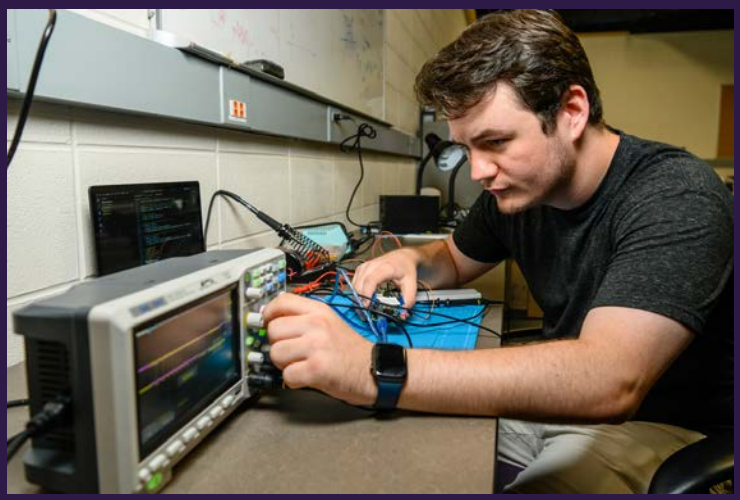
EUREKA!

Abstract Book | 2023



CLEMSON HONORS EUREKA! UNDERGRADUATE RESEARCH

Clemson University HONORS COLLEGE

EUREKA! 2023 was one of the best summers of my life. From being fascinated by microscopic cells in the lab to the vast connections and lifelong friendships made in the heart of campus, I can easily recommend EUREKA! to any incoming Honors freshman led by their curiosity toward research and their urge to create unforgettable relationships.

TULSI PATEL
2023 EUREKA! PARTICIPANT

About EUREKA!

EUREKA! (Experiences in Undergraduate Research, Exploration, and Knowledge Advancement) gave 31 incoming Clemson Honors students the chance to dive into a research experience before their first year even began on Clemson University campus.

Working as part of a team or one-on-one, EUREKA! gave these students the chance to engage early and start a path toward their next great discovery. Students were able to choose between in-person and online delivery options for a five-week period of research, scholarship, and community building, with all participants working with top faculty at Clemson.

Our online and in-person programs also had student counselors to help guide the EUREKANs through the program and conduct research of their own. Many of the participating students continue their projects throughout their undergraduate years. We hope their enthusiasm for research will encourage their peers to follow their lead to build an exciting and productive environment for undergraduate research, scholarship, and discovery at Clemson University.

Focus on Research and Community

Whether in-person or online, students worked on research projects under the direction of faculty mentors in fields ranging from religion and philosophy to physical sciences and engineering. Students also attended workshops and seminars on various topics designed to orient them to academic life on campus and provide them with the basic skills needed to perform research in a broad range of areas.

On top of the educational rewards of active participation in undergraduate research, the EUREKANs were introduced to campus resources and interacted with many faculty, staff, administrators, and other students. They developed networks of supportive mentors and colleagues that will serve them well in their academic careers.

EUREKA! In-Person Counselors Taran Kavuru, Makenzie Jones (Head Counselor), and Christopher Lewis

EUREKA! Online Counselors Ethan Anderson and Olivia Mathis (Head Counselor)

How We Started

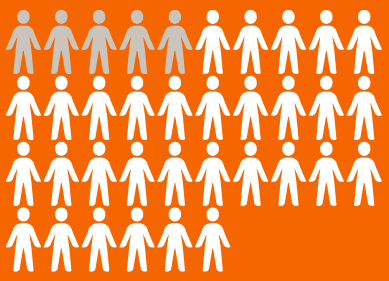
Created in 2006, the new “Experiences in Undergraduate Research, Exploration and Knowledge Advancement!” (EUREKA!) program was based on an idea conceived by Stephen Wainscott, former Director of the Clemson University Honors College, and further developed by a committee of the following members (listed with their University roles at that time):

- Dwight Camper, Professor of Entomology, Soil, and Plant Science;
- Dana Irvin, Assistant Director of the Clemson University Honors College;
- Pam Mack, Associate Professor of History;
- James McCubbin, Professor and Chair of Psychology;
- Mary Miller, Special Assistant to the Provost;
- Gary Powell, Professor Emeritus of Genetics and Biochemistry;
- Sean Williams, Associate Chair and Professor of English; and
- Bill Pennington, Professor of Chemistry.

Where We Are in 2023

2

delivery options



36 Clemson Honors students (including 5 counselors)

85

% of students who plan to participate in research in the fall

2023 EUREKA! Students

Participant	Hometown	Major	Faculty Mentor	Page
Omar Abdel Azim	Greenwood, SC	Computer Science	Dr. Dilupneet Aidhy	5
Ethan Anderson	Fort Mill, SC	Computer Science	Dr. Long Cheng	6
Kylie Avitabile	Alpharetta, GA	Biological Sciences	Dr. D. Matthew Boyer	7
Eric Blanchard	Charlotte, NC	Biological Sciences	Dr. Diana Ivankovic	8
Jennifer Covel	Mansfield, OH	Preprofessional Health Studies	Dr. Kerry Smith	9
Jacob Davis	Taylors, SC	Engineering	Dr. Ethan Kung	10
Peyton Deets	Charlotte, NC	Biological Sciences	Dr. Michael Sehorn	11
Alex Gillespie	Simpsonville, SC	Biochemistry	Dr. Liangjiang (LJ) Wang	12
Taylor Henry	Beaufort, SC	Biological Sciences	Dr. Zhicheng Dou	13
Carley Hitzelberger	Greenville, SC	Preprofessional Health Studies	Dr. Celina Checura	14
Andrew Hodges	Greenwood, SC	Physics	Dr. Nianyi Li	15
Makenzie Jones	Rock Hill, SC	Bioengineering	Dr. Dan Simionescu	16
Shayar Joshi	Greenville, SC	Packaging Science	Dr. Hong Luo	17
Taran Kavuru	Fort Mill, SC	Computer Science	Dr. Long Cheng	18
Andrew Ko	Havertown, PA	Engineering	Dr. Venkat Krovi	19
Makenna Lankford	Charleston, SC	Genetics	Dr. Michael Sehorn	20
Thomas Lee	Inman, SC	Engineering	Dr. Rodrigo Martinez-Duarte	21
Garrett Lewis	Columbia, SC	Mechanical Engineering	Dr. Michael Carbajales-Dale	22
Olivia Mathis	Piedmont, SC	English	Dr. Ana Thayer	23
Ashton McEntarffer	Pelzer, SC	Computer Science	Dr. Mert Pesé	24
Miles McFadden	Greer, SC	Computer Science	Dr. Bing Li	25
Ava McKee	Waxhaw, NC	Biochemistry	Dr. Michael Sehorn	26
Aubree Miller	Bennettsville, SC	Chemistry	Dr. Cheryl Ingram-Smith	27
Tulsi Patel	Simpsonville, SC	Biological Sciences	Dr. Zhicheng Dou	28
Jamison Peebles	Naperville, IL	Computer Science	Dr. Liangjiang (LJ) Wang	29
Abbey Grace Pickrel	Roebuck, SC	Engineering	Dr. Hong Luo	30
Delanie Robertson	Severna Park, MD	Engineering	Dr. Matthew Boyer	31
Stephanie Rodriguez-Umana	North Myrtle Beach, SC	Engineering	Dr. Rodrigo Martinez-Duarte	32
Hannah Rowe	Indian Trail, NC	Genetics	Dr. Cheryl Ingram-Smith	33
Isabella Stamato	Florence, SC	Engineering	Dr. Diana Ivankovic	34
Kevius Tribble	Newberry, SC	Computer Science	Dr. Mert Pesé	35
Deekshita Vemuri	Greenville, SC	Psychology	Dr. Diana Ivankovic	36
Weber Whelan	Brookhaven, GA	Computer Science	Dr. Hong Luo	37
Leila Williams	Summerville, SC	Psychology	Dee Vemuri	38
Mia Yancey	Conway, SC	Biochemistry	Dr. Nianyi Li	39
Reynolds Young	Fort Mill, SC	Biochemistry	Dr. Khaled Abdelaziz	40

Omar Abdel Azim

WITH DR. DILUPNEET AIDHY, DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

Prediction of Stacking Fault Energy in High Entropy Alloys using Convolutional Neural Networks

Materials Science (MS) is an area of study regarding the research and development of new materials. One exciting sector of the field is the development of high-entropy alloys. An alloy is a mixture of two or more metallic elements. High entropy alloys (HEAs), a type of alloy composed of elements in roughly equal proportion, have shown improved structural and mechanical properties compared to their traditional alloy counterparts. These HEAs are made up of layers that construct a crystal structure. When interruptions occur in the normal stacking layers, this leads to dislocations in the crystal structure, releasing an energy called Stacking Fault Energy (SFE). SFE provides important insights into the mechanical properties of HEAs such as deformation mechanisms, tensile properties, and ductility. This research uses machine learning to predict the SFE of various HEAs, which are simulated using a program. In each HEA modeled, an image representation of its charge density is used and the system is doped with a specific dopant element, which contains a different charge density than its neighbors, to introduce the SFE. Using images circumvents the need to use a variety of inputs like composition or bond length, because it encompasses several input features.

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Ethan Anderson

WITH TARAN KAVURU, MOHAMMED ALDEEN, AND DR. LONG CHENG, COLLEGE OF ENGINEERING, COMPUTING, AND APPLIED SCIENCES

Data Collection for the Integrative Cyberinfrastructure for Online Abuse Research Project (ICOAR)

As social media sites continue to grow, the prevalence of online harassment and abuse grows as well. Consequently, many research endeavors are pursuing artificial intelligence (AI) and machine learning tools to rapidly detect, stop, and analyze instances of online abuse. Unfortunately, social and behavioral scientists engaging in this research often lack the means to utilize these tools successfully. As a solution, ICOAR aims to offer an easy-to-use interface for collecting data from various social media sites, running pre-trained sentiment and toxicity models for annotation, training and validating new models, and visualizing results.

This research focused on building ICOAR's dynamic data collection system such that it can pull from various prominent social media sites such as Twitter, Reddit, Instagram, and TikTok, giving researchers the ability to do highly targeted searches and apply different techniques to sort and classify data. A variety of data collection methods, such as scraping, crawling, and official application programming interface (API) requests, were implemented to address the issue of consistent data collection being interrupted by frequent social media platform and API changes.

Kylie Avitabile

WITH DELANIE ROBERTSON, LEILA WILLIAMS, AND DR. MATTHEW BOYER, DEPARTMENT OF ENGINEERING & SCIENCE EDUCATION

Understanding the Experiences of Neurodivergent Learners in Higher Education

Neurodivergence is a non-medical umbrella term that is used to describe those with variance in their neurological function from what is considered normal. Commonly known neurodivergent disorders include autism spectrum disorder, attention deficit hyperactivity disorder (ADHD), dyslexia, developmental coordination disorder (DCD), and many others. In higher education, there has been an increasing number of individuals self-identifying as being neurodivergent, including students, faculty, staff, administrators, and other learners within higher education. Neurodivergent learners often face personal struggles, discrimination, and challenges caused by their specific disorder in higher educational settings. The purpose of this research is to gain a better understanding of the experiences of those neurodivergent individuals within higher education. A survey tool will be utilized to collect responses from both self-identifying neurodivergent individuals, as well as neurotypical individuals, in regard to their experiences within higher education environments, followed by an interview with select participants. The goals of this study are to pilot data collection tools and inform the design of individualized studies that focus on particular areas of interest in the larger context of the experiences of neurodivergent learners in higher education.

Eric Blanchard

WITH ISABELLA STAMATO, DEEKSHITA VEMURI, ETHAN WILSON, ZOE VICKERY, AUBREY MATTINGLY, AND DR. DIANA IVANKOVIC, SCHOOL OF NURSING, HEALTHCARE GENETICS

Mediterranean Herb Effects on Cancer Cell Lines and Zebrafish Embryos

Breast cancer is currently one of the most widespread forms of cancer, affecting one in every four women. A common treatment strategy for breast cancer is chemotherapy, which uses many harmful drugs, including Doxorubicin, to kill cancer cells to stop them from spreading. Doxorubicin works by targeting all fast-growing cells within the body, causing severe cell damage and exhaustion in all patients who take it due to non-cancerous cells also being destroyed. This project focuses on testing the ability of Mediterranean herb extracts to inhibit cancer cells from multiplying with less damage to non-cancerous cells as a possible alternative treatment to Doxorubicin and its harmful side-effects.

Specifically, zebrafish (Danio rerio) are used in assessing the toxicity of these herbs. Embryos were exposed to differing concentrations of the extracts then observed every 24 hours for three days. Data was gathered on how they influenced the zebrafish's growth. The toxicity assessment aims to find the optimal concentrations of the herb treatments that do not negatively affect the development of the embryos. Once assessments are completed, the next step is adding human breast cancer cells to zebrafish embryos and determining whether the extracts have any impact on the cancer without harming the fish.

Jennifer Covel

WITH ALANNA SCOGGINS AND DR. KERRY SMITH,
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Role of phosphofructokinase and 6-phosphofructo-2-kinase/fructose-2,6-bisphosphatase in Cryptococcus neoformans

Cryptococcus neoformans, an opportunistic fungal pathogen, is responsible for greater than 190,000 deaths annually. C. neoformansaffects immunocompromised individuals, especially those with AIDS in both Latin America and sub-Saharan Africa. Primary infection occurs via inhalation into the lungs, and as the infection progresses, C. neoformans can cause a life-threatening infection in the brain called cryptococcal meningitis. The current treatments for cryptococcal meningitis are expensive and not always effective, so finding targets for the development of new antifungals is key. Previously, researchers have deemed a functional glycolytic pathway in C. neoformans as essential for virulence, making enzymes in this pathway possible drug targets. Phosphofructokinase (ΔPfk1) converts fructose-6-phosphate to fructose-1,6-bisphosphate in the third step of glycolysis.6-phosphofructo-2-kinase/fructose-2,6-bisphosphatase (ΔPfk2-Fbp2) generates and breaks down fructose-2,6-bisphosphate, a positive regulator of Pfk1 in glycolysis. Mutant strains of ΔPfk1 (CNAG_04676) and ΔPfk2-Fbp2(CNAG_04221) were obtained and demonstrated poor growth on glucose but not glycerol. Both showcased reduced production of melanin, a pigment produced by C. neoformans to protect against host immune defense mechanisms. The results of the study indicate the roles of ΔPfk1 and ΔPfk2-Fbp2 in C. neoformans merit further exploration.

Jacob Davis

WITH BASANT REGMI AND DR. ETHAN KUNG,
DEPARTMENT OF MECHANICAL ENGINEERING

Computational Cardiovascular Research on Carotid Stenosis

Carotid stenosis is a condition involving the narrowing of the carotid arteries from a build-up of plaque. It can cause thrombi to form and lead to stroke.

The purpose of this project is to determine the factors of carotid stenosis that best predict the likelihood of a stroke occurring. Ten 3D models of the carotid artery bifurcations, belonging to both stroke and non-stroke patients with carotid stenosis, were developed by constructing paths and segmentations on imaging data of the arterial pathways using a cardiovascular simulation software known as SimVascular. A finite element mesh was created from each 3D model, simulations were performed using the software SimVascular for computational fluid dynamic tests, and the resulting 3D hemodynamic patterns were analyzed using a software known as Paraview. Observations of the data from these models and simulations can be further analyzed to better diagnose the stroke risk in patients with carotid stenosis to determine the need for treatment.

Peyton Deets

WITH MAKENNA LANKFORD, AVA MCKEE, OLIVIA EZZELL, AND DR. MICHAEL SEHORN, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

DNA Repair and Genome Instability

Intrachromosomal centromeric facial anomalies (ICF) is a genetic disorder characterized by distinct facial dysmorphisms, immunodeficiency, and variable intellectual disabilities. One form of ICF involves mutations in the HELLS protein that is involved in chromatin remodeling and epigenetic modulation. HELLS was also found to be involved in the repair of DNA double strand breaks (DSB). Once a DSB forms, the ends of the DNA are processed in a way that allows end joining. Mutations in HELLS result in abnormal B lymphocyte development and reduced IgG class switching recombination. As a result, HELLS is thought to play a role joining the ends of a processed DSB. HELLS is known to bind and hydrolyze ATP as an energy source to power its chromatin remodeling activity. It is not known how these activities facilitate the joining of DSB ends. The results from this biochemical study on HELLS will eventually lead to a more thorough understanding of the role HELLS plays in the joining of DSB ends.

Alex Gillespie

WITH JAMISON PEEBLES, CONNOR MCGRATH, SNEHAL SHAH, AND DR. LIANJIANG WANG
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Prediction of Novel Autism Risk Genes by AI-Based Genomic Data Mining

Autism Spectrum Disorder (ASD) is a heterogeneous neurodevelopmental disorder characterized by impaired social skills and repetitive behaviors. About 98% of the human genome does not encode proteins and consists of non-coding RNA genes. The largest class of non-coding RNA genes are long non-coding RNAs, which are greater than 200 base pairs in length. Currently, almost all known ASD risk genes are protein-coding, and many lncRNAs have yet to be identified as ASD risk genes. The use of various machine learning techniques may facilitate the functional annotation of lncRNAs and identify which lncRNAs are potential ASD risk genes. Three different machine learning algorithms were used in this study: Support Vector Machine (SVM), Random Forest (RF), and Artificial Neural Network (ANN). These supervised learning algorithms searched for and identified relevant features in the training dataset of previously identified ASD genes, and used these features to predict novel risk genes. Based on the ROC-AUC curve, a method used to assess the effectiveness of machine learning models, the SVM model showed the highest performance. Finally, the DAVID functional analysis tool was used to validate the models, and the ENSEMBL genome browser was used to visualize candidate lncRNAs in proximity to known ASD risk genes.

Taylor Henry

WITH TULSI PATEL AND DR. ZHICHENG DOU
DEPARTMENT OF BIOLOGICAL SCIENCES

Development of A Fluorescent Histomonas meleagridis Strain for Drug Development Against a Turkey Protozoan Pathogen

Histomonas meleagridis is a pathogen that causes a highly contagious disease with a high mortality rate known as histomoniasis in turkeys. The condition is easily transmitted through infected feces by turkeys and other poultry. Current treatment development for the disease is severely hindered due to the difficulty of parasite growth by manual parasite enumeration through an optical microscope. Introducing fluorescent genes into Histomonas would significantly facilitate parasite quantification using an epifluorescence microscope or plate reader during drug development.

This study aims to introduce a gene encoding a fluorescent protein “mScarlet” into a Histomonas gene expression plasmid. The plasmid carries 5'- and 3'-untranslated regions (UTRs) of a Histomonas cathepsin L-like protease, which are important gene regulatory elements. The mScarlet gene will be flanked by both elements for its expression in the parasites via a series of molecular biology techniques such as PCR, gel electrophoresis, plasmid purification, restriction enzyme digestion, ligation, and Escherichia coli (E. coli) transformation. Upon the generation of this mScarlet-expressing vector, it will be introduced into the Histomonas parasites by electroporation for expression. The transgenic mScarlet-expressing Histomonas will display vibrantly red fluorescence, allowing for visualization and quantification during drug screenings.

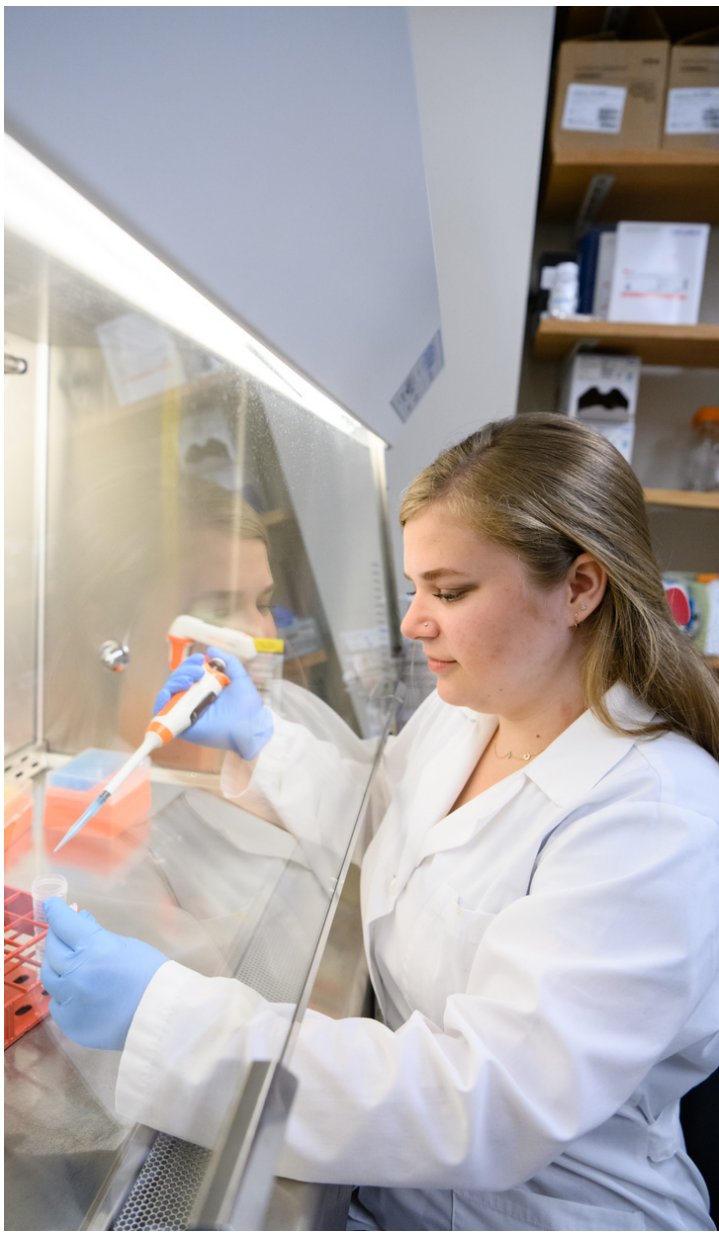
Carley Hitzelberger

WITH KENDALL RICHEY AND CELINA CHECURA
PIEDMONT REC AND BIOENGINEERING DEPARTMENT

Effects of Photobiomodulation on Oocyte Maturation

In vitro fertilization (IVF) is an assisted reproductive technology in which oocytes (mammalian eggs) are fertilized in vitro using sperm to produce embryos. In humans, IVF is typically used for infertility, while bovine IVF is used to treat infertility and improve genetic characteristics to support the cattle industry. Photobiomodulation is defined as the utilization of light energy to initiate chemical changes within cellular structures.

The purpose of this study was to use red light (wavelength 660-665 nm) to stimulate oocyte mitochondria during maturation. Bovine oocytes were aspirated from abattoir ovaries and distributed into treatment groups. Oocytes were exposed to 10 minutes of red light at hour 20 from the start of maturation (Light group), or to no light (Control group). At hour 20, 22, and 24, mitochondrial membrane potential was measured using fluorescence microscopy and analyzed with a Cytation-1 (BioTek) imaging instrument. The experiment was replicated three times. Relative fluorescent units were compared in a mixed model of repeated measures (Mixed procedure, SAS Institute). There was not a significant ($p>0.05$) difference between the Light and Control groups for neither treatment nor time effects. A higher number of replicates may be needed to show the effect of photobiomodulation on oocyte maturation.



Drew Hodges

WITH MIA YANCEY, MARY AIYETIGBO, AND NIANYI LI
SCHOOL OF COMPUTING

Physics-based Deep Learning for Computer Vision

The realm of computer vision aims to replicate human visual comprehension in AI systems, equipping them to accurately identify and interpret objects in images and videos. This research explores the application of a cutting-edge image distortion correction algorithm, "Unsupervised Non-Rigid Image Distortion Removal via Grid Deformation," in synergy with Teachable Machine, an accessible web-based image recognition tool. The goal is to improve the image recognition precision in video inputs containing turbulent distortions caused by air or water.

The proposed distortion correction framework can bypass the necessity for pre-training on annotated datasets or any supplementary data. Furthermore, it functions independently of the correctness of physics-based fluid models. The system's effectiveness was investigated by enabling Teachable Machine to recognize different playing cards. Subsequently, images of one such card were captured while submerged underwater, causing visual distortion from ripples. A comparative analysis between the Teachable Machine's identification of these distorted images and the output after distortion correction indicated a significant enhancement in object identification accuracy.

Such breakthroughs in image distortion correction augment computer vision systems' proficiency in interpreting real-world visual data. As society progresses technologically, these advances harbor immense possibilities for practical applications in domains such as autonomous systems, healthcare, surveillance, and more

Makenzie Jones

WITH ALEX CARTER, DR. JUAN CARLOS CARILLO GARCIA, DR. AGNETA SIMIONESCU AND DR. DAN SIMIONESCU, DEPARTMENT OF BIOENGINEERING

In Vitro Testing of Tissue Engineered Small-Diameter Vascular Grafts for Diabetic Patients

Peripheral arterial disease (PAD) involves arterial narrowing or blockages that restrict blood flow to patients' limbs. Current treatments for PAD include bypass surgery using the patient's arteries or veins as a graft. However, one-third of patients do not have adequate blood vessels, and diabetic patients exhibit chronic hyperglycemia, which leads to cross-linking and stiffening of the extracellular matrix, affecting both the natural arteries and the implanted grafts. Therefore, developing a tissue-engineered vascular graft for diabetic patients could improve the quality of life of patients with PAD.

This study aims to demonstrate the successful creation of living grafts using decellularized porcine carotid arteries seeded with human umbilical vein endothelial cells (HUVECs) to prevent the activation of the coagulation cascade and subsequent clotting and blockages upon implantation. HUVECs were seeded onto the lumen by infusion, and the arteries were placed into a sterile vascular bioreactor that mimics physiologically relevant pulsatile pressure and flow conditions of an artery. Initial Hhistology confirmed the presence of HUVECs on the lumen after two weeks in the bioreactor. While preliminary data are promising, future improvements in endothelialization techniques, successful seeding of vascular fibroblasts and smooth muscle cells, and testing in diabetic media are needed before preclinical testing.

Shayar Joshi

WITH ABBEY GRACE PICKREL, WEBER WHELAN, AND DR. HONG LUO, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Agricultural Biotechnology - MiRNA Gene Manipulation for Enhanced Crop Resistance to Abiotic Stresses

Biotechnology has revolutionized agriculture by addressing challenges posed by abiotic stressors like drought, heat, nitrogen deficiency, and salinity. Plant genetic engineering using recombinant DNA and transgenic technologies allows researchers to alter plant genome and biological processes and evaluate how different genes impact plant response to abiotic stresses in an effort to improve plant performance under environmental adversities enhancing crop yield. Genetically modifying plants often involves introduction of desired genes into single cells of the target organisms and regeneration of the transformed cells into plants expressing the transgenes. MicroRNAs, the small RNA molecules involved in post-transcriptional regulation of target genes, have been shown to play critical roles in stress response pathways. Here, the data presented demonstrates how to genetically engineer perennial grasses for enhanced plant resistance to multiple abiotic stresses by manipulating expression of various miRNA genes in transgenic plants. These advancements offer promising solutions to enhance agricultural efficiency, combat food scarcity, and cultivate tolerant crops in underutilized areas. By altering the genetic information of plants, researchers observe the impacts on stress tolerance and crop yield. Biotechnology presents valuable tools to modify crops, provides insights into increasing plant tolerance to abiotic stress, and promotes food security for the benefit of humanity.

Taran Kavaru

WITH ETHAN ANDERSON, MOHAMMED ALDEEN, AND DR. LONG CHENG, COLLEGE OF ENGINEERING, COMPUTING, AND APPLIED SCIENCES

Integrative Cyberinfrastructure for Online Abuse Research (ICOAR)

As social media sites continue to grow, the prevalence of online harassment and abuse grows as well. Consequently, many research endeavors are pursuing artificial intelligence (AI) and machine learning tools to rapidly detect, stop, and analyze instances of online abuse. Unfortunately, social and behavioral scientists engaging in this research often lack the means to utilize these tools successfully. As a solution, ICOAR aims to offer an easy-to-use interface for collecting data from various social media sites, running pre-trained sentiment and toxicity models for annotation, training and validating new models, and visualizing results.

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Andrew Ko

WITH ANISH GHANA, JACOB LIKINS, ADITYA KROVI, DHRUV MEHTA, AND DR. VENKAT KROVI,
DEPARTMENT OF AUTOMOTIVE ENGINEERING
(ARM LAB)

Perception for Autonomous Robots

Autonomous Robots (ARs) are revolutionizing various industries, from warehouse logistics and military operations to agriculture and mining. In challenging environments ensuring reliable object detection within the perception pipeline is critical.

Prior to deploying on full-scale vehicles, testing on small-scale robots and within simulations is essential, reducing cost of potential damages to ARs. The Vex AI competition is an ideal testing platform, challenging students to create autonomous robots for competitive gameplay.

First, a virtual model of the robot was assembled in Onshape, a powerful CAD platform. The model was trained using ISAAC Sim, NVIDIA's robotics simulator. The robot was physically deployed using the Jetson Nano GPU, designed to accelerate real-time computing. Also, the Intel realsense camera which utilizes an Infrared sensor and two cameras to see in three dimensions. The YOLO object detection algorithm is used to recognize game elements. Additionally, with odometry, the robot can localize its position within the field. The culmination of perception, planning, and control modules allows the Vex robot to accurately perceive and react to its environment, meeting the objective of the Vex AI competition. This poster showcases an end-to-end workflow for deploying a robust object detection pipeline, thereby enhancing perception capabilities for autonomous robots.

Makenna Lankford

WITH PEYTON DEETS, AVA MCKEE, OLIVIA EZZELL, AND DR. MICHAEL SEHORN, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

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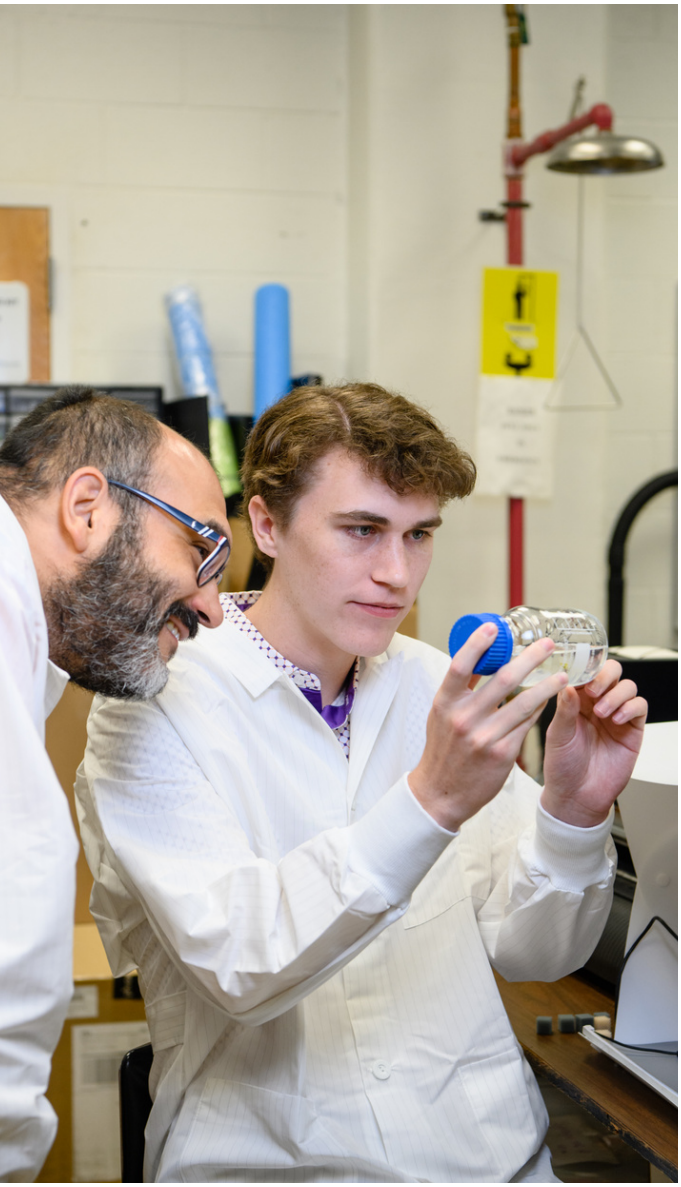
Thomas Lee

WITH STEPHANIE RODRIGUEZ-UMANA AND
DR. RODRIGO MARTINEZ-DUARTE, COLLEGE OF
ENGINEERING, COMPUTING, AND APPLIED SCIENCES



Not all cellulose is the same; plant cellulose or bacterial cellulose, which is more sustainable?

Plants are the most well-known source of cellulose. Extracting it from the plant cell wall includes sterilization, dehydration, and chemical treatments. In contrast, bacterial cellulose (BC) is produced pure in bioreactors from different microorganisms and culture media. BC is a promising alternative because of its purity and material properties. However, there is a lack of a methodical comparison of sustainability, pertaining to protecting the environment's resources, its ability to meet demand, and the economic profit, of these two. In this project, the processes, parameters, and resources required to produce cellulose from plants and bacteria are initially reviewed.

There was a comparison between the production stages of growing, harvesting, transporting, and processing. In the growing stage, plant cellulose (PC) had a larger growth duration and water consumption than BC, however, BC had a reduced yield. PC could be harvested by hand or machine. BC is typically harvested by hand. Unlike BC, PC requires transportation of materials from the harvesting site to the processing site. Both PC and BC require a processing stage for purification. In future studies, this initial study can serve as a basis to compare more parameters to further identify the most sustainable cellulose source for a given purpose.

Garrett Lewis

WITH MUZAN IJEOMA AND DR. MICHAEL CARBAJALES-DALE, DEPARTMENT OF ENVIRONMENTAL ENGINEERING

Sustainability: Techno-Economic Assessment of Solar PV System

Access to electricity remains a fundamental barrier to community development throughout the Global South. Common obstacles to electrifying these regions include widespread poverty, significant distances between communities, and local conflict. Several of these obstacles can be mitigated through use of microgrid systems.

This study examines the technical, economic, and environmental viability of microgrid structures in Sub-Saharan Africa, with a particular emphasis on modeling a microgrid system to electrify Kabuiri, a village in northern Nigeria. Kabuiri had been cut off from various national public services due to regional conflict with Boko Haram. A series of modeling programs were used to simulate systems capable of meeting local demand. These systems may include photovoltaic panels, batteries, diesel, and biomass-pyrolysis-based generator systems. Model feasibility was evaluated using variable fuel prices and environmental conditions to approximate ideal microgrid structure.

Optimal project architecture consisted of a hybrid arrangement of photovoltaic panels, lead acid batteries, and a diesel generator. This system architecture provided 360-killowatt-hours per day to users with a peak demand of 48.61-killowatts at a levelized cost of energy of $0.103 per kilowatt-hour. The hybrid system is estimated to produce annual emissions of 3,321-kilograms of carbon dioxide, 19.5-kilograms of nitrous oxides, and 8.13-kilograms of sulfur dioxide.

Olivia Mathis

WITH LILIANE SILVA AND ANA THAYER, DEPARTMENT OF AGRICULTURAL SCIENCES, DEPARTMENT OF ANIMAL & VETERINARY SCIENCES, DEPARTMENT OF PLANT & ENVIRONMENTAL SCIENCES

Climate-Smart Agricultural Practices in Forage-Livestock Systems in South Carolina

The livestock industry is one of South Carolina's (SC) most important agricultural activities. Forages are the primary feed source for livestock due to favorable climatic conditions, adapted forage species, and access to local nutrient sources (e.g. poultry litter). In recent decades, there has been increasing concern with environmental aspects and the sustainability of forage-livestock systems. In the United States, agriculture is the source of 10% of greenhouse gas emissions (EPA, 2019). In a pilot initiative through the United States Department of Agriculture climate-smart grant, Clemson University, South Carolina State University, and 27 project partners are providing incentives to farmers to implement production practices across four SC commodities with the goal of reducing greenhouse gas emissions. Within the "Forages for Beef Cattle" program, 123 operations will receive incentives for implementing one, or a combination, of the following improved practices in livestock-forage systems: incorporation of legumes, use of poultry litter, and prescribed grazing.

Ashton McEntarffer

WITH KEVIUS TRIBBLE AND DR. MERT PESÉ,
SCHOOL OF COMPUTING

Fingerprinting Automotive ECUs Using CAN Ringing

Cyber attacks on automobiles have been a growing concern since the early 2000s. Modern cars use Control Area Network (CAN) Bus systems to control vehicular functions, but resource constraints lead to low security. Many existing security methods have known vulnerabilities. This study aims to develop a new security technique by utilizing the electronic ringing phenomenon to fingerprint an electronic control unit (ECU) from its ringing pattern. Ringing is a unique oscillation of a voltage signal after a bit transition, observed in most electronic devices.

Theoretically, ECUs can be identified by their distinctive ringing pattern, so a foreign ringing pattern reveals an attacking ECU. By detecting a foreign ECU, malicious attacks on automobiles can be prevented. The proposition shows promise because a support vector machine trained solely on the voltage features displays a 99% accuracy for identifying ECUs.

Miles McFadden

WITH ABHISHEK SHARMA AND DR. BING LI,
DEPARTMENT OF AUTOMOTIVE ENGINEERING

Artificial Intelligence for Intelligent Vehicle Driving Safety

Intelligent and autonomous vehicles utilize aspects of machine learning and artificial intelligence in order to detect objects along their path. Neural networks are used in object detection, which is essential for certain intelligent vehicles such as self-driving cars. Even though most vehicles are not yet self-driving, there are still many systems in vehicles today that are considered intelligent vehicle features.

With intelligent vehicles becoming more common, drivers must become educated about their car's features to ensure their safety. Even though these intelligent vehicles are designed to reach their destination safely, there have been instances where drivers in intelligent vehicles have been injured or killed. Reports of these instances must be studied to ensure the safety and consistency of intelligent vehicles. The purpose of this study is to educate drivers about intelligent vehicles and to investigate why intelligent vehicles crash in order to improve driving safety.

Ava McKee

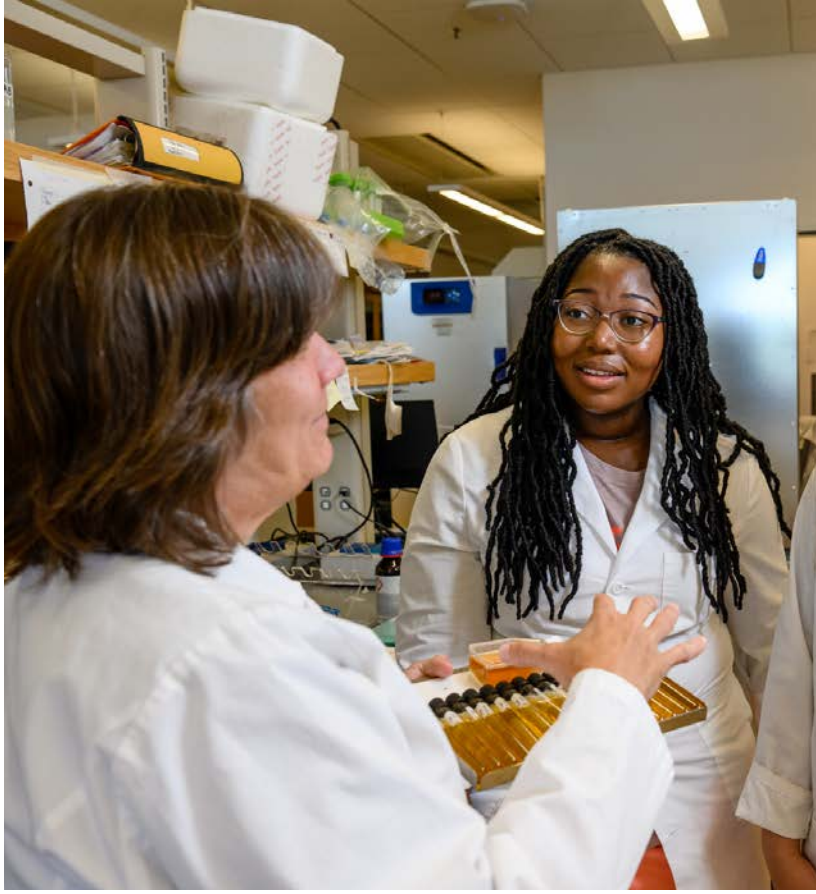
WITH PEYTON DEETS, MAKENNA LANKFORD, OLIVIA EZZELL, AND DR. MICHAEL SEHORN, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

DNA Repair and Genome Instability

Intrachromosomal centromeric facial anomalies (ICF) is a genetic disorder characterized by distinct facial dysmorphisms, immunodeficiency, and variable intellectual disabilities. One form of ICF involves mutations in the HELLS protein that is involved in chromatin remodeling and epigenetic modulation. HELLS was also found to be involved in the repair of DNA double strand breaks (DSB). Once a DSB forms, the ends of the DNA are processed in a way that allows end joining.Mutations in HELLS result in abnormal B lymphocyte development and reduced IgG class switching recombination.As a result, HELLS is thought to play a role joining the ends of a processed DSB. HELLS is known to bind and hydrolyze ATP as an energy source to power its chromatin remodeling activity. It is not known how these activities facilitate the joining of DSB ends. The results from this biochemical study on HELLS will eventually lead to a more thorough understanding of the role HELLS plays in the joining of DSB ends.

Aubree Miller

WITH HANNAH ROWE AND DR. CHERYL INGRAM-SMITH, DEPARTMENT OF GENETICS AND BIOCHEMISTRY



Gene Analysis of the Metabolism and Cyst Formation in the Human Pathogen Entamoeba histolytica

Entamoeba histolytica is a human pathogen that causes dysentery. Symptoms include bloody diarrhea lasting several weeks, fever, stomach pain, cramping, and nausea. According to the World Health Organization, there are ~100 million symptomatic E. histolytica infections each year, although up to 1 billion people may be infected as ~90% of infections are asymptomatic.

E. histolytica has two life forms: the growing amoeba and the dormant cyst. Cysts have a hard shell made of chitin and proteins to withstand harsh environments and are responsible for transmitting disease through contaminated food and water. Cysts convert to the amoeba form in the small intestine, which then colonizes the large intestine. Here, amoebae can form cysts again in a process called encystation. Encystation requires changes in gene expression. Genes that are turned up or down at the same time may be regulated by the same proteins binding upstream at specific sequences.

In this project, we used the MEME program to analyze the upstream regions of sets of genes that are turned up or turned down together to identify sequences that are shared among multiple genes within a set. This may be a way to identify regulatory sequences responsible for initiating the encystation process.

Tulsi Patel

WITH TAYLOR HENRY AND
DR. ZHICHENG DOU, DEPARTMENT OF
BIOLOGICAL SCIENCES

Development of A Fluorescent Histomonas meleagridis Strain for Drug Development Against a Turkey Protozoan Pathogen

Histomonas meleagridis is a pathogen that causes a highly contagious disease with a high mortality rate known as histomoniasis in turkeys. The condition is easily transmitted through infected feces by turkeys and other poultry. Current treatment development for the disease is severely hindered due to the difficulty of parasite growth by manual parasite enumeration through an optical microscope. Introducing fluorescent genes into Histomonas would significantly facilitate parasite quantification using an epifluorescence microscope or plate reader during drug development.

This study aims to introduce a gene encoding a fluorescent protein “mScarlet” into a Histomonas gene expression plasmid. The plasmid carries 5'- and 3'-untranslated regions (UTRs) of a Histomonas cathepsin L-like protease, which are important gene regulatory elements. The mScarlet gene will be flanked by both elements for its expression in the parasites via a series of molecular biology techniques such as PCR, gel electrophoresis, plasmid purification, restriction enzyme digestion, ligation, and Escherichia coli (E. coli) transformation. Upon the generation of this mScarlet-expressing vector, it will be introduced into the Histomonas parasites by electroporation for expression. The transgenic mScarlet-expressing Histomonas will display vibrantly red fluorescence, allowing for visualization and quantification during drug screenings.

Jamison Peebles

WITH ALEX GILLESPIE, CONNOR MCGRATH, SNEHAL SHAH, AND DR. LIANJIANG WANG, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Prediction of Novel Autism Risk Genes by AI-Based Genomic Data Mining

Autism Spectrum Disorder (ASD) is a heterogeneous neurodevelopmental disorder characterized by impaired social skills and repetitive behaviors. About 98% of the human genome does not encode proteins and consists of non-coding RNA genes. The largest class of non-coding RNA genes are long non-coding RNAs, which are greater than 200 base pairs in length. Currently, almost all known ASD risk genes are protein-coding, and many lncRNAs have yet to be identified as ASD risk genes. The use of various machine learning techniques may facilitate the functional annotation of lncRNAs and identify which lncRNAs are potential ASD risk genes.

Three different machine learning algorithms were used in this study: Support Vector Machine (SVM), Random Forest (RF), and Artificial Neural Network (ANN). These supervised learning algorithms searched for and identified relevant features in the training dataset of previously identified ASD genes, and used these features to predict novel risk genes. Based on the ROC-AUC curve, a method used to assess the effectiveness of machine learning models, the SVM model showed the highest performance. Finally, the DAVID functional analysis tool was used to validate the models, and the ENSEMBL genome browser was used to visualize candidate lncRNAs in proximity to known ASD risk genes.

Abbey Grace Pickrel

WITH SHAYAR JOSHI, WEBER WHELAN, AND DR. HONG LUO, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Agricultural Biotechnology - MiRNA Gene Manipulation for Enhanced Crop Resistance to Abiotic Stresses

Biotechnology has revolutionized agriculture by addressing challenges posed by abiotic stressors like drought, heat, nitrogen deficiency, and salinity. Plant genetic engineering using recombinant DNA and transgenic technologies allows researchers to alter plant genome and biological processes and evaluate how different genes impact plant response to abiotic stresses in an effort to improve plant performance under environmental adversities enhancing crop yield. Genetically modifying plants often involves introduction of desired genes into single cells of the target organisms and regeneration of the transformed cells into plants expressing the transgenes.

MicroRNAs, the small RNA molecules involved in post-transcriptional regulation of target genes, have been shown to play critical roles in stress response pathways. Here, the data presented demonstrates how to genetically engineer perennial grasses for enhanced plant resistance to multiple abiotic stresses by manipulating expression of various miRNA genes in transgenic plants. These advancements offer promising solutions to enhance agricultural efficiency, combat food scarcity, and cultivate tolerant crops in underutilized areas. By altering the genetic information of plants, researchers observe the impacts on stress tolerance and crop yield. Biotechnology presents valuable tools to modify crops, provides insights into increasing plant tolerance to abiotic stress, and promotes food security for the benefit of humanity.

Understanding the Experiences of Neurodivergent Learners in Higher Education

Neurodivergence is a non-medical umbrella term that is used to describe those with variance in their neurological function from what is considered normal. Commonly known neurodivergent disorders include autism spectrum disorder, attention deficit hyperactivity disorder (ADHD), dyslexia, developmental coordination disorder (DCD), and many others. In higher education, there has been an increasing number of individuals self-identifying as being neurodivergent, including students, faculty, staff, administrators, and other learners within higher education. Neurodivergent learners often face personal struggles, discrimination, and challenges caused by their specific disorder in higher educational settings.

The purpose of this research is to gain a better understanding of the experiences of those neurodivergent individuals within higher education. A survey tool will be utilized to collect responses from both self-identifying neurodivergent individuals, as well as neurotypical individuals, in regard to their experiences within higher education environments, followed by an interview with select participants. This study aims to pilot data collection tools and inform the design of individualized studies that focus on particular areas of interest in the larger context of the experiences of neurodivergent learners in higher education.

Delanie Robertson

WITH KYLIE AVITABLE, LEILA WILLIAMS, AND DR. MATTHEW BOYER, DEPARTMENT OF ENGINEERING AND SCIENCE EDUCATION

Stephanie Rodriguez-Umana

WITH THOMAS LEE AND DR. RODRIGO MARTINEZ-DUARTE, COLLEGE OF ENGINEERING, COMPUTING, AND APPLIED SCIENCES

Not all cellulose is the same; plant cellulose or bacterial cellulose, which is more sustainable?

Plants are the most well-known source of cellulose. Extracting it from the plant cell wall includes sterilization, dehydration, and chemical treatments. In contrast, bacterial cellulose (BC) is produced pure in bioreactors from different microorganisms and culture media. BC is a promising alternative because of its purity and material properties. However, there is a lack of a methodical comparison of sustainability, pertaining to protecting the environment's resources, its ability to meet demand, and the economic profit, of these two. In this project, the processes, parameters, and resources required to produce cellulose from plants and bacteria are initially reviewed. There was a comparison between the production stages of growing, harvesting, transporting, and processing. In the growing stage, plant cellulose (PC) had a larger growth duration and water consumption than BC, however, BC had a reduced yield. PC could be harvested by hand or machine. BC is typically harvested by hand. Unlike BC, PC requires transportation of materials from the harvesting site to the processing site. Both PC and BC require a processing stage for purification. In future studies, this initial study can serve as a basis to compare more parameters to further identify the most sustainable cellulose source for a given purpose.

Hannah Rowe

WITH AUBREE MILLER AND DR. CHERYL INGRAM-SMITH, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

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In this project, we used the MEME program to analyze the upstream regions of sets of genes that are turned up or turned down together to identify sequences that are shared among multiple genes within a set. This may be a way to identify regulatory sequences responsible for initiating the encystation process.

Mediterranean Herb Effects on Cancer Cell Lines and Zebrafish Embryos

Breast cancer is currently one of the most widespread forms of cancer, affecting one in every four women. A common treatment strategy for breast cancer is chemotherapy, which uses many harmful drugs, including Doxorubicin, to kill cancer cells to stop them from spreading. Doxorubicin works by targeting all fast-growing cells within the body, causing severe cell damage and exhaustion in all patients who take it due to non-cancerous cells also being destroyed. This project focuses on testing the ability of Mediterranean herb extracts to inhibit cancer cells from multiplying with less damage to non-cancerous cells as a possible alternative treatment to Doxorubicin and its harmful side-effects.

Isabella Stamato

WITH ERIC BLANCHARD, DEEKSHITA VEMURI, ETHAN WILSON, ZOE VICKERY, AUBREY MATTINGLY, AND DR. DIANA IVANKOVIC, SCHOOL OF NURSING, HEALTHCARE GENETICS

Specifically, zebrafish (Danio rerio) are used in assessing the toxicity of these herbs. Embryos were exposed to differing concentrations of the extracts then observed every 24 hours for three days. Data was gathered on how they influenced the zebrafish's growth. The toxicity assessment aims to find the optimal concentrations of the herb treatments that do not negatively affect the development of the embryos. Once assessments are completed, the next step is adding human breast cancer cells to zebrafish embryos and determining whether the extracts have any impact on the cancer without harming the fish.

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Kevius Tribble

WITH ASHTON MCENTARFFER AND DR. MERT PESÉ, SCHOOL OF COMPUTING

Deekshita Vemuri

WITH ISABELLA STAMATO, ERIC BLANCHARD, ETHAN WILSON, ZOE VICKERY, AUBREY MATTINGLY, AND DR. DIANA IVANKOVIC, SCHOOL OF NURSING, HEALTHCARE GENETICS AND GENOMICS

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Weber Whelan

WITH SHAYAR JOSHI, ABBEY GRACE PICKREL, AND DR. HONG LUO, DEPARTMENT OF GENETICS AND BIOCHEMISTRY

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Leila Williams

WITH KYLIE AVITABILE, DELANIE ROBINSON, AND
DR. MATTHEW BOYER, DEPARTMENT OF
ENGINEERING AND SCIENCE EDUCATION

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Mia Yancey

WITH ANDREW HODGES, MARY AIYETIGBO, AND
DR. NIANYI LI, SCHOOL OF COMPUTING

Physics-based Deep Learning for Computer Vision

The realm of computer vision aims to replicate human visual comprehension in AI systems, equipping them to accurately identify and interpret objects in images and videos. This research explores the application of a cutting-edge image distortion correction algorithm, "Unsupervised Non-Rigid Image Distortion Removal via Grid Deformation," in synergy with Teachable Machine, an accessible web-based image recognition tool. The goal is to improve the image recognition precision in video inputs containing turbulent distortions caused by air or water.

The proposed distortion correction framework can bypass the necessity for pre-training on annotated datasets or any supplementary data. Furthermore, it functions independently of the correctness of physics-based fluid models. The system's effectiveness was investigated by enabling Teachable Machine to recognize different playing cards. Subsequently, images of one such card were captured while submerged underwater, causing visual distortion from ripples. A comparative analysis between the Teachable Machine's identification of these distorted images and the output after distortion correction indicated a significant enhancement in object identification accuracy.

Such breakthroughs in image distortion correction augment computer vision systems' proficiency in interpreting real-world visual data. As society progresses technologically, these advances harbor immense possibilities for practical applications in domains such as autonomous systems, healthcare, surveillance, and more.

Host-Pathogen interactions in Campylobacter Infections in Chickens and Humans

Reynolds Young

WITH MUSTAFA NAGUIB AND DR. KHALED ABDELAZIZ, DEPARTMENT OF ANIMAL AND VETERINARY SCIENCES

Campylobacter jejuni is a bacterium that commonly colonizes the gut of avians, particularly poultry. While it doesn't cause disease in birds, when humans are infected with the bacteria, the resulting disease can be catastrophic in the bodies of the young, elderly, and immunocompromised. The innate immune response serves as an important defense mechanism against infection. The purpose of this study is to understand the role of chicken and human macrophages as "the first immune responder" in defending against infection by C. jejuni. Mice macrophages have been used to represent human immune defense. Using Nitric Oxide (NO) as a measure of macrophage activity, it has been found that chicken macrophages (MQ-NCSU cells) produce higher levels of NO when stimulated using live C. jejuni than mice macrophages (RAW Cells).

In this experiment, RAW and MQ-NCSU cells were infected with live C. jejuni and continually checked for NO levels at 2 and 6 hours. A phagocytic assay was also performed to measure the phagocytic activity of macrophages following infection with C. jejuni at 2 and 6 hours. Observation of data shows the more effective ability of MQ-NCSU cells to perform phagocytosis, perhaps illustrating why chickens have resistance to disease caused by c. jejuni.

The EUREKA! Team

This and every year, we are so appreciative of the many dedicated Clemson Honors College staff and faculty who work together to provide a quality program for all of our EUREKANs, with special thanks to Susan Falendysz, EUREKA! Director, and Rachael Wallace, EUREKA! Program Assistant, for their leadership.


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