. To restore these ecosystems, the team researches the best methods for preparing a site for restoration and the importance of restoring a site to its original ecosystem.

Historically, wildfires and grazing kept prairie ecosystems healthy by prohibiting tree growth and acting as natural fertilizers. Fire suppression and lack of grazing animals allowed an invasion of trees in the Piedmont prairies. Tree colonization contributes to the loss of native prairie plants. The team is attempting to restore native grasses such as little bluestem, *Schizachyrium scoparium*, Indian grass, *Sorghastrum nutans*, and broomsedge, *Andropogon virginicus*. Reintroducing these species along with other native prairie plants will increase biodiversity, which can provide habitat for wildlife and hopefully build a functioning prairie ecosystem.

To identify the best restoration practices and the impact of those practices on prairies, the Creative Inquiry team conducts experiments in Clemson's greenhouses and the Clemson Experimental Forest. They use the greenhouses to study fire severity and the impacts of controlled burning on a variety of native Piedmont prairie plant species. The experiments in the Clemson Experimental Forest study different site preparation methods such as using herbicides, tilling, mowing or weed whacking the area before planting seeds. Their goal is to determine which methods give the plants the best chance of survival. Preliminary results show that the use of herbicides in site preparation yields the highest survival rate of native plant seeds. "I think it killed everything that was there before, which sort of made it a blank slate," Hagan said. The herbicides create a fresh start for all the native plants to grow by removing the competing plants.

During the summer, students in the Summer Creative Inquiry and Undergraduate Research (CI+UR) program work on a wetland restoration project in the Brosnan Forest near Charleston. Originally an attempt was made to restore this site to a forested wetland with no success. The plants would not grow at the site so the land managers contacted Hagan and her team for help. First, the team conducted a plant survey. With the survey data and knowledge from the previous attempt to restore the wetland, the team hypothesized that the site might be an herbaceous wetland with few woody stems rather than a forested wetland. This would explain the previous failed attempt. "If you're trying to plant species in a place that is outside of their niche, they're not going to thrive or survive," JB Rehrig, a sophomore environmental and natural resources major, said. The restoration of this wetland could have positive impacts on flood mitigation and water purification in the surrounding areas.

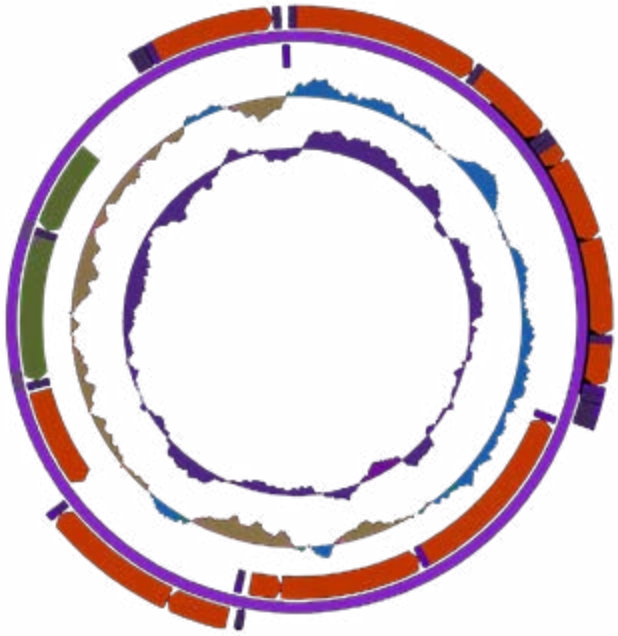
Without habitat restoration, wildlife conservation efforts would suffer due to the lack of available native habitats. Endangered species need healthy ecosystems to thrive and repopulate. "I think being able to provide an outlet of restoration is important for the sense of making sure there's still something to conserve and something to manage for," Rachel Brown-Villarreal, a junior wildlife and fisheries biology major, said. Teams such as this Creative Inquiry lay the ground work that contributes to the success of future conservation efforts.

The welcome sign for the Clemson Experimental Forest, the location of some of this team's research.

A PIECE OF THE PUZZLE

By KELSEY HARRIS

When most people build a puzzle, they are not dealing with the issue of animal conservation; however, the Mitochondrial Genomics Creative Inquiry project, mentored by Dr. Antonio Baeza and graduate students Alyssa Baker and Natalie Stephens in the Department of Biological Sciences, is helping connect the pieces of the animal conservation puzzle. This team creates mitochondrial genomic resources for endangered species. These resources allow scientists from around the world to match DNA from samples taken in the field to the species in which it belongs. Knowing a species' location in the environment informs the overall conservation efforts for these species.



A generic example of a mitochondrial genome. Specific examples of species mitochondrial genomes can be found on the team's webpage.

The videos, posters and papers that the team creates include all the mitochondrial genetic information of that specific organism such as proteins, ribosomal ribonucleic acid (rRNA) and transfer ribosomal ribonucleic acid (tRNA). Animal cells contain more mitochondria than cellular nuclei; therefore, using mitochondrial DNA makes it easier to identify different species because they have a thousand times more mitochondrial DNA than nuclear DNA.

Endangered species are sometimes difficult to track, but by using DNA samples and mitochondrial genomes, it is easier to detect their presence or absence. The Creative Inquiry team's focus is on species with an endangered or vulnerable status that have little genomic documentation, such as the leopard shark, alligator snapping turtle, giant river otter and volcano rabbit. "What we're doing is a piece of the puzzle to help in the conservation biology of these species," Baeza said.

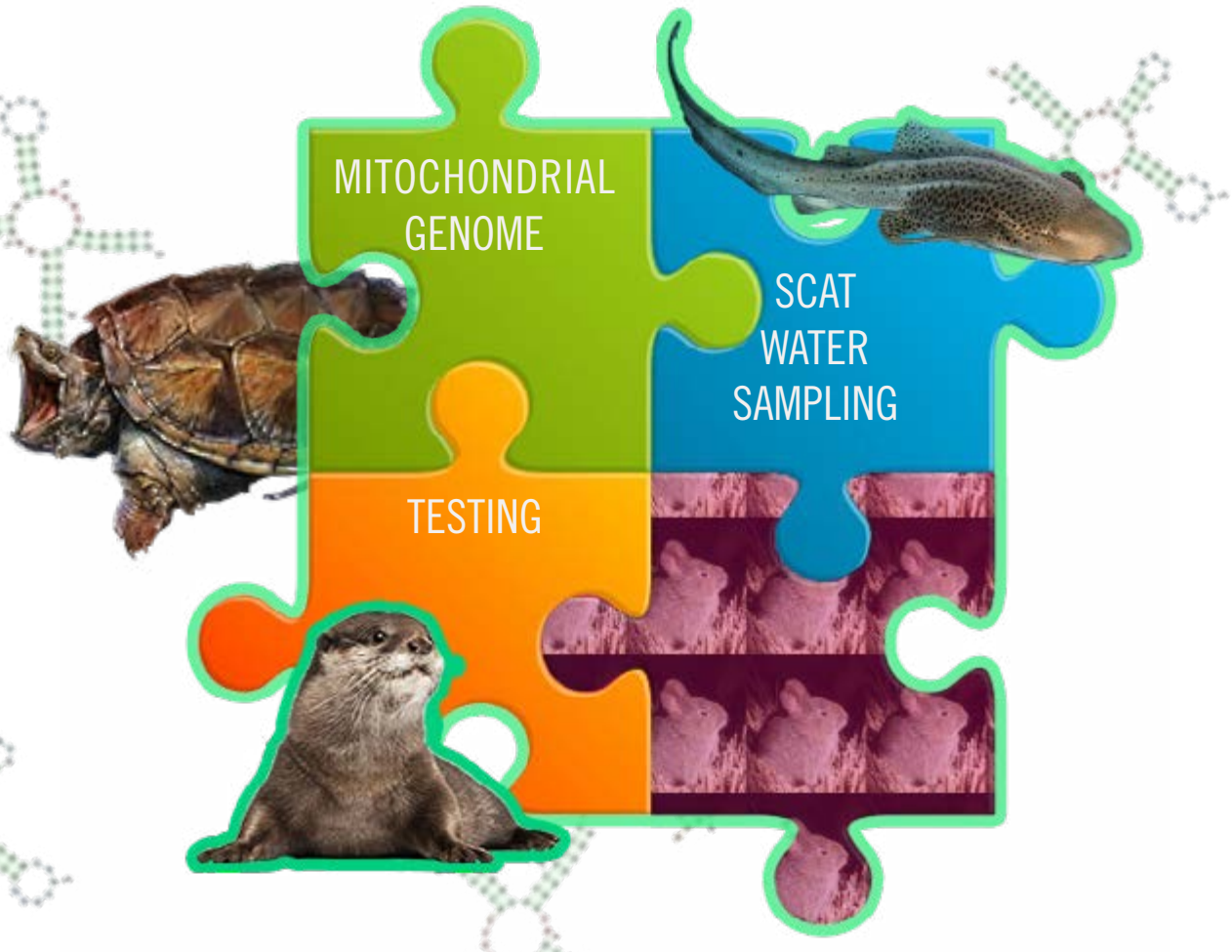
Using scat or water samples, researchers can obtain DNA and match that DNA sequence with the reference mitochondrial genome that this Creative Inquiry team created for that species. A match indicates the presence of the species in the area. Hopefully, mitochondrial resources will make the detection of endangered species easier benefiting the overall conservation efforts for these species. "It shows us how we can work better to help benefit the animals if we can understand them more from a DNA level," Chase Murawski, a junior microbiology major, said.

Beginning a career in research can be a daunting but meaningful experience. "Coming into college, I thought I wanted to do research, but I'd never actually done anything outside our school labs, so I wanted to get involved with something like [this project]," Kate

Fee, a junior biological sciences major, said. Fee is compiling the mitochondrial genome of the alligator snapping turtle. Commercial fishing, hook ingestion and harvesting threaten this animal. She compiles the genome so that all the published research on that species can be found in one place. Then she creates visualizations of the genome, which can be used by conservation teams to establish the presence of the species and inform their conservation efforts such as habitat restorations and species reintroductions.

Baeza not only exposes his Creative Inquiry students to animals throughout the world, but he also exposes them to peers from around the world through an International Virtual Exchange (IVE) program. Through the IVE, students collaborate with peers from Mexico, Peru, Colombia, Costa Rica and El Salvador. This not only provides students with an opportunity to collaborate with people from around the world but also teaches them a lesson on empathy. The Creative Inquiry team hears from international students about the reality of conservation needs for endangered species in other countries. This teaches the students that even though these conservation issues are not happening at home, they still impact real people around the world.

Slowly, but surely, the giant puzzle that is endangered species conservation efforts is being put together.

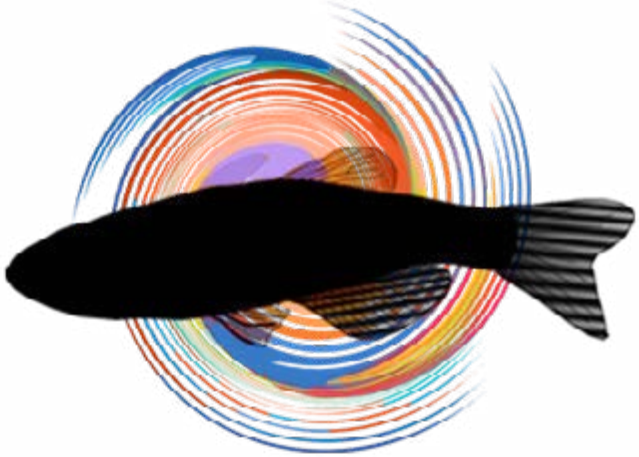


BRAINBOW CONNECTION

By JB REHRIG

Speech changes, impaired balance and loss of automatic movements are symptoms of Parkinson's disease, a complex disease with no current cure. Issues processing and producing dopamine are thought to be the culprit of the disease's progression. This is the foundation of the Development of a Zebrafish Model of Parkinson's Disease to Analyze Novel Treatment Methods Creative Inquiry project, led by Dr. Jessica Larsen in the Department of Chemical and Biomolecular Engineering and bioengineering graduate student Emme Bagwell. The ultimate goal is to treat Parkinson's disease by increasing dopamine production and uptake.

Larsen credits the innovation and success of the project to her Creative Inquiry students. "You get to the reality of the situation that undergraduate students are just as valuable as graduate students, and I think it's very unique to this campus and very unique to this program," Larsen said. Bagwell joined the project as a junior and is now a graduate student mentor. She joined the project due to a personal connection to the research. "My grandmother passed with Parkinson's disease, so when this project was getting started and became available, I already knew before I even applied that it was going to be such a great fit," Bagwell said. Her positive experience in the project motivated her to apply to graduate school at Clemson.



When the Creative Inquiry project began, the focus was to identify a bioindicator enzyme for Parkinson's disease. However, during a literature review, Bagwell and Minhyun Shin, a senior bioengineering major, discovered that other Parkinson's research laboratories used a genetically modified zebrafish, *Danio rerio*, called brainbows as their models. Not only are these fish cheap, fast breeding and have their genome mapped, but their brains are similar to humans. These brainbow zebrafish have an inflorescence gene in their brain that glows in the presence of compounds, such as dopamine, which allows researchers to easily see the effects of treatments on a living subject.

ABOVE: Tanks of 'brainbow' zebrafish are reared in the Life Sciences Aquatics Laboratory.

LEFT: This graphic depicts the rainbow colors that give 'brainbow' fish their nickname.

They also found that tyrosine hydroxylase, a precursor to dopamine production, was mentioned in many research papers, but there were few studies that addressed its role in the onset of Parkinson's disease. The students convinced Larsen to change the focus of the Creative Inquiry project to focus on a new treatment method that kickstarts dopamine production in the brain using tyrosine hydroxylase. Larsen hopes to find a molecule, ideally one that already exists in medication, that can produce more tyrosine hydroxylase or increase dopamine transporters.

The students presented their work at conferences which helped reinforce the importance of their research. "Every single time we present, there are people telling us how important this project is to them because someone that they know died of Parkinson's, and how excited they are for us to make a difference," Doris Migliaccio, a junior genetics and psychology double major said.

The Creative Inquiry students continue to drive this project. Nicole Henkel, a junior chemistry major, and Migliaccio participated in the Summer Creative Inquiry and Undergraduate Research program, where they encountered issues with the care and experimental protocols of the zebrafish. The published protocols were for immature fish, but the team needed to use adult fish. So, Henkel and Migliaccio designed new protocols for testing on adult fish. Migliaccio used SolidWorks, a 3D design software, to create a new tool to handle the fish. After many trials, she was able to print a usable tool. Self-driven students teaching themselves a new skill is a hallmark of this exciting project.

Migliaccio created and 3D printed a y-maze to assess cognitive defects in the adult fish.

Students presented their research at the annual Biomedical and Engineering Society conference in San Antonio, Texas.

"Every single time we present, there are people telling us how important this project is to them because someone they know died of Parkinson's, and how excited they are for us to make a difference."

Migliaccio

PRESERVING WOODLAND CEMETERY

By JB REHRIG

Clemson University, founded in 1889, has a rich and complex history. Part of the complicated history is in the Woodland Cemetery. Many important families and those honored by Clemson are buried there; however, recently the University discovered hundreds of unmarked graves. The Woodland Cemetery Preservation and Memorial Creative Inquiry project, led by Dr. Sara Collini in the Department of History and Geography and Dr. Rhondda Thomas in the Department of English, aims to restore dignity and respect to those buried there by identifying remains and establishing a memorial in their honor.

This Creative Inquiry project arose after two students, Sarah Adams and Morgan Molosso, '21 graduates, visited the Fort Hill Slave and Convict Cemetery and found it in a state of disrepair. After a clean up of the site, further research using ground penetrating radar discovered an additional 667 unmarked graves.

The team collaborates with the Special Collections and Archives Department of the Libraries. Using the special collections and archives the team looks for first—and second—hand accounts, artifacts and other records that are tied to the cemetery. Most of the records are digital now, but the students also search original journals and books. "Academically, this has really helped me in understanding how archives work and the whole process of pulling an item or just trying to find something that you're looking for within an archive," Beau Clarey, a junior history major, said.

Everyone working with this project emphasizes the importance of this work to Clemson, the community and the memory of the unknown individuals buried in the cemetery. "We can't change the past, and we don't know how much we're going to be able to do in the future, but we can encourage people to think about all the people on campus, living or dead and how Clemson got here in an empathetic way," Alexis Thomas, a junior history major, said. Many other participants echoed this same sentiment; the priority is uncovering history to make sure those forgotten are respected and the entirety of Clemson's history is remembered.

To reach the greater Clemson community, the team works with Marquise Drayton, the community engagement assistant for Woodland Cemetery, to meet with descendants of the people enslaved by the University in the past, as well as other constituents in the area. Drayton knows community outreach and student work are essential to the success of the project.

By involving Clemson University and the local community, the Creative Inquiry students can see the real impacts of their research on people. Students learn an empathetic approach to archival research as those affected by the disrespectful burial of enslaved peoples, convicted laborers and others who have been mistreated by the University. The members of the Creative Inquiry project will continue to make a collaborative effort to right the wrongs of history.

TRASH TO TREASURE

By KELSEY HARRIS

The amount of plastic thrown into landfills, which is hundreds of thousands of pounds annually, is increasing as new technologies, such as 3D printing, are on the rise. The REFil—Recycling Excess Filament—Creative Inquiry project, mentored by Dr. William Martin from the Department of General Engineering, focuses on repurposing polylactic acid (PLA) waste from 3D printing facilities into recycled filament. Without the efforts of this Creative Inquiry team, PLA waste ends up in a landfill, but now it has a new life.

To make a batch of recycled filament, the team collects a large bin full of discarded PLA material from 3D printing facilities on campus. They grind the waste up and funnel it into a filament maker, where it is melted and blended before it is spooled outside of the machine. The result is a spool of recycled filament ready to make new 3D prints.

The team wants to provide a consistent mechanism for Clemson University to make and use spools of 100% recycled filament; however, the challenge lies with consistency issues in the recycled spool. “For every week that we get a good run, we have a month of runs that weren’t so good,” Brandi Baldus, a junior materials science and engineering major, said. Since transforming waste from 3D printers into recycled material is a new endeavor, the team does not have experts to turn to. “Nobody knows the answer,” Sarah Maxwell, a junior computer engineering major, said. To troubleshoot, the team references online forums from the filament maker manufacturer’s website to inform manipulations to the process. They test the quality and consistency of the recycled filament by 3D printing a gecko and doorstop as test prints. If the filament passes, they distribute the recycled spools for students to use on their 3D printed projects.

Baldus (front) and Maxwell (back) process a batch of discarded filament to make a spool of recycled filament.

In the future, the team hopes to move the recycling process to the Makerspace at the Watt Family Innovation Center. There the filament maker will be able to work on a larger scale. The Watt Makerspace operates five days a week allowing the students to work with the filament machine more frequently. With more frequent runs, there will be faster progress making recycled filament more consistent and ready for everyday use.

With every test run, the team gets closer and closer to unlocking the full potential of recycled filament.

DRIVING SIMULATION

By KELSEY HARRIS

Automobile related accidents are one of the leading causes of death for young adults in the United States. Drivers are paying less attention to the road and more to their phones. The Driving Simulation & Eye Tracking for Human Performance Research Creative Inquiry project is mentored by Dr. Dustin Souders, Dr. Shubham Agrawal and graduate students Kathryn Baringer, Alan Mintz and Tyler Riley from the Department of Psychology. They seek to improve the safety of today's roads by studying the impacts of distractions and driver monitoring systems, a device that re-engages drivers using technology.

The team uses a research design that involves the manipulation of focused attention, wind speed and frequency of distraction. Participants are given the task of driving down a highway while simultaneously completing another task. They read aloud a set of numbers displayed on the tablet in the center console of the simulator, which simulates a distraction similar to texting while driving. During the trials, the team manipulates the wind speed of the simulation and how much focus should be given to each task.

While in the simulation, participants wear eye trackers which allows the team to study scanning patterns. This data is also valuable to automotive companies. It informs vehicle designers of what is distracting to the drivers. "If we can predict factors about how things may be more distracting or less distracting and look at the effects of different variables there, hopefully, we get a better handle on how to keep people engaged in the driving task," Mintz said.

The team's results show there is a significant difference in reaction times between older adults and younger adults. It is easier for younger adults to switch their attention from the road to the tablet and back to the road without moving outside the lane or going completely off the track. "It is really just a skill drop-off thing and kind of what you know versus what you grow up with," Adam Razavi, a senior psychology major, said.

In the future, the team plans to analyze older and younger adults' automation preferences and performance with various driver monitoring systems. They will compare a system that reminds drivers to keep their hands on the wheel by using a pressure sensor with another that reminds drivers to keep their eyes on the road through monitoring facial expressions. Along with preferences, the team will examine the safety of each system by measuring how close the participants come to crashing when given a critical situation, such as when a car swerves on the road.

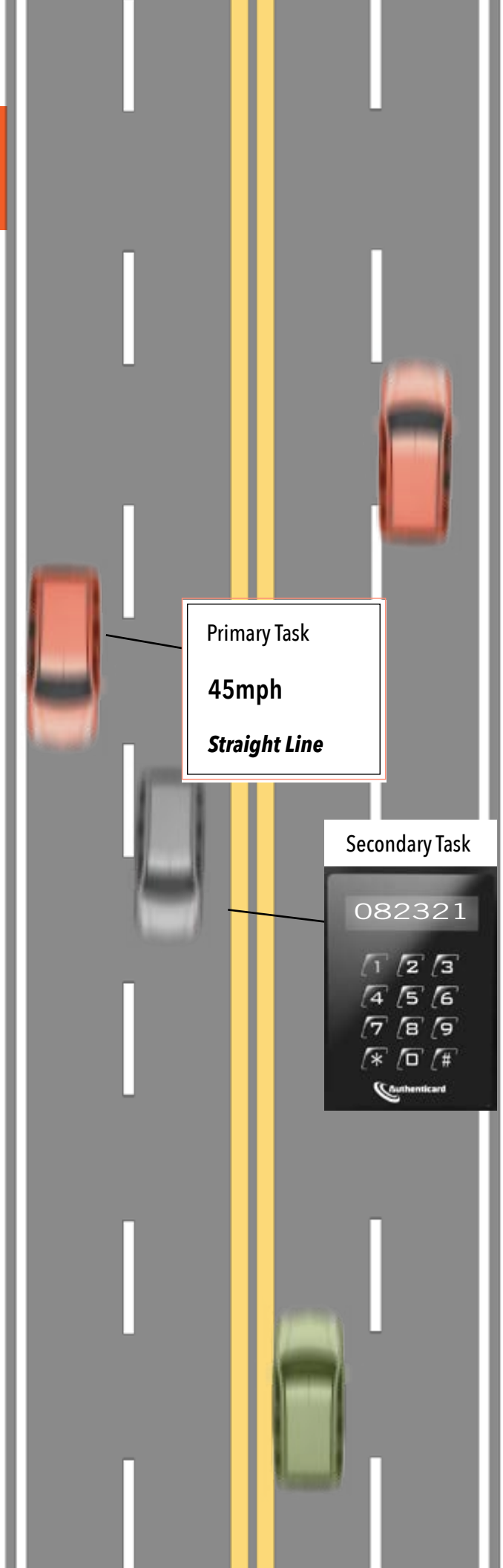
"Almost 40,000 people die a year on U.S. roads in car accidents," Souders said. The team hopes to decrease this number by improving driver monitoring systems and bringing people's attention back to the road.

Souders demonstrates the driving simulator and controls.

Enlargement of driving simulation from the perspective of the user.

Research participants in the simulator are given a primary task, such as driving straight at a defined speed.

Then the research team assigns a secondary task, or distraction, such as reading numbers on the console which is similar to texting.



PLM PROCESSES

By KAT SAHD

Thanks to a gift from the Siemens Corporation, a group of Clemson students have access to technology that prepares them for careers in process optimization in any industry. The PLM Processes and CAD/CAE Tools with Application to Vehicle Component Design Creative Inquiry project, led by Dr. John Wagner, Dr. Greg Mocko and graduate student John Morris in the Department of Mechanical Engineering, prepares students to model real-life processes and learn technology not otherwise encountered in class.

The Creative Inquiry team works on a combination of individual and group projects that contribute to the end goal of building a virtual model of a robot. They utilize Product Lifecycle Management (PLM) software, which allows key stakeholders in a product to access data that they can utilize to make decisions. This software allows for designers to optimize an item digitally without having to build physical models to test.

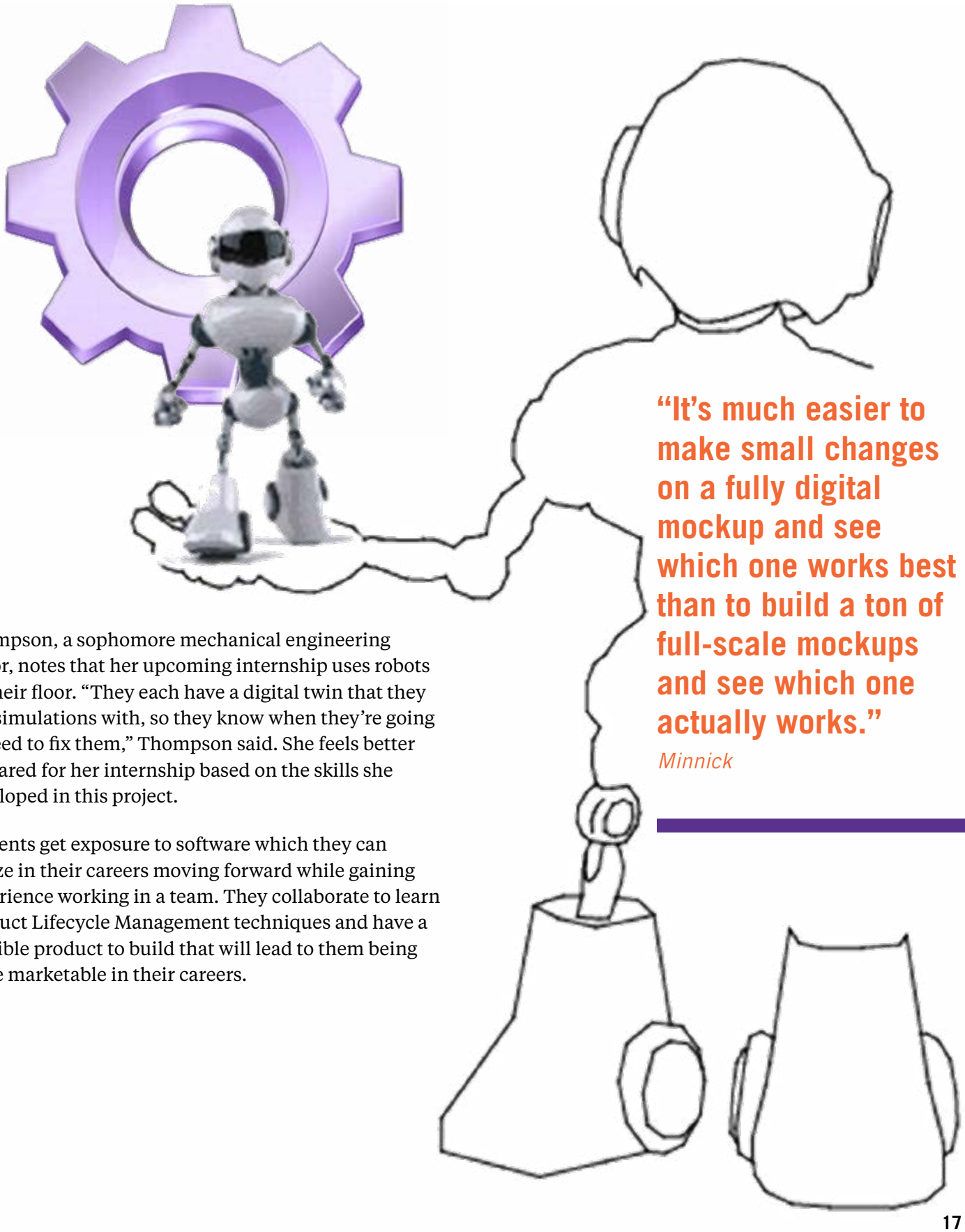
A digital twin is a virtual copy of an object or process that is used to make decisions about optimization. The twin is immediately updated and can be manipulated to mimic possible scenarios. "It's much easier to make small changes on a fully digital mockup and see which one works best than to build tons of full-scale mockups and see which one actually works," Alex Minnick, a freshman mechanical engineering major, said.

Mocko and Wagner demonstrate a robot's function for their students.

Mocko manipulates a robot's "leg" to test sensor communication with the digital twin.

Regardless of the industry the students end up in, they will be able to leverage the technical knowledge and soft skills they gained during this Creative Inquiry project. Teamwork provides opportunities for an individual's strengths to be highlighted in some tasks and requires close collaboration to complete other tasks. The students choose projects that align with their interests while working alongside the team towards their common end goal. For example, they all worked on a project together where they built an odometer from scratch in order to focus on teamwork skills. This odometer is one of the sensors that is used to communicate to the digital version of the robot. Data from the robot automatically populates into the online models.

This Creative Inquiry experience allows the students to have tangible experiences outside of what they learn in class, while they are exposed to technologies that many of them will use in their future careers. Sydney



“It’s much easier to make small changes on a fully digital mockup and see which one works best than to build a ton of full-scale mockups and see which one actually works.”

Minnick

Thompson, a sophomore mechanical engineering major, notes that her upcoming internship uses robots on their floor. “They each have a digital twin that they run simulations with, so they know when they’re going to need to fix them,” Thompson said. She feels better prepared for her internship based on the skills she developed in this project.

Students get exposure to software which they can utilize in their careers moving forward while gaining experience working in a team. They collaborate to learn Product Lifecycle Management techniques and have a tangible product to build that will lead to them being more marketable in their careers.

MORE THAN CAMP

By KELSEY HARRIS

Middle school is one of the most pivotal times for anyone, especially young girls: school is harder, friendships get rockier and self-esteem is at an all-time low. The pressure is high for girls to look and act a certain way from a young age. The Finding Your Voice Camp Creative Inquiry project is mentored by Dr. Denise Anderson, Associate Dean for Undergraduate Studies, Faculty Affairs and Inclusive Excellence in the College of Behavioral, Health and Social Sciences. This project assesses the impact of participating in a women-led outdoor recreation camp on middle school girls' self-efficacy, or self-confidence in their ability to complete goals, and body image.

The camp was established in 2012 when Anderson discovered that middle school girls dropped out of sports because of peer pressure, body-image issues, fear and lack of self-confidence. The Finding Your Voice Camp's purpose was to introduce girls to non-traditional outdoor activities such as kayaking, rock climbing, yoga and self-defense to help build intrapersonal skills. The campers also participate in counselor-led activities that further build their self-confidence and support a healthy body image. Girls at past camps watched a video of models' photos undergoing photo editing to show them how these body types are unrealistic and created with a computer.

Although the camp is in the spring, the Creative Inquiry students begin to plan in the fall. "What's kind of challenging is that [the camp] is a next semester thing so all our ideas are a little bit more abstract," Mary Callie Turner, a sophomore nursing major, said. To prepare for the camp, the Creative Inquiry team analyzes previous camps' pre- and post-surveys, focus groups and a Youth Experience Survey, which examines youth's developmental experiences in extracurricular activities and programs. They spend time considering what changes and enhancements should be made for the next camp based on the results of their analysis.

For the Creative Inquiry students, it is rewarding to see how data informed planning impacts the camp experience. "We work for two semesters leading up to camp, and so it's so fulfilling to see everything that you've been doing for the past two semesters, and how it's playing into effect," Clara Dendtler, a junior nursing major, said.

Participating in this camp increases the middle school girls' confidence, ability to try new things and desire to step outside their comfort zone. One of the best outcomes of this camp is the lasting impact on both the campers and counselors. "My favorite part is . . . seeing the students work together to work with the middle schoolers and just get such joy out of it," Anderson said. The camp is mutually beneficial because the counselors internalize the messages about body positivity that they are teaching to the girls.

Though the camp is only a weekend long, the lessons taught will stay with the campers and counselors forever.

Middle school aged girls participate in a weekend of outdoor, physical and mental well-being focused activities. Top left: kayaking; bottom left: making collages; right: yoga

Campers and counselors set their wish boats to sail. Photos provided by Anderson

CLEMSON
CREATIVE INQUIRY

Did you know?

In 2022 - 2023, Creative Inquiry awarded more than 95 undergraduates and 38 mentors with travel grants to present at 23 national and international conferences.

CREATIVE INQUIRY + UNDERGRADUATE RESEARCH

DATA DRIVEN DISASTER RELIEF

By KAT SAHD

When disaster hits, plans must be set in place to ensure a safe evacuation for those in danger. The Data-Driven Disaster Relief Logistics Planning Creative Inquiry project, led by Dr. Yongjia Song in the Department of Industrial Engineering, aims to identify the needs of disaster-stricken communities by analyzing historical data on hurricanes to provide recommendations for future disasters. The students in this Creative Inquiry project develop their research skills in decision modeling to identify potential improvements in evacuation procedures to save lives.

The students use data from past hurricanes' movements and wind probabilities to understand common themes and patterns. They receive this information from Hurrevac, a tool from the National Hurricane Program that provides data from past natural disasters. The team then creates optimization models using Python and Gurobi, programming languages, to run possible scenarios depending on their focus. One problem they are solving is getting cots to displaced individuals and those unable to leave during a storm. They model hurricanes and how trucks could get supplies to shelters across South Carolina in the event of a hurricane. "We were able to take what the forecasting models show and determine if that [the model] was the appropriate call or not and how to move forward in the future to make it better," Catherine Case, a junior industrial engineering major, said.

They connect their work to tangible outcomes by considering how the disasters they study affect communities and individual people. "It's not just solving a math problem. There's a psychological aspect behind how things work, and that's something that you would need to apply in later problems," Case said. The numbers and models become reality by focusing on relief items such as how to get cots to individuals.

The team has found common problems in how people receive aid after a disaster, such as how vulnerable communities are less likely to request funding from the Federal Emergency Management Agency, FEMA, after a hurricane. This gap keeps communities that need it most from being aware of the aid that they can receive. They hope to use their work to provide recommendations to the government. "My end goal is to identify the vulnerabilities, to essentially reexamine the plan that they have in place and see how operational research can essentially help people deal with these kinds of disasters," Song said. He hopes to impact how the logistics of emergency situations can affect the individuals in the eye of the storm and beyond.

This team's work goes a long way in saving lives and providing insight into the most optimal plan when disaster strikes. Through research skills and optimization models, students hope to affect outcomes by studying real-world events.

READY, SET, LAUNCH

By KAT SAHD

It is not rocket science. That is until a group of Creative Inquiry students design and launch a rocket for space flight. The Spaceflight Mission Planning and Rocket Experiment Development Creative Inquiry project, led by Dr. Stephen Kaeppler in the Department of Physics and Astronomy, allows undergraduates to develop skills in space flight design and rocket launching. Combining technical skills and practical experience working in teams helps prepare students for careers in any related field.

Peer mentorship drives the success and direction of this Creative Inquiry project. After experience building rockets, students can stay in the project and become mentors of novice team members.

Austin Smith, a senior physics and mathematics double major, is a founding member and peer mentor in the Creative Inquiry project. He guides the other peer mentors and participants throughout their experiences. "Each team has different objectives they take on—it's pretty open. All we tell them is you have to launch a rocket, and it needs to take some science," Smith said. There are several small teams within the project, each selects a different rocket function to manipulate with the ultimate goal to build a complete model. Each team launches their rocket at the end of the semester.

The skills developed in this Creative Inquiry project will lend themselves to any career the students pursue, whether in the space industry or not. "You have class projects and you have leadership roles, but being a leader of an actual thing that needs to be built is much different. It's good industry experience, and I feel like anybody in our group also gets good industry experience," Smith said.

This project allowed James Hutchison, a senior environmental and natural resources major, and Smith to present at the 25th European Space Agency (ESA) Symposium on European Rocket and Balloon Programmes and Related Research in Biarritz, France. "It's the entire rocket and balloon community ... it was cool to see, oh, this is what we do in the future if we keep going this way," Smith said. They shared how they introduce students to the rocket science industry in a presentation titled "Clemson University Student Space Program: Educating Students in the Field of Space Physics."

By allowing students the freedom to choose their own goals for the project and keeping passionate students on the project as mentors, this tight-knit group gets an experience they would not get in class.

"You have class projects and you have leadership roles, but being a leader of an actual thing that needs built is much different. It's good industry experience ..."

Smith

Above and Bottom-right: Hutchison (left) and Smith (right) enjoy the opportunity to present their research at the 25th ESA Symposium on European Rocket and Balloon Programmes and Related Research conference in Biarritz, France. Photos provided by Smith

The 'APAWLLO' test flight in a local field.

THE LAST MEAL

By KELSEY HARRIS

A mysterious decline of the bobcat, *Lynx rufus*, population on Kiawah Island, SC piqued researchers' curiosity which led to a search for the culprit. They found that bobcats were inadvertently consuming rodenticide, a poison meant to kill rodents, by eating rats. Rodenticide does not kill instantly, so the poison is accumulating in bobcats that prey on the rats that ingested rodenticide. The Carnivore Ecology Creative Inquiry project, mentored by Dr. David Jachowski and graduate student Meghan Keating from the Department of Forestry and Environmental Conservation, monitors this bobcat population through camera traps.

To monitor the bobcats, the Creative Inquiry team set up camera traps in different potential bobcat habitats around the island. The team then processes the photos to identify the species present. By doing so, they can monitor the abundance of bobcats and potential prey in each habitat type. "We want to know what prey is out there, that way we can understand [the bobcat's rodenticide consumption] based on what they've been eating, what they're selecting for, if that has any influence on whether or not they are being exposed," Keating said.

The Creative Inquiry team knows the importance of communicating and advocating their findings to educate the community on pressing ecological issues. "You need everyone on the same page if you're trying to do something," Christian Blackburn, a junior wildlife and fisheries biology major, said. Large-scale change requires not only the knowledge provided by the researchers but the passions and advocacy from the community.

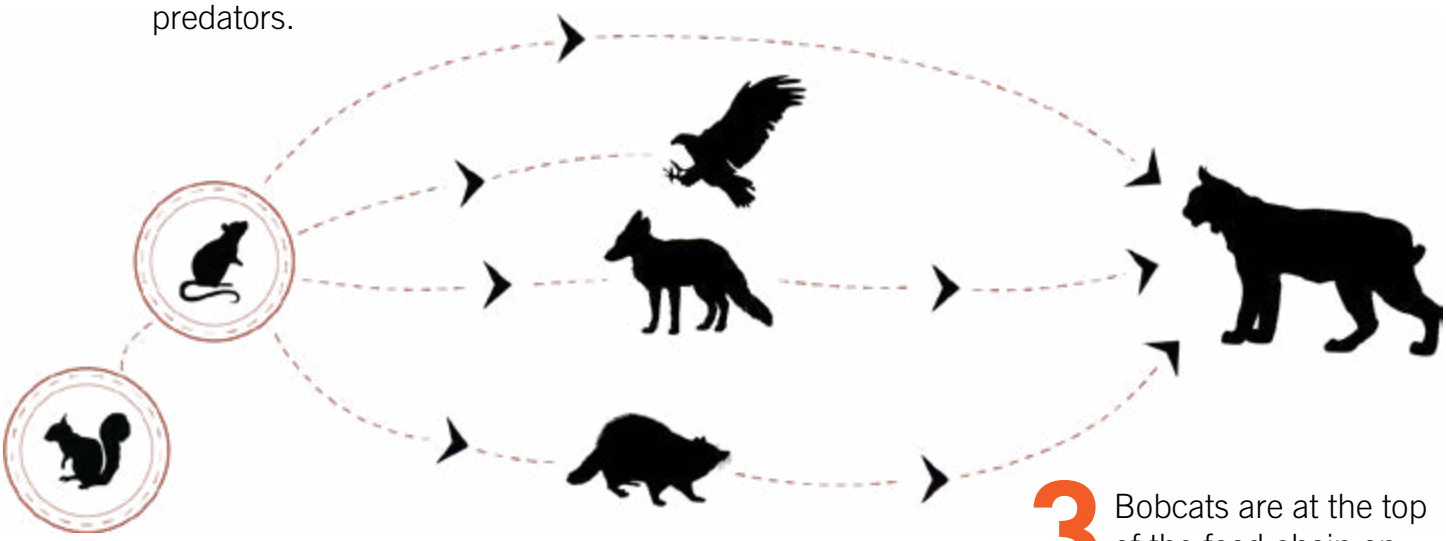
The team collaborated with the Bobcat Guardian Program to develop a campaign for the residents on the island to stop the use of rodenticides or switch to a rodenticide without anticoagulants, chemicals that thin blood. Since the bobcats are famous on the island for providing excellent pest control services, many of the locals are reacting positively to these campaigns. "What we're doing right now is testing to see whether this is an effective program and monitoring that population to see if the population is coming back [after decreased use of rodenticides]," Blackburn said. The students have been able to see the positive impact that community involvement has on recovering animal populations.

The team and the community members hope to see their collaboration make a positive impact on the bobcat population and possibly a full recovery.

A mother bobcat leads her kitten through the shrub thicket on Kiawah Island, SC. Photo provided by Keating

Keating sets up a trail camera in the maritime forest on Kiawah Island, SC. Photo provided by Keating

1 Rats and other rodents eat the poison do not die immediately, but become lethargic and are east prey for other predators.



2 Smaller predators like hawks, foxes, and raccoons consume the poisoned rodents. This can cause their death.

3 Bobcats are at the top of the food chain on Kiawah Island. They feed on rodents and smaller predators. If their prey is poisoned, it can result in their death.

CORAL CONSERVATION

By KELSEY HARRIS

(L to R): Cem Geray, Randi Sims, Childress and Maddie Parker scuba dive in the Florida Keys National Marine Sanctuary.

For most people, the Florida Keys are pictured as a gorgeous destination with sunny weather, cool ocean breezes and not a care in the world. However, for the Marine Ecology Creative Inquiry project, the Florida Keys are an important site for coral reef conservation and restoration. As the temperature of the oceans rise, coral reefs are more susceptible to infectious diseases and coral bleaching, which decrease reef health and can ultimately lead to the loss of marine biodiversity. This team, mentored by Dr. Michael Childress and graduate student Kea Payton from the Department of Biological Sciences, studies coral reef ecology and uses their results to inform conservation and restoration efforts and educate the public on the impact climate change has on reef systems and ultimately on humans.

This Creative Inquiry team travels to the Florida Keys National Marine Sanctuary to collect data from 30 reef sites multiple times a year. The team measures the abundance of reef fish, lobsters, urchins and other marine organisms to estimate the health of the coral reef. This ecosystem plays a vital role in the overall health of the ocean since it supports 25% of all marine species.

The team members work on several projects related to coral reef health and conservation such as the effects of snail removal and marine debris on coral health and reef biodiversity. Diana Molnar, a senior biological sciences major, studies aggregation cues in *Coralliophila galea*, coral-eating snails. Molnar collects *C. galea* in the field and returns to Clemson where she conducts maze experiments. This experimental design uses a maze in which the snails can choose between four path options, each ending with a different abundance of snails. To conduct the experiment, she places a snail in the middle of the maze and records which path the snail chooses. The paths end with zero, one, two or three snails.

"A healthy ocean, a healthy coral reef, is good for the planet and good for us."

Childress

The results of this experiment indicate that the snails prefer to congregate together and inform snail control initiatives. Since scuba divers manually remove snails from coral, efficiency is key. Failing to remove all snails from a coral may leave it vulnerable to rapid reinfection

Payton scuba diving in the Florida Keys. Both photos above were provided by Childress.

due to recruitment of additional snails. “It comes down to the question: Is it more effective to spread efforts far and wide to reach more corals or focus on thorough removal from fewer corals?” Molnar said.

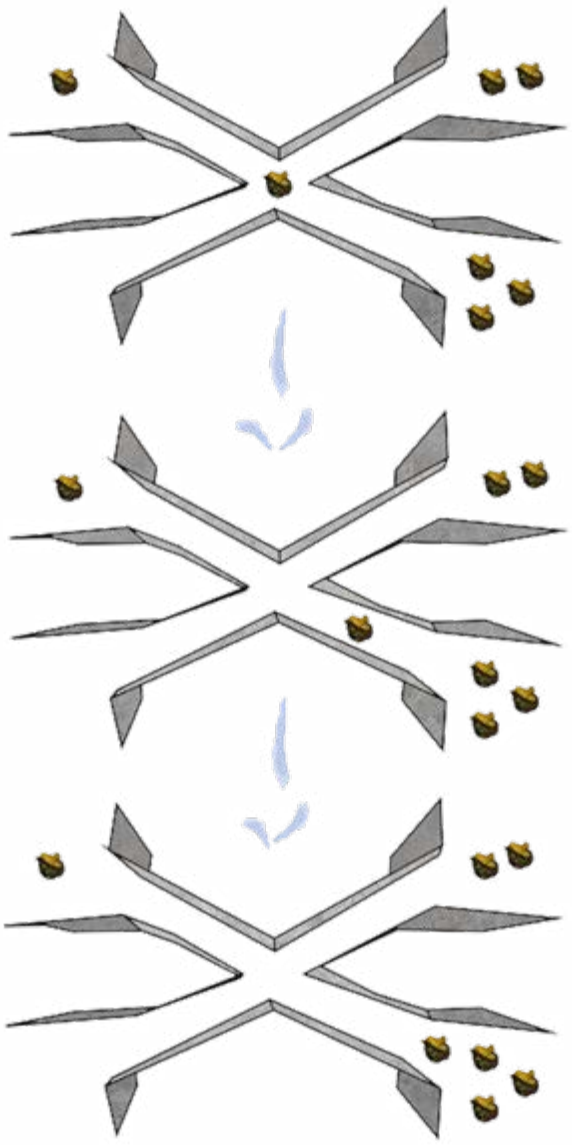
The Creative Inquiry team is also studying the impacts of removing marine debris from coral reef systems. Over time human-made litter enters the ocean and can become integrated into the reef. Removing these littered items can have a negative impact on marine life if the organisms use the debris as foraging habitat or refuge. Specifically, the team wants to know if removal of debris (all or specific types) will negatively impact the survival of invertebrate populations compared to if the debris was left in the ocean. The team photographs and collects debris from the reefs such as fishing ropes, nets and traps. Then they analyze the size of the debris, the organisms affected and the estimated biomass of those organisms. These measurements will allow for an estimate of species diversity and biomass removed per pound of debris and by debris type. All this information is considered when weighing the costs and benefits of removing the waste.

This research on marine litter can be used as a marine debris management tool and inform removal dives. By studying the amount of biomass being removed,

The coral-eating snail *Coralliophila galea* feeding on Caribbean elkhorn coral *Acropora palmata*, leaving white skeleton behind. Photo © Elizabeth Shaver

researchers and divers will be more educated on the ecological impact of waste removal. Overall, the team hopes this research can help improve the guidelines that surround removal practices.

Ultimately, the Creative Inquiry’s goal is for people to understand the consequences of climate change and anthropogenic impacts on reef communities. Even if



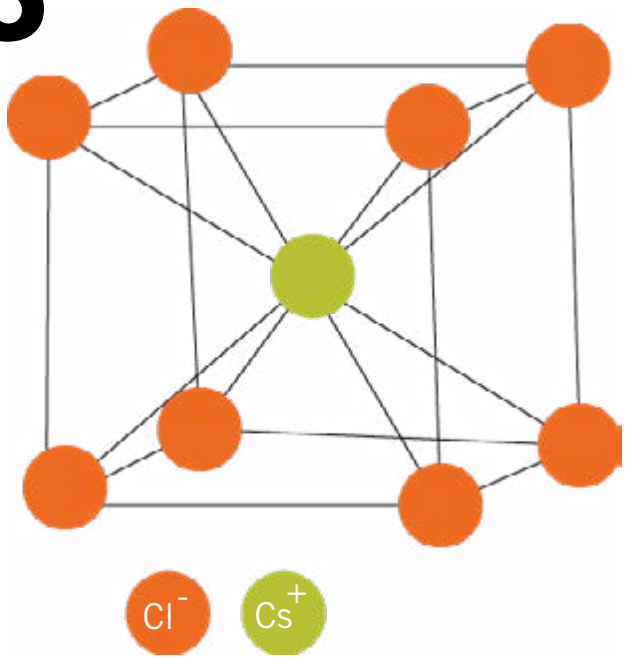
The experimental design of the coral-eating snail aggregation cues study.

the ocean is a thousand miles away, ignoring the effects of climate change and marine debris on coral reefs can diminish access to commonly consumed products such as sustainable seafood and marine bioproducts, such as medicine. Additionally, marine life would lose shelter and resources for food. Humans and sea creatures alike would suffer many valuable losses without a focus on coral reef conservation and restoration.

MARVELOUS MISTAKES

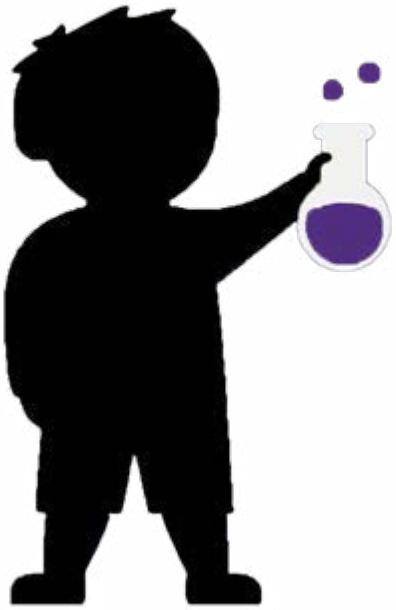
By JB REHRIG

Throughout history, there are examples of world-changing scientific discoveries that happened completely by accident—penicillin, plastic, and the microwave, just to name a few. Eutectic solvents, which are liquids with an ionic charge, are another accidental discovery and the focus of the Creative Inquiry project Deep Eutectic Solvents Based on Halogen Bonding for Energy Applications and as Tunable Reaction Media. Led by Drs. William Pennington and Colin McMillen in the Department of Chemistry, the project focuses on creating crystals or eutectic solvents, which can be used for invaluable processes, such as metal extraction and biodiesel manufacture, and could significantly advance these fields.



This depicts Cesium Chloride. By mixing is with eutetic solvents the melting point can be lowered by hundreds of degrees.

This Creative Inquiry project itself arose from an accidental breakthrough by its faculty mentors. Pennington and McMillen are crystallographers; their research involves creating crystals with potentially valuable properties and predictable structures. When attempting to create these crystal structures, molecules in powdered form spontaneously create liquids as opposed to solids. They initially discarded the liquid waste product from these reactions until McMillen and Pennington realized it might be usable. The researchers recognized the reaction's waste was similar to the newly discovered eutectic solvents. "And so, we have suddenly realized that we were throwing away a goldmine," Pennington said about their own lab's discovery of eutectic solvents.



Eutectic solvents have a charge similar to ionic solvents but a much lower melting point. In addition, they are capable of hydrogen bonding. These factors make it a possible, safer alternative to other solvents such as toxic organic compounds.

Eliza Haines, a general engineering major, learned about this Creative Inquiry project as an incoming student through EUREKA!—a program for rising first-year students entering the Clemson University Honors College. Before coming to Clemson, Haines knew she wanted to be involved in research. By participating in the project, she not only developed her research skills but also developed soft skills. "I developed some teamwork skills, as well as learning to work with professors, learning to work with mentors. Being able to communicate and do all of these things was really nice," Haines said.

An unexpected discovery was the catalyst for this Creative Inquiry project that continues to advance and engage students from different majors, interests and even other universities.

THROUGH THE LENS OF A BOOK

By JB REHRIG

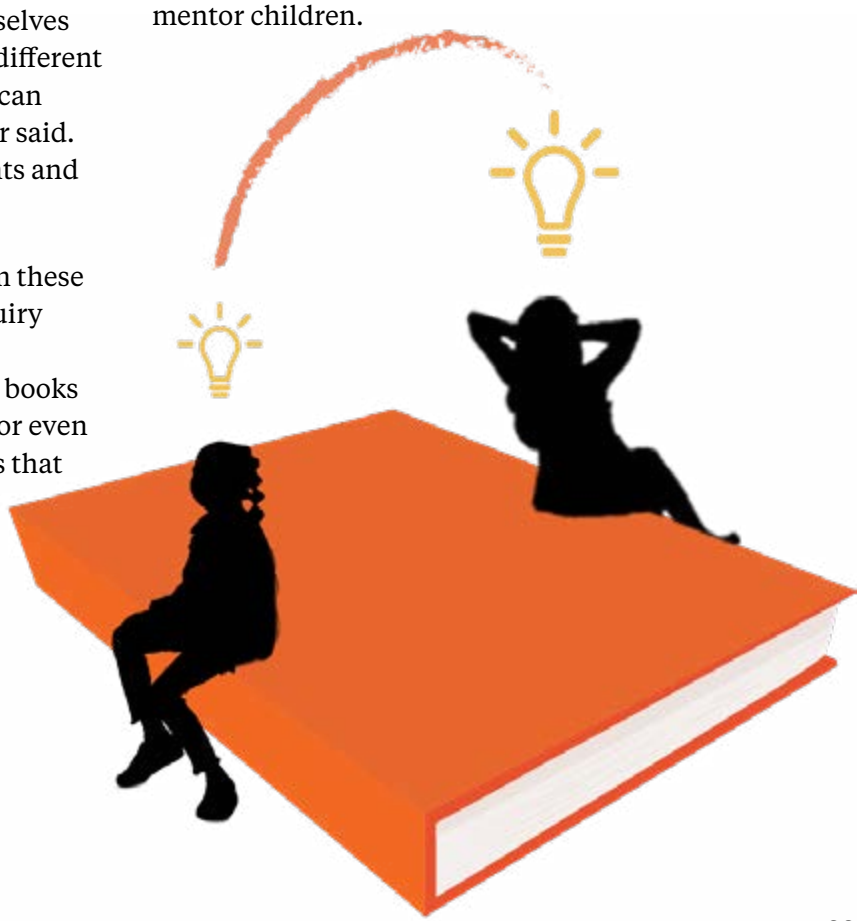
It is a widely regarded viewpoint that children are the future of society. But that begs the question, how do we best prepare kids to be empathetic, successful and responsible adults? The What Makes a Book Worth Sharing? A Review of Children's Literature Creative Inquiry project, led by Drs. Koti Hubbard and Kristen Abel of the Department of Teaching and Learning, hopes to answer this question by finding literature that teaches children skills for adulthood.

Creative Inquiry students select and evaluate books each year. Each year, the topic of interest varies, but the most recent iteration focused on diversity and culture. Dorsey Winchester, a senior early childhood education major, talked about one of the concepts important for children: mirrors, windows and doors. "You need to have books that a kid can read and see themselves reflected back, they need to have a peek into a different mindset and culture, and then something that can open the door to them exploring it," Winchester said. This allows children to diversify their viewpoints and experiences.

Children are not the only ones that benefit from these books. The future teachers in this Creative Inquiry project take what they learned into their future teaching experiences and careers. "Those were books that I should have gone and looked for myself, or even knew existed so I could look them up. It gave us that awareness and that exposure," Emily Seay, an early childhood education major, said.

Hubbard is an editor for *Literacy Matters*, a South Carolina journal that shares resources for educators, and she oversees a literature review column, *Windows, Mirrors and Sliding Glass Doors* which is where the findings of the Creative Inquiry team are published. She wants educators to be able to communicate with their students about difficult topics. "Maybe they need to have a conversation, they just don't know how to go about it: books are an outlet for that," Hubbard said.

By participating in the literature review, Creative Inquiry students can help educators in South Carolina, as well as themselves, better prepare to teach and mentor children.



DETECTING THE DECEIVER

By KELSEY HARRIS

The potential of winning a $500 gift card or exclusive reward is enticing. Scam emails with promising gifts are common in inboxes. Typically, malware detection and protection software eliminate these scam attacks. However, a recent switch in cybersecurity focuses on how humans can protect themselves against these online attacks. The Dangers of Online Inauthentic Media Creative Inquiry project, mentored by Dr. Dawn Sarno and graduate student Jeffrey Black in the Department of Psychology, focuses on the characteristics of humans that make them more susceptible to phishing emails, scam text messages, fake news headlines and scam voicemails to educate susceptible people about these scams.

Since modern society relies so heavily on technology, people will always be the last line of defense against scams. Humans interact with online environments daily, so it is important to have protection against online scammers. To identify the characteristics of people susceptible to these cyberattacks, the Creative Inquiry team conducts an online survey that asks participants to classify different forms of digital media as legitimate or not legitimate. The team measures the accuracy of the participants' classification of real and fake emails, text messages, news headlines and voicemails. Participants also complete the Digital Literacy Scale, a measure of digital intelligence, and a Cognitive Reflection Test, which measures participants' impulsivity.

The Creative Inquiry team's results indicate that people are more susceptible to different forms of scams if they tend to be more impulsive or lack digital literacy. A lack of digital literacy means an individual struggles with navigating, evaluating and communicating information online. Additionally, individuals who fall for one form of online deception are more likely to fall for other forms. Understanding what characteristics make someone more susceptible to scams is the first step to learning how to protect themselves, instead of relying solely on technology. They know whether or not they need to be more cautious and aware of online scams.

Engaging in this research is valuable for students such as Maggie Harris, a senior psychology major, and Elizabeth Paradise, a senior criminal justice major.

Black reviews the phishing stimuli data with the CI team.

Introducing Heidi Mylie, the head agent for the Creative Inquiry team's phishing intervention, IMPAWSTER.

This Creative Inquiry project helps them get more comfortable with making mistakes and gain confidence in their research skills, which will help them reach their future career goals. "It's good to be able to make the mistakes now ... so then when you actually get into doing your own research, you know you've had some practice," Harris said. Sarno makes the Creative Inquiry project a safe place for the students to make mistakes which allows them to understand that research is not a linear process. "It feels like this [Creative Inquiry] has given me more confidence," Paradise said.

This is an example of a phishing email.

Online deception impacts not only individual lives but also other areas such as the world of business. One employee falling for a scam can compromise an entire company. It is similar to a chain reaction because if the boss falls for a scam, then the scammer can gain access to their email account and infiltrate the whole company. A lack of knowledge of digital deception can be dangerous because there is a possibility that money is lost and identities are stolen.

The potential ramifications of falling for scams is why the team is working on a training module for Clemson students named IMPAWSTER. This spy themed training module will teach Clemson students what a phishing email is and how to detect one. "Unfortunately, I can't tell you how many times I've had students come into the lab and be like 'I don't know what a phishing email is,'" Sarno said. IMPAWSTER will help educate students on phishing emails and make them less likely to be susceptible to scams.

So, next time there is an offer in your inbox that is too good to be true, it might be the case.

JOINT EFFORT

By KAT SAHD

Imagine breaking a finger and having a customized, fashionable splint for healing. That is the goal of the 3D Printing Jointed Customizable Splints Creative Inquiry project led by Dr. Tyler Harvey from the Department of Bioengineering. Hunter Jimenez, Jackie Hanna and Martin Lautenschlager, all senior bioengineering majors, conceptualized the Creative Inquiry project while in another class together. "I think as engineers, we're naturally problem solvers. We had been looking for hands-on research in CIs and decided to create our own when we recognized that there was a need in the medical industry for a better solution incorporating

Hanna, Lautenschlager and Jimenez display some of the 3D-printed finger splints they created.

innovative technology like 3D printing," Jiminez said.

The team collaborates with clinicians at the Prisma Hand Center in Greenville to determine the gaps between patient needs and what is available on the market. Then, they consider the design and functionality of splints, with specific consideration given to patients' desires to remove their splints for everyday activities such as driving or cooking. "They [clinicians] reiterated that [patients discarding the splints] is a huge problem that they encounter all of the time; they just don't have the time to address it," Jiminez said. Clinicians also reported that taking off the splints prolongs the time to heal. "When they had those splints off, the deformity would occur again," Lautenschlager said.

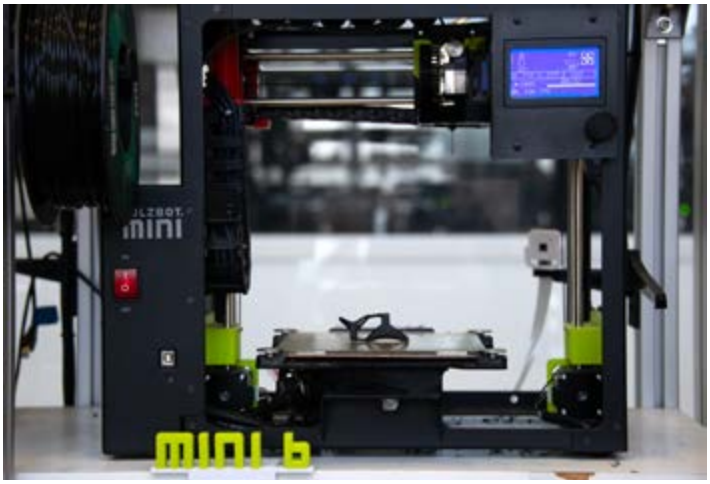
"This [CI] has given me the chance to go beyond hardcore science classes ans actually apply it to something real."

Hanna

The Creative Inquiry team then creates their own designs using 3D printing software. By designing with style and functionality in mind, they hope patients will be more inclined to keep their splints on for the duration of their injury.

Through this Creative Inquiry project, the students learned valuable techniques in product design and problem-solving, specifically in relation to 3D printing. They worked through issues surrounding the finger's swelling at different stages of the healing process, including each phase of healing in their designs. In the future, they hope to test on subjects with various finger sizes and streamline their process.

"This [CI] has given me the chance to go beyond hardcore science classes and actually apply it to something real," Hanna said. The students appreciate the opportunity to network with clinicians, apply their knowledge from class, and design products to solve real-world problems.


mini


26

BREAKING BOUNDARIES WITH BIOSENSORS

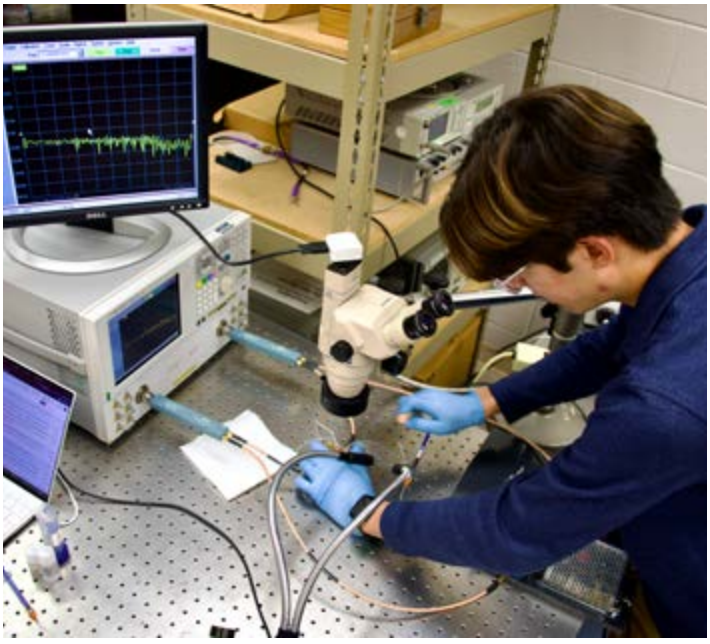
By ANNABELLA COTUGNO

The classification of cells was an important advancement in science. Since then, cancer and other pathogenic cells had to be biopsied from a patient in order to be classified. The Effects of Radio-Frequency on Biological Cells Creative Inquiry project, led by Dr. Pingshan Wang in the Department of Electrical and Computer Engineering, studies the effects of radiofrequencies on cells to develop biosensors that use microwave techniques. These biosensors will be used to classify cells in a non-invasive manner which will assist in the detection of dangerous pathogens or cancer cells.

For four and a half years, Gabe Cutter, a senior computer engineering and economics double major, has conducted radiofrequency cell research with Wang. The Creative Inquiry research examines the microwave characteristics of non-living organic microparticles inside a microfluidic channel built into one of the biosensors that continuously moves tiny amounts of liquid. The direction of the research took a turn when, to the team's surprise, they discovered the cells were rotating inside the microfluidic channel. This discovery occurred after they stretched the standard spherical particles while studying different aspect ratios, such as ovals. By stretching the cells into ovals, they observed the rotation that was not seen with the original spheres. After stretching, signal changes in the sensor indicate that the particle rotations may have new and interesting effects. To the team's knowledge, particle shape-based microwave field effects have never been researched before and could have profound impacts on physics.

The team hopes their biosensors will one day become a commercial product and be used to non-invasively classify cells such as pathogens that infect plants or sense blood glucose concentrations to detect hyperglycemia. The intricate engineering and design of the sensors present a lot of unexpected hurdles for the team to navigate. "One thing I've learned about experimental research is that it is as much an art as it is a science," Cutter said. When the team faces challenges, such as sensor corrosion or microfluidic channels clogging, they brainstorm potential solutions to make successful advancements.

Participating in Creative Inquiry opened doors to other opportunities for Cutter, including scholarships and publications. He received the 2021 Goldwater Scholarship and the 2022 Astronaut Scholarship. "The Astronaut Scholarship was a really cool experience



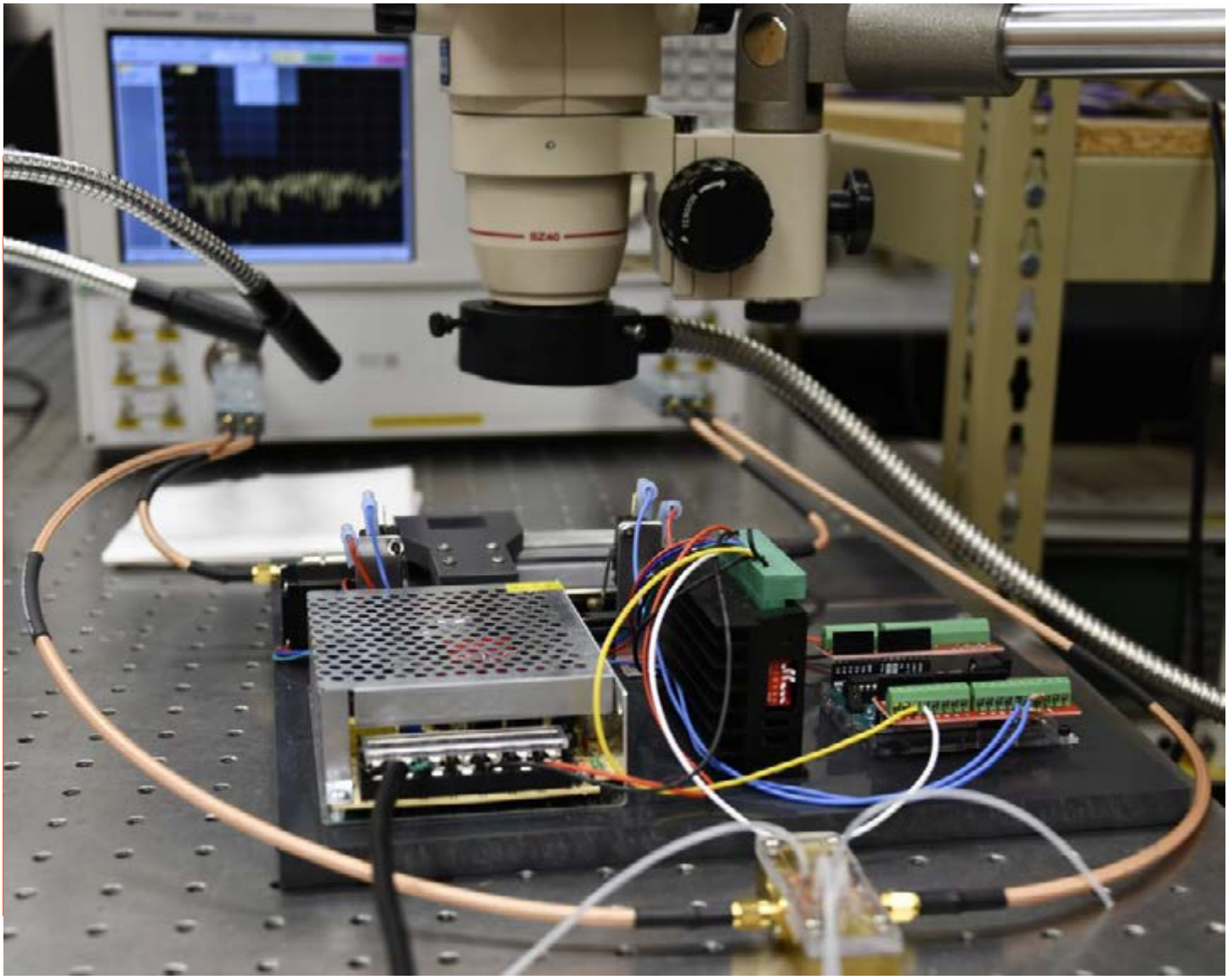
Cutter sets up the biosensors in the microscope apparatus to prepare for an experiment.

because I got to attend a technical conference and spend some time with other people who shared my interests," Cutter said. He has gained invaluable knowledge and experiences, and plans to apply these transferable skills to quantum technologies in graduate school.

This complex but rewarding research has the potential to make groundbreaking advancements in science and public health. Cutter encourages all Clemson students to get involved in any sort of research while in school. "It's not that big of an opportunity cost to just hop in, especially as a freshman or a sophomore," Cutter said. "I think it's some of the most valuable work someone can do in undergrad, not only for the public, but for themselves because of the professional connections and the personal development you can get from learning about what you do and don't like. I think it is the peak of what Clemson has to offer."

"I think it's some of the most valuable work someone can do in undergrad ... I think it is the peak of what Clemson has to offer."

Cutter



A closer look at the biosensor and microfluidic setup.

NANOMATERIALS

By KELSEY HARRIS

The Nanomaterials Studio Creative Inquiry team constantly challenges the phrase "out of sight, out of mind." Dr. Fadi Abdeljawad in the Department of Mechanical Engineering mentors this team as they explore materials on a near-atomic scale. The team furthers the impact and relevance of this unseen subject by engaging in STEM outreach programs for Clemson area youth in hopes to spark their interest in fields such as material science.

The team's goal is to analyze materials that measure on a near-atomic scale in hopes to create a material that will survive in any environment. For example, the material inside of a jet engine needs to be very strong and maintain its strength at very high temperatures. With the help of Clemson's supercomputers and machine learning, they are exploring the fundamental side of engineering and understanding nano-scale properties to improve the application of nanomaterials. Comprehending science on a small scale is the foundation for making large-scale improvements.

The Creative Inquiry project focuses on laser beams in 3D printers. "We're coming up with ways to map out the potential parameters that we can change based on those laser properties," Giovanni Orlandi, a junior mechanical engineering major, said. Power, speed and shape of the laser are some of the variables the team is changing. There are an extensive number of different combinations that impact laser properties. To reduce the number of test runs, Orlandi utilizes machine learning and algorithms to predict the potential change without having to run every possible combination. His solution for extreme environments is to focus on the material. "If we can improve the materials themselves, the properties themselves, then extreme environments won't be an issue because we can make better materials," Orlandi said. Additionally, improving these laser beams can make the creation of different manufactured parts easier by allowing companies to make cheaper and hyper-personalized parts without the need for molds.

This Creative Inquiry project is equally committed to outreach with the youth in the Clemson area. Primarily, the team works with Clemson Elementary School to teach students different atomic and crystal structures using ball and stick kits. "I really enjoyed going to help with the elementary schoolers. Just trying to get to see

Sarah Hunt explains laser properties and potential changes based on changing variables.

them start to get a little understanding of it," Aiden Tombuelt, a junior mechanical engineering major, said.

"Science communication is as important as the science itself," Abdeljawad said. This is why he believes it is important for his Creative Inquiry students to not only be able to conduct research with nanomaterials but also share that research with the rest of the community.

"Science communication is as important as the science itself."

Abdeljawad

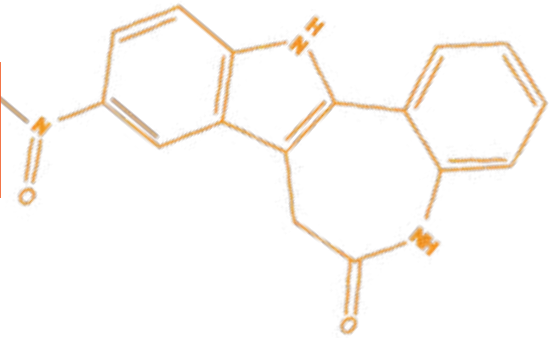
CLEMSON
CREATIVE
INQUIRY

FOCUS ON CREATIVE INQUIRY

POSTER FORUM

The Annual Focus on Creative Inquiry (FoCI) event is Clemson's university-wide poster forum that showcases undergraduate research, service-learning and other experiential learning activities supported by the CI program. FoCI presentations are targeted at a general audience, allowing presenters the opportunity to communicate their work outside of their disciplinary terminology. Each CI Project should submit one poster that presents the overall work of the project.

LEARNING THE LAB WITH LAUNCH



By KAT SAHD

The laboratory techniques and treatments involved in cancer research can take years to master. To onboard students in this specialized research, Dr. Marc Birtwistle, from the Department of Chemical and Biomolecular Engineering, created a preliminary project, The Cancer Systems Biology in the Birtwistle Lab LAUNCH Creative Inquiry project. LAUNCH Creative Inquiry projects are introductory projects that allow students to gain specialized skills required prior to starting a more technical research project. This LAUNCH project aims to phase students into a lab environment by giving them a semester of learning very specific procedures before they move on to more technical projects in future semesters.

The Cancer Systems Biology in the Birtwistle Lab LAUNCH Creative Inquiry project provides students with a first-semester introduction to the technical skills needed to pursue future research in Birtwistle's laboratory. It also allows students to speak with others in the lab and find projects to work on in later semesters. Students become exposed to lab practices and learn about other projects that are being conducted by participating in this LAUNCH CI while they enter an atmosphere that encourages the exploration of ideas. "You realize how much other work goes into research and experimenting," Emma Funke, a senior biological sciences major, said about her experience in the LAUNCH project.

The LAUNCH students' projects cover a wide variety of inquiries into cancer research. Most involve improving techniques to make them more efficient. Other projects focus on building computational models of cancer cells so scientists can further understand specific drug treatments' effects on the cells. The Birtwistle lab wants to ensure that cancer treatments include the latest advancements and are as up-to-date as possible. Birtwistle allows students to continue past projects or start new ones depending on what they are interested in as they move from LAUNCH to different Creative Inquiry projects.

The LAUNCH students have the opportunity to connect with students conducting their own research while learning the complex techniques employed in this type of research in hopes of deciding which project they want to join in the future. After LAUNCH, Funke is studying the effects of a drug palbociclib on proteins in the body. This medication inhibits cyclin-dependent kinase (CDK), which is important in cell growth. "We are looking to see what other proteins are affected when we administer this drug ... I've been learning a lot and have gotten a lot of independence," Funke said. It is commonly studied in cancer as cancer cells grow uncontrollably, so CDK's search for mutations that could potentially slow down or stop this growth. She cites the LAUNCH experience with her being trusted to explore and ask questions.

Funke credits exposure to the lab with helping her to engage in further research. "I think the CI has given me a lot of confidence in my ability to pursue upper-level graduate work," Funke said. She plans to attend medical school and continue research on cancer treatments after graduation.

By learning valuable research skills and lab etiquette, students in this Creative Inquiry project can see what a working lab looks like early in their careers; they are able to explore critical areas of cancer research and see the responsibility that it takes to work in a lab setting.

The Healthcare Logistics team takes a break outside their lab. From L to R: Ariane Chanda, Ian Venkatesan, Taaffe, Winni Zheng, Patel, Steven Foster

HOSPITAL HANDOFF

By KAT SAHD

While a trip to the hospital may never be ideal, making admission processes safe and efficient can give patients peace of mind. The Healthcare Logistics and Patient Flow: Observation and Analysis Creative Inquiry project, led by Dr. Kevin Taaffe in the Department of Industrial Engineering, seeks to help physicians and patients alike with issues the healthcare field faces, specifically in stress and patient management. The current focus is on studying patterns that occur when physicians hand off patients between shifts.

They work to respond to needs in the hospital system identified by the physicians they collaborate with from the emergency department of the hospital. The team is focused on two projects this year. The first project analyzes data on hospital admission and wait times in the emergency room to see where conflict arises during a patient's admission process. The team looks for patterns between staff productivity and wait times using the data provided by the hospital. Factors such as severity of a patient's condition are taken into account as they look for correlations in the data.

The second project measures physical manifestations of stress, such as heart rate variability and perspiration. The students use Empatica watches, which collect real-time data, while health professionals work. The data is used to visualize reactions to shift changes to determine whether that causes additional stressors for medical professionals.

The Creative Inquiry students not only get applicable experience in the industrial engineering field but get to understand the many issues that healthcare workers face and see how their research impacts physicians' lives. They become immersed in the projects and can understand the language and systems they may use if they enter the healthcare industry. "It gives me a hands-on experience, to see this side of the field, and if I like it or not to help me decide what kind of future I want," Rahul Patel, a junior industrial engineering major, said. All of the students in the Creative Inquiry expressed interest in some area of the healthcare industry and said this experience helped them narrow down their career paths.

The team will continue their research with the collaborating hospitals and they hope to publish their findings. While their work may never completely remove a patient's fear from a hospital trip, taking steps to improve processes allows patients to focus on getting better and keeps physicians focused on patient health.

"It gives me hands-on experience ... to help me decide what kind of future I want."

Patel

TROUBLE IN EL TIPLE

By ANNABELLA COTUGNO

Colombia is famous for its exotic fruits, delicious coffee and festive carnivals. However, many Colombian communities do not get to enjoy these luxuries, as they are faced with violence and food insecurity. The Can (Bio)sensing Tools be Used to Empower Communities Disproportionally Burdened by Environmental Contamination? Creative Inquiry project works with a disadvantaged community facing threats of industry created monocultures and ensuing water pollution issues in Colombia. The project is mentored by a diverse team—David Bahamon-Pinzon, a biosystems engineering graduate student, Dr. Eric McLamore, from the Department of Agricultural Sciences and Dr. Diana Vanegas, from the Department of Environmental Engineering and Earth Science.

El Tiple is a small village located in the southwestern part of the municipality of Candeleria, Colombia. It is rural and the residents lived on the crops they grew, until a sugarcane monocrop displaced some of the land used for local agriculture, used the water resources for irrigation and polluted the environment with the intensive use of fertilizers and aerial spraying. These practices not only impact local food availability but their water. High levels of pesticides contamination make the water dangerous to consume. The Creative Inquiry team is developing biosensors to help the residents monitor water quality.

The main goal of this Creative Inquiry project is to create an environmental surveillance program to support and empower the people of El Tiple. To achieve this, Bahamon-Pinzon leads the team to create biosensors that detect environmental pollutants in the water.

To customize the sensors for El Tiple, the team works with the community to understand the environment. Marissa Coll, a junior language and international health major, and Isabel Long, a senior language and international health major, are in charge of translating interviews and analyzing the local demographics, respectively. Coll translates Spanish interviews from a community leader in El Tiple so the team can understand the issues. Long focuses on community development by studying demographic information, such as size and growth, using the Asset Based Community Development (ABCD) model, to better understand the community. “The most surprising thing is how multidimensional this project is. When I saw it, I was like ‘Oh cool. Water sensors,’ but then there’s community development and translating and trying to make it user friendly. There’s just so many aspects to it that I didn’t realize before I jumped in,” Long said.

They already have a functional sensor, but it is very complex and not user friendly. “We consider all characteristics of the community when we design the technology. We use low-cost materials, and facile fabrication methods. We want to have it user friendly, so it’s very context specific,” Bahamon-Pinzon said. Once they customize the sensors for El Tiple, they plan to develop educational programs for the community so they can use the technology long term.

The Creative Inquiry team met with residents of El Tiple to discuss the sensors, the impact of pollution and other issues to the community. Now, members of the community feel more informed and empowered in meetings with their government because they understand what is happening and can advocate for themselves and push for solutions.

This project not only affects the people of El Tiple, but also students in the Creative Inquiry project. “Even though I don’t live there, just being able to do this small labor of translating these interviews has been a really rewarding experience for me,” Coll said. The team recognizes what a large impact the project has on El Tiple, and how eventually it can be valuable for any community facing problems caused by monoculture crops and water pollution. This Creative Inquiry project demonstrates that knowledge truly is power.

INNOVATIVE RECRUITING

By ANNABELLA COTUGNO

The foundation of a successful athletic program is its recruiting. Hanna Gibson, in the Department of Graphic Communications, leads the Women's Basketball Recruitment and Design Creative Inquiry project to collaborate with the basketball coaching staff in their recruiting efforts. This project is in its infancy, but the coaching staff already likes what they see. In such a competitive sports environment, it is essential to maximize recruiting efforts to assemble the best team possible.

Gibson pairs graphic communications and packaging science students together to brainstorm, design and create prototype recruitment mailers. The students have creative freedom to design the mailers and are encouraged to explore new, fun ways to engage the recipients. Grace Webster, a junior graphic communications major, and Julia Humanchuk, a junior packaging science major, worked together on a prototype. Their theme was lake life in respect to Clemson, and included pictures of Lake Hartwell, the Snow Family Outdoor Fitness and Wellness Complex and the rowing docks. "It's so cool to think about how something I made gets delivered to the homes of girls who might be playing for our basketball team soon," Webster said.

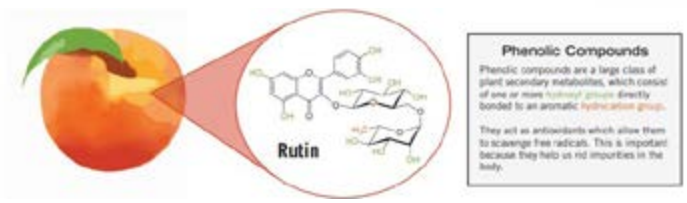
Gibson talks about how this project is important to bridge the gaps between academics and athletics. "Somehow, these two entities both exist on a college campus, but they're so separate," Gibson said. "There is such an interest in marketing and project management and packaging for athletics that's growing, so for me it's just a really interesting thing to see different majors working together and bridging that gap between the academics and athletics." She hopes that one day this project will expand to other sports teams such as volleyball, softball, baseball, soccer and men's basketball.

Potential photograph of a basketball sun setting over Lake Hartwell. Photo taken by Jacob Kerby

THE CHALMERS CARR III AND LORI ANN CARR ENDOWMENT FOR CREATIVE INQUIRY

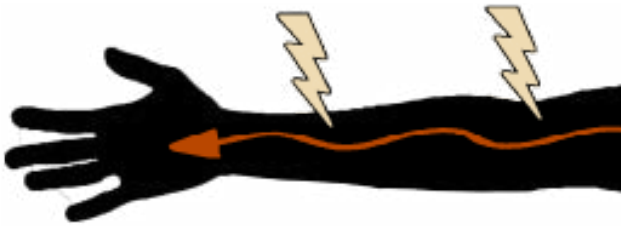
In 2014, Chalmers Carr III ('90) and Lori Anne Carr ('90, M'92) established the Creative Inquiry program's first endowment to support student research in fruit and vegetable crop production, agriculture industries and rural economic development. As founders of the family-owned and operated Titan Farms, the Carrs are proud to extend their professional work to bolster the Clemson student experience and the Clemson family.

Enjoy the collage of photos from projects supported through the Carr Endowment. Projects vary from innovative packaging to impact of bloom time to rural health and cancer research.



MODELING MAYHEM

By JB REHRIG



When investigating events that pose a danger to humans, mathematic models can provide a solution. The Heat Transfer Along the Human Arm in Electric Arch Phenomenon: Mathematical Modeling with Advanced Engineering Apps Creative Inquiry project is led by Dr. Irina Viktorova and Sofya Alekseeva in the School of Mathematical and Statistical Sciences. The team creates mathematical models of everyday occurrences such as electric currents and stress on artificial joints.

Though this team's research is in mathematics, it addresses safety. One area of research is the movement of heat transfer and electricity through a human arm. Modeling these processes can potentially mitigate injuries to those who work with electricity. "The electric arc is not investigated—it really is very dangerous, of course—and cannot be predicted, which is why there are a lot of casualties," Viktorova said about the inspiration for the project. Another area of interest for the Creative Inquiry team is testing viscoelasticity, or the behavior of materials with both elastic and fluid properties, in polymers and biomedical devices to model stress on the devices when in the human body.

Although most of the students are not mathematical sciences majors, they see the benefits of participating in this Creative Inquiry project. This project is particularly interesting to computer science and various engineering majors. "This is just a good basis for all STEM fields, or at least all STEM fields that would be dealing with mathematics and processes," Chase Rochester, a sophomore mechanical engineering major, said.

"The electric arc is not investigated—it really is very dangerous, of course—and cannot be predicted, which is why there's a lot of casualties and everything."

Viktorova

IMAGE GUIDED DRUG DELIVERY

By KELSEY HARRIS

Five percent. That is the survival rate for patients with a diagnosis of a glioblastoma brain tumor. This type of cancer is very aggressive and difficult to treat with surgery, radiation or chemotherapy. Scientists hope that by improving brain imaging they can increase this survival rate. The Image-Guided Drug Delivery to the Brain Creative Inquiry project is mentored by Dr. Jessica Larsen in the Department of Chemical and Biomolecular Engineering, Dr. Angela Alexander and graduate students Joey Lavalla and Megan Pitz in the Department of Bioengineering. The Creative Inquiry team aims to improve computed tomography (CT) imaging to make it more effective in diagnosing glioblastoma brain tumors.

Although magnetic resonance imaging (MRI) is the industry standard for viewing brain tumors, the team works with CT imaging because it is more accessible to hospitals due to cost. Additionally, MRIs can only detect stages three and four of brain cancer. This late diagnosis is a significant contributor to the low survival rate in patients with glioblastoma brain tumors. The Creative Inquiry team discovered that using gold as a contrast agent helps improve the CT image and makes a better image in comparison to an MRI image. This works by using a drug delivery system that injects the patient with gold nanoparticles. Due to its high electron affinity, the gold increases the fluorescence of the location of the tumor, which makes it easier for doctors to see on scans. In turn, increased visibility allows the doctors to remove blood vessels that are feeding the tumor, ultimately killing it.

However, this team's discovery did not come without any difficulties. When they initially tested gold as a contrast agent, the element caused the cancer cells to grow. So, they created a polymeric system to encapsulate and shield the cancer cells from the gold to prevent tumor growth. The students do not let setbacks hinder their progress. "It's research. Things happen. [You] just have to overcome that and move on," Emily Barnett, a junior bioengineering major, said.

In order for this methodology to be approved for hospital use, the team's delivery system must undergo animal testing. Currently, they are trying to successfully establish a glioblastoma brain tumor in mice so that they can take CT images using the gold contrast agent. Additionally, they are working towards using their delivery system to transport chemotherapeutic drugs to the tumor in the mice. This delivery system would not only be able to image the tumor but also deliver treatment directly to the site. This will make treatment more efficient because the doctors can see the area they are administering chemotherapeutics to in real time and know if they are targeting the correct section of the brain.

Though this research is very meticulous and time consuming, it is rewarding. "I know that we're doing something so much bigger than ourselves," Isabel Ray, a senior bioengineering major, said.

Overall, the team is revolutionizing CT imaging and paving a pathway for future cancer research.

UP AND

A glimpse at new Creative Inquiry projects that *Decipher* will feature in the future.

EXPERIENTIAL CONSULTING

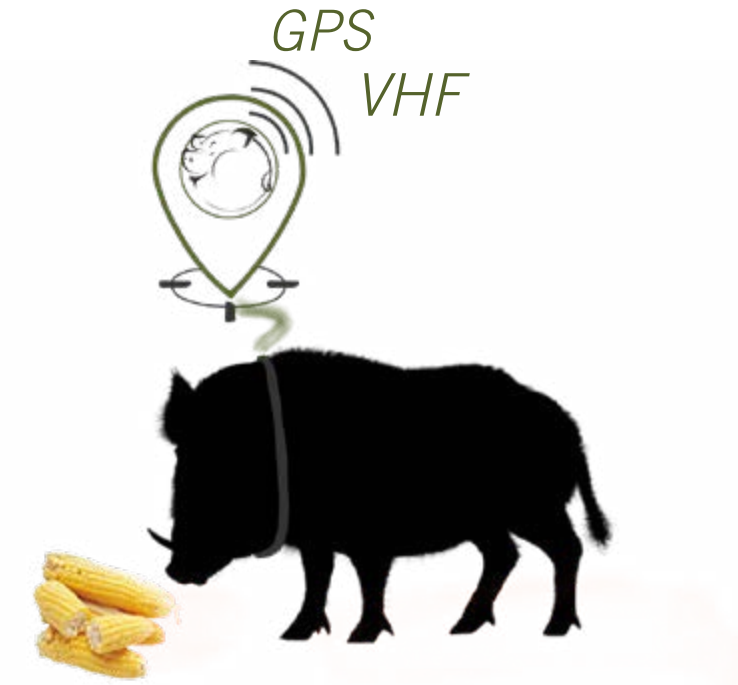
Consulting is an industry that hires 20% of students with a business degree. The Experiential Consulting Creative Inquiry project, led by Dirk Roskam in the Department of Management, seeks to introduce students to the consulting industry in various different sectors and with different employers to give students insight into the career of a consultant.

Students are split between four cohorts, each in collaboration with a leader in the consulting industry. One group focuses on market opportunities through Grant Thorton. Another focuses on mergers and acquisitions while implementing a new Enterprise Resource Planning, or ERP system, in a merger with Deloitte. PricewaterhouseCoopers collaborates with a team surrounding a publishing company's role in the digital transformation. Finally, Thought Logic Consulting sponsors a cohort that looks at Honey Baked Ham's channel optimization. This is when a company seeks to increase performance indicators such as customer acquisition cost. These groups are able to visualize the different sectors and opportunities that consulting provides, as well as the ability physically network and learn from industry leaders.

Students work in small teams with an assigned consulting firm and a defined focus. However, the approach to team formation is unique. Students are asked to create a resume for themselves ten years in the future in order to segment them into groups that combine different strengths. "By looking at and understanding that they have plans and desires to go into certain industries or sectors, I try to put students in cohorts where they're going to complement each other but still create significant degrees of relevance of where their career aspirations will be," Roskam said.

Students also gain the opportunity to receive offers for employment through the class. "From this course, I'd love students to be able to walk away with a much broader understanding of what the consulting industry is, what career paths and opportunities there are and an enhanced ability to explore their intellectual curiosity in strategy and development," Roskam said.

COMING



HOG WILD

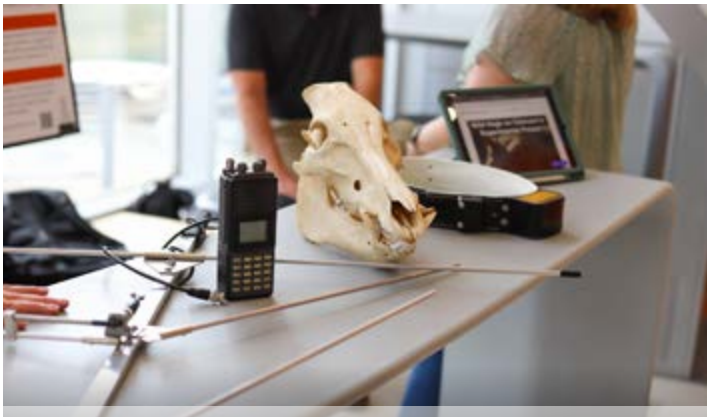
The Hog Wild on the Clemson Experimental Forest Creative Inquiry project, mentored by Drs. Greg Yarrow and Erin Buchholtz in the Department of Forestry and Environmental Conservation, addresses the management of wild hogs on the Clemson University Experimental Forest (CUEF). Students work in teams to locate areas on the forest with evidence of wild hogs activity. Then they bait these areas with corn and monitor the areas by remote cameras. If the hogs return to the area, the team erects net traps to capture the hogs.

During the past year, the Creative Inquiry team captured 49 wild hogs. GPS/VHF collars were attached to 19 adult hogs. Students tracked the VHF-collared hogs, and satellites monitored the GPS-collared hogs. The data is analyzed to track movements and identify habitat use on the CUEF.

The results of this study will be used to inform hog management practices—hopefully before the hogs go hog wild on the CUEF.

The team caught some hogs in the Clemson Experimental Forest.

The students move a tranquilized hog in order to put a GPS collar on it.



The team displayed their equipment and a hog skull at FoCI.

AWARDS FOR MENTORING IN CREATIVE INQUIRY

Each year, students have the opportunity to nominate their faculty or graduate student mentors for the Phil and Mary Bradley Award for Mentoring or the Graduate Student Award for Mentoring in Creative Inquiry. The recipients are recognized at the University's Spring Awards Ceremony.

The Phil and Mary Bradley Award for Mentoring in Creative Inquiry

The Phil and Mary Bradley Award for Mentoring in Creative Inquiry is presented to one faculty mentor each spring in recognition of outstanding work with undergraduate students. The award is made possible by an endowment from the Bradleys, and consists of a plaque and a salary supplement.

Dr. Cathy Bodinof Jachowski

The 2023 recipient of the faculty award was presented to Dr. Cathy Jachowski, faculty in the Department of Forestry and Environmental Conservation, by President Clements and Provost Jones in May.

The Graduate Student Award for Mentoring in Creative Inquiry

This award is presented to one graduate student mentor each spring in recognition of outstanding work with undergraduate students. The award consists of a plaque and a stipend. Vishal Manjunatha, a doctoral student in Food, Nutrition and Packaging Sciences, received the The 2023 award.

Vishal Manjunatha

SUPPORT CREATIVE INQUIRY

WHAT DO YOUR DOLLARS DO?

Gifts to Creative Inquiry help provide experiential learning opportunities for our students as well as send students to research field sites and conferences where they conduct and communicate their research, bring hands-on learning activities to the community, and so much more.

HOW TO DONATE

Give securely online at **ci.clemson.edu/donate.**

You can also call **864–656–5896** or send a check payable to:

Clemson Fund, PO Box 1889, Clemson, SC 29633

*Note the check is for the **Creative Inquiry Gift Operating Account**.

Give Today!

SPECIAL THANKS TO OUR FRIENDS & DONORS

Dr. & Mrs. William C. Alexander
Dr. Lawrence R. Allen
Mrs. Martha M. Ball
Dr. Elizabeth A. Baxley
Mr. Nathan L. Bohlmann
Mr. James R. Bottum
Bradley Family Foundation
Mr. & Mrs. Phil Bradley
Dr. Jeromy J. Britton
Mr. Fred Caldwell
Mrs. Lisa C. Laudeman Campbell
Mrs. Sue G. Campbell
Mr. W.R. Campbell, Sr.
Brig. Gen. Chalmers Carr, Jr.
Ms. Darlene Donelson
Dr. Thomas M. Duncan
Eli Lilly & Company Foundation
Mrs. Sandra M. Fitt
Dr. Lawrence D. Fredendall
Mrs. Carolyn K. Funke
Dr. Jennifer E. Gerow
Mr. & Mrs. William T. Gillespie
Dr. Richard E. Goodstein
Ms. Lisa C. Grant
Dr. Erin Groover
Dr. Doris Helms
Mrs. Verna G. Howell
Mrs. Betty Hund
Dr. Debra Jackson
Dr. Antonis Katsiyannis
Drs. Blaine Keister & Stephanie Shinmachi
Dr. John A. King
Mrs. JoVanna J. King
Mrs. Lisa J. King
Dr. Kara Lascola
Ms. Patricia H. McAbee
Mr. & Mrs. Robert & Brenda Muldrow, Jr.
Dr. Janice G. Murdoch
Dr. William T. Pennington
Lt. Col. Jason Pike
Mr. Marion L. Powell IV
Mrs. Margaret C. Pridgen
Mrs. Libby Rauch
Ms. Claudia Reyner
Dr. Mary E. Richardson
Mrs. Kirsten J. Robertson
Mr. Wayne Roper
Mrs. Catherine T. Sams
Dr. Thomas R. Scott
Mr. & Mrs. Goz Segars
Dr. Jeromy B. Snider
Dr. Barbara J. Speziale
Mr. Joseph D. Swann
Dr. & Mr. Cheryl & Frank Tauriello
Titan Production Company, LLC
Mr. Harrison F. Trammell
Dr. & Mrs. Roger & Kathryn Troutman
Dr. Kay L. Wall
Ms. Anolyn K. Watkins
Dr. & Mrs. Charles & Linda Watt
Mrs. Karen A. White
Mrs. Kristen M. Williams
Dr. & Mrs. Samuel M. Willis, Jr.
Dr. Anne Wooldridge

CORPORATE CI

CLEMSON CREATIVE INQUIRY CORPORATE

There is no 'typical' Creative Inquiry (CI) project. From the start of the CI program, projects have originated from many diverse sources—including from a professor's research, students' ideas or observations of community or campus needs.

In recent years, businesses have discovered the power of CI to develop talent, to attract interns and employees and to familiarize college students with the workings of their industries.

The Corporate CI program allows industries to engage Clemson's creative, talented undergraduates in industry-relevant research projects. The corporate partner proposes a topic, identifies representatives to work with the student team and supports project expenses.

The results benefit all. Students gain understanding of real-world work topics and opportunities to network with potential future employers. Companies gain visibility on campus, insights into selected project topics and relationships that help recruit interns and employees.

The ideal Corporate CI project involves open-ended topics that can be addressed over two or more semesters of iterative exploration, design, implementation and evaluation cycles. A Clemson faculty member mentors the team. The needs of the project will determine the composition of the student team. Students may be recruited from one or several disciplines.

CI and industry—a natural expansion for the inquisitive minds of Clemson students and a contribution to building the workforce of the future.

THANK YOU TO OUR PAST AND PRESENT CORPORATE SPONSORS

ally do it right. · Tupperware · PERKINS + WILL · Trulite GLASS & ALUMINUM SOLUTIONS · SIEMENS · FRESH · vf · WEYERHAEUSER FAMILY FOUNDATION · Ulbrich We Deliver Precision · U.S. Endowment for Forestry and Communities

CLEMSON
CREATIVE INQUIRY

clemson.edu/ci

Follow us! @ciclemson