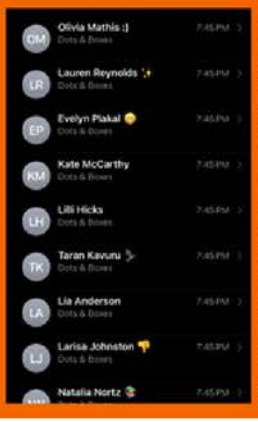
EUREKA!

Abstract Book | 2022



CLEMSON HONORS EUREKA! UNDERGRADUATE RESEARCH

Clemson University HONORS COLLEGE

My EUREKA! Experience

RYAN MEYER
2021 EUREKA! PARTICIPANT
2022 EUREKA! COUNSELOR
RISING SOPHOMORE

After having participated in EUREKA! 2021 as a student and in EUREKA! 2022 as a counselor, I can truly say that EUREKA! has been one of the best things that has happened to me during my time at Clemson.

I have been able to make lifelong friends, memories, and engage in research that will extend past the program!

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 this year's 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 three student counselors each 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.

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:

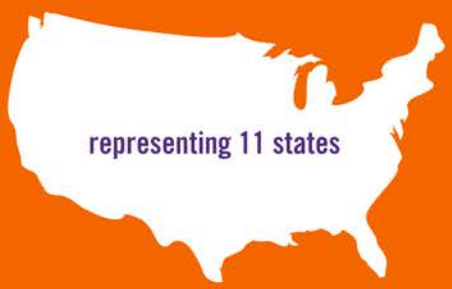
- Dwight Camper, Professor of Entomology, Soil, and Plant Science;
- Dana Irvin, Assistant Director of the Clemson University Honors College;
- Pam Mack, Associate Professor of History;
- James McCubbin, Professor and Chair of Psychology;
- Mary Miller, Special Assistant to the Provost;
- Gary Powell,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

Where We Are in 2022

2

delivery options

37 Clemson Honors students
(including 6 counselors)



2022 EUREKA! Students

Participant	Hometown	Major	Faculty Mentor	Page
Ethan Anderson	Fort Mill, SC	Computer Science	Dr. Long Cheng	5
Lia Anderson	Louisville, KY	Engineering	Dr. Shunyu Liu	6
Katie Barfield	Chapin, SC	Biochemistry	Dr. Haiying Liang	7
Max BeGole	Clemson, SC	Biochemistry	Dr. Joan Marler	8
Sophie Burhans	Homer, NY	Language and International Business	Mr. Reed Watson	9
Mercy Crapps	Tallahassee, FL	Biological Sciences	Dr. Ethan Kung	10
Abigail Curran	Irmo, SC	Genetics	Dr. Michael Sehorn	11
Brooke Dillingham	York, SC	Genetics	Dr. Michael Sehorn	12
Samaha Duffy	Knoxville, TN	Biochemistry	Dr. Kerry Smith	13
Alex Fiorentino	Clemson, SC	Microbiology	Dr. Diana Ivankovic	14
Ainara Garcia	Clemson, SC	Computer Engineering	Dr. LiangJiang (LJ) Wang	15
Cooper Gill	Midlothian, VA	Biological Sciences	Dr. LiangJiang (LJ) Wang	16
Justin Guevara-Silva	Mount Pleasant, SC	Computer Science	Dr. Nianyi Li	17
Eliza Haines	Charlotte, NC	Engineering	Dr. William Pennington	18
Lilli Hicks	Greensboro, NC	Chemistry	Dr. Hong Luo	19
Larisa Johnston	Lodi, CA	Mathematical Sciences	Dr. Kerry Smith	20
Makenzie Jones	Rock Hill, SC	Engineering	Dr. Ethan Kung	21
Taran Kavuru	Fort Mill, SC	Computer Science	Dr. Long Cheng	22
Maggie Kearns	South Bend, IN	Health Science, PPHS	Dr. Diana Ivankovic	23
Kathleen Kidd	Mount Pleasant, SC	Engineering	Dr. Ethan Kung	24
Garrett Lewis	Chapin, SC	Engineering	Dr. Shunyu Liu	25
Kaden Liles	Houston, TX	Economics	Dr. Matthew Voigt	26
Olivia Mathis	Piedmont, SC	General Engineering; Biosystems	Dr. Hong Luo	27
Kate McCarthy	Kansas City, MO	Genetics	Dr. Kerry Smith	28
Omika Merchant	Simpsonville, SC	Microbiology	Dr. Hugo Sanabria	29
Ryan Meyer	Simpsonville, SC	Economics and Management	Mr. Reed Watson	30
Apurva Mitta	Columbia, SC	Engineering	Dr. Cheryl Ingram-Smith	31
Irtija Nazim	Orangeburg, SC	Engineering	Dr. Kasra Sardashti	32
Natalia Nortz	Fort Mill, SC	Biological Sciences	Dr. Cheryl Ingram-Smith	33
Evelyn Plakal	Elgin, SC	Microbiology-Biomedicine	Dr. Sharon Bewick	34
Samuel Quan	Greenwood, SC	Computer Engineering	Dr. Yingjie Lao	35
Lauren Reynolds	Walterboro, SC	Health Science, PPHS	Dr. Cheryl Ingram-Smith	36
Brianna Sebastian-Olazabal	Myrtle Beach, SC	Engineering	Dr. William Pennington	37
Zoe Vickery	Greenwood, SC	Health Science, PPHS	Dr. Diana Ivankovic	38
Deena Warid	North Charleston, SC	Biochemistry	Dr. Cheryl Ingram-Smith	39
Amelia Weber	Vero Beach, FL	General Engineering	Dr. Pingshan Wang	40
Preethika Yetukuri	Indian Land, SC	Mathematical Sciences	Dr. Long Cheng	41

Ethan Anderson

WITH TARAN KAVURU, PREETHIKA YETUKURI, SONG LIAO, JEFFREY YOUNG, AND DR. LONG CHENG
COLLEGE OF ENGINEERING, COMPUTING, AND APPLIED SCIENCES

Data Analysis on User Reviews for Identification of a Common Alexa Issue

Voice assistants have grown rapidly in popularity. They use voice recognition to understand their user's commands and carry out, in the case of Amazon's Alexa, skills, which are auxiliary programs developed by a third party to add more functionality. These skills can be enabled by Alexa users from the skill store. Users are also able to leave reviews about the skill. Being able to quickly analyze these reviews enables a better understanding of the skill ecosystem and the problems being faced collectively across skills by users. One of these problems is when Alexa is unable to understand the user's commands, leading to frustrating interactions and a subsequent negative review, which we classify as an Alexa Understanding Review (AUR). Developing a methodology for detecting these reviews and applying this methodology to a large review data set has shown that about 0.6% of all reviews and 1.2% of all negative reviews can be categorized as an AUR.

Lia Anderson

WITH GARRETT LEWIS AND DR. SHUNYU LIU
DEPARTMENT OF AUTOMOTIVE ENGINEERING

Additive Manufacturing Synthesis of High Entropy Alloys

Metal additive manufacturing processes, particularly laser-directed energy deposition (LDED) has been applied to synthesizing multi-component advanced materials for harsh environment usages for decades. High entropy alloys, generally consisting of 4 – 6 principal elements, have great potential to replace traditional alloys due to their synergistic high strength and ductility characteristics at cryogenic temperatures. LDED has been used for rapid and flexible synthesis of candidate high entropy alloys.

The purpose of this research is to establish a baseline understanding of the laser-directed energy deposition process and high entropy alloys as well as fabrication of high entropy alloys using LDED. The suitable principal elements for high entropy alloys to possess the desired characteristics ultimately depends on the physical and chemical properties of elements and microstructure of the fabricated high entropy alloys. Additional considerations of significance include the melting points of constituent metals and their independent lattice structures, status of feedstock powders, feed rate, and LDED parameters such as scanning speed, laser power, hatch spacing, and the absorptivity of constituent metals at the utilized laser frequency. Significant porosity and the buildup of residual stresses are notable defects of LDED that often require significant post treatment.

Katie Barfield

WITH WHITNEY GUILLOT, BETHANY NEVILLE, PARTH PATEL, AVA ZOU, AND DR. HAIYING LIANG
DEPARTMENT OF BIOCHEMISTRY AND GENETICS

Distinguish the US Golden Camellia Collection with the Maturase K Gene

Golden camellia is a sought after ornamental plant for its rare yellow flowers. Due to its scarcity, information about its genomics and diversity is increasingly important. The first step toward contrasting collection diversity with natural diversity is an investigation of genetic diversity and allele richness. Maturase K, a rapidly evolving plastid chloroplast gene, was used to distinguish between species and hybrids in the golden camellia collection available in the U.S. and to select samples for a continuation of the study which will use simple sequence repeat markers.

During this study, putative golden camellia plants were collected from nurseries and botanical gardens in the United States, DNA was extracted from leaves, MatK sequences were amplified via PCR, examined through gel electrophoresis, sent for sequencing, and the results were compared with a NCBI protein database and used to build a phylogenetic tree of the collection. The resulting phylogenetic tree showed that all the known yellow-flowering camellia formed a clade, along with a few other color camellias. For the samples that have been analyzed, they are grouped with the same clade.

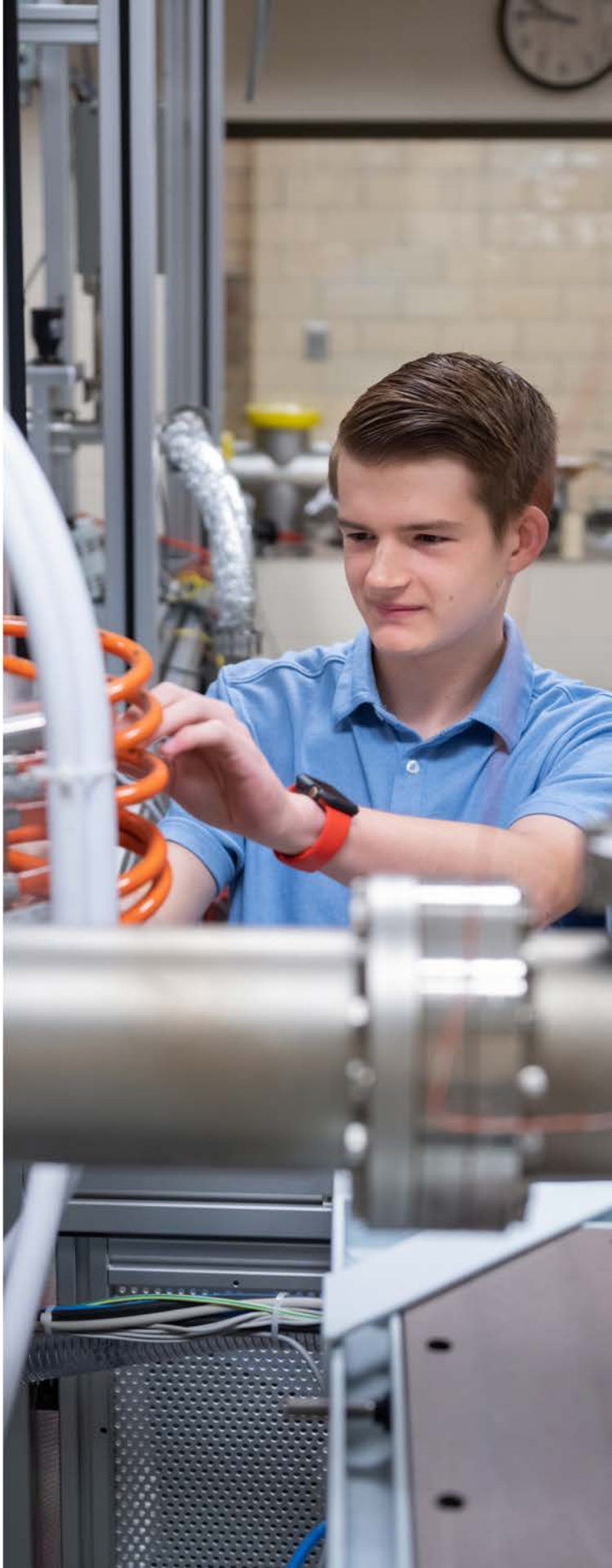
Max BeGole

WITH RICHARD MATTISH, PATRICK JOHNSON, AND
DR. JOAN MARLER
DEPARTMENT OF PHYSICS AND ASTRONOMY

Estimation for Overlapping Highly Charged Ion Signals from the CUEBIT

The CUEBIT (Clemson University Electron Beam Ion Trap) is an apparatus that creates highly charged ions. A Faraday cup is used to record the current conducted from highly charged ions from the CUEBIT after they have turned 90 degrees under the effects of a bending magnet. Performing a scan of the magnetic field shows the amount of ions in a given charge to mass ratio (q/m). There is an overlap between different ions which have the same charge to mass ratio. Because of this, the exact quantity of specific ions is unknown in these combined peaks.

The purpose of this analysis is to estimate individual currents of ions with overlapping signals. This was done using two data samples, one using Argon and one using Neon. This data, along with different ways of estimations for individual signals, was plotted using python. The results showed that background gas, Oxygen 4+ made a significantly less effect on the Neon data than the Argon data.



Sophie Burhans

WITH RYAN MEYER, DR. JORGE GARCIA, DR. PATRICK WARREN, AND MR. REED WATSON
DEPARTMENT OF ECONOMICS

Guaranteed Basic Income Pilot

Guaranteed Basic Income, known as GBI, is a government policy that grants unconditional cash payments to households or individuals on a regular basis. Unlike other welfare programs, eligibility is independent of employment status or household composition. Basic economic theory predicts that guaranteeing a stable source of income might, on the one hand, decrease labor force participation. On the other hand, GBI potentially releases individuals from poverty traps—traps that can lead to job loss, eviction, bankruptcy, or reduced health.

In recent years, several cities have launched GBI pilot programs. In these urban settings, GBI is shown to reduce the variability of consumption, improve mental and physical health, and increase career-related investments such as internships, classes, and job hunting. There is no evidence of a disemployment effect; in fact, recipients are more likely to be employed than non-recipients.

The purpose of this study is to examine the impacts of GBI in rural areas and compare them to those impacts in urban areas through a randomized controlled trial. There are key socioeconomic differences that lie between urban and rural areas that may impact the results of a GBI program in a rural setting, including educational, health, and financial outcomes.

Evaluating Stroke Risk through Fluid Dynamics Analyses

Current methods to determine treatment plans in carotid artery stenosis patients involve examining the percent blockage within the artery. However, this standard remains limited in its ability to accurately identify patients with high stroke risk. The goal of this research is to use computational models and fluid dynamics simulation data to search for a better metric for determining if treatment is needed. Preliminarily, this involved constructing 3-dimensional carotid artery models using patient CT scans via software Simvascular. Fluid dynamics simulations were then conducted for each model and results were analyzed using Paraview. Out of the 24 models originally constructed, simulations were successfully conducted for 19. When analyzing the data from these 19 simulations, pressure was used to determine the accuracy of the results. The ten models with the most accurate pressures were selected to have their results analyzed. Out of these ten, half were from patients who have had strokes and the remaining half were from patients who had not. By analyzing the mean blood velocities from each of these ten models, it was found that the mean blood velocity in patients who have had a stroke was lower than patients who had not.

Mercy Crapps

WITH KATHLEEN KIDD, MAKENZIE JONES, RAYMOND KEAN, AND DR. ETHAN KUNG
DEPARTMENT OF MECHANICAL ENGINEERING

Abigail Curran

WITH BROOKE DILLINGHAM, GARRETT BUZZARD, AMARACHUKWU ONOH, AND DR. MICHAEL SEHORN
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Genomic Mutations in BRCA2 Dutch 6 and MEILB2

Homologous recombination (HR) is a DNA repair pathway that helps preserve genome integrity by repairing DNA double-strand breaks (DSBs). The ends of a DSB are processed to expose a single strand DNA (ssDNA) tail upon which BRCA2 loads RAD51 to form a RAD51-ssDNA nucleoprotein filament. BRCA2 is localized to a DSB by MEILB2 during meiosis. This project focuses on identifying DNA-binding regions of both MEILB2 and a poorly studied fragment of BRCA2 by changing amino acids in these regions to disrupt DNA binding activity. After isolating the gene sequences, designed primers were used to introduce the mutations via PCR mutagenesis into the MEILB2 gene and the fragment of BRCA2. The results from these experiments will provide valuable insight into the role of these DNA binding domains located in MEILB2 and BRCA2.

Brooke Dillingham

WITH ABIGAIL CURRAN, GARRETT BUZZARD, AMARACHUKWU ONOH, AND DR. MICHAEL SEHORN
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Samaha Duffy

WITH LARISA JOHNSTON, KATE MCCARTHY
AND DR. KERRY SMITH
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

The Role of L-Carnitine Metabolism in the Pathogenesis of Cryptococcus neoformans and Other Fungi

Fungal infections kill one and a half million people per year worldwide. Cryptococcus neoformans, the leading cause of fungal meningitis, plays a large role in infection of immunocompromised patients, especially those in Sub-Saharan Africa and southeast Asia with HIV/AIDS. Lung macrophages, which present a first line of host defense against C. neoformans infection, provide a glucose-poor environment and nonpreferred carbon sources such as acetate are important early in establishment of a pulmonary infection. During growth on acetate or fatty acids, L-carnitine serves as an essential carrier for intracellular transport of acetyl units into the mitochondria for metabolism via the tricarboxylic acid cycle. Thus, it is likely the synthesis/transport of L-carnitine is vital during infection.

This study examines the biosynthetic pathway of L-carnitine in various pathogenic fungi and determines this pathway's role in the virulence of C. neoformans. Genomic databases describe which pathogenic fungi contain the pathway. Additionally, sequence alignment programs analyzed which amino acids are valuable for protein/enzyme function. Finally, theoretical mitochondrial targeting sequence programs determined the pathway's location. After examining the enzymes and transporters of the L-carnitine pathway one may use the data to predict virulence in pathogenic fungi and eventually develop antifungal treatments.

Alexander Fiorentino

WITH MAGGIE KEARNS, ZOE VICKERY, AND
DR. DIANA IVANKOVIC
DEPARTMENT OF NURSING

The Effects of Mediterranean Herb Extracts on a Variety of Breast Cancer Cell Lines

In the United States, breast cancer is the second most common cancer in women behind skin cancer. Current treatment options for breast cancer harm both healthy cells and cancerous cells. The purpose of this research is to compare two control breast cell lines exposed to a Mediterranean herb, versus doxorubicin, a form of chemotherapy. This research will further examine the effects of this Mediterranean herb extract on the metabolic growth of MCF-12A and MCF-12F cell lines. According to the Warburg Effect, cancer cells have increased metabolic rates in anaerobic pathways.

This project is specifically focusing on the Mediterranean herbs effect on the metabolic progression of MCF12-A and MCF12-F cell lines compared to doxorubicin, also examining the difference between MCF12A and MCF12F cell lines when treated with the Mediterranean herb. MCF-12A and MCF-12F are both non-tumorigenic cell lines, which allows inferences on whether Mediterranean herb harms healthy cells.

Prediction of Novel Autism Risk Genes by Genomic Data Mining

This study has focused on long non-coding RNAs (lncRNAs) and their potential connection to Autism. In this project, artificial intelligence, specifically machine learning techniques, were used to predict and analyze Autism (ASD) Risk Genes.

Initially, a model was trained with over 2,000 separate gene IDs that could be classified as positive (ASD) or negative (all other) genes was run. By training the model, it was then able to predict 645 high-confidence lncRNA candidates and analyze them by cross matching to find the genes that were positive in all three models (ANN, SVM, RF). Then using the DAVID Functional Annotation tool, the predicted 645 high-confidence lncRNA candidates were filtered to find the known biological process, in hopes for a better understanding of each individual candidate.

Ainara Garcia

WITH COOPER GILL, SNEHAL SHAH, ANQI WEI, AND PROFESSOR LIANGJIANG WANG
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Cooper Gill

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Justin Guevara-Silva

WITH ELLIOT MCMILLAN AND PROFESSOR NIANYI LI
SCHOOL OF COMPUTING

Understand Objects' Motion Using Deep Learning

In the information age, there is an abundance of data and machine learning models are needed to make sense of the data and generate their own algorithms to interpret the data. One specific branch of machine learning, Deep Learning, deals with feeding labeled data to various model architectures. These models are capable of tasks such as detecting objects in real time for surveillance or identifying cancerous cells.

The purpose of the research was to learn how different machine learning models operate to ultimately build an object detector that can identify the famous Clemson Paw. The research consisted of learning how a Faster RCNN can be used to achieve this task, utilizing previously explored models such as feed forward neural networks and convolutional neural networks. Each model's performance is heavily dependent on hyperparameters such as epochs, learning rates, and input/output dimensions. Through trial and error the right parameters are found to yield the greatest accuracy on the test set and lowest training loss.

Eliza Haines

WITH BRIANNA SEBASTIAN-OLAZABAL, DR. COLIN D. MCMILLEN, AND DR. WILLIAM T. PENNINGTON
DEPARTMENT OF CHEMISTRY

Cocrystal Formation Between Thiones and Organoiodines

X-ray analysis has revealed that varying the stoichiometries of Diisopropylbenzimidazolethione and different organoiodines in cocrystallization experiments can result in halogen bond motifs with varying dimensions. Additionally, cocrystals formed from different chalcones with the same molecular ratios are not always isostructural.

Lilli Hicks

WITH OLIVIA MATHIS AND DR. HONG LUO
DEPARTMENT OF BIOCHEMISTRY AND GENETICS

Plant Genetic Engineering for Enhanced Abiotic Stress Response

Adverse environmental conditions, especially drought, heat, salt, and nitrogen deficiency, are limiting factors for plant development and agricultural productivity. Plant genetic engineering using recombinant DNA technologies allows modification of genes and biological pathways involved in plant stress responses in important crops to produce new cultivars with enhanced abiotic stress tolerance and yield, alleviating the challenge of feeding the Earth's growing population. Biotechnology techniques work to genetically engineer plants through the regeneration of plants from single cells harboring introduced foreign genes, a process engaging chimeric gene construction, gene transfer to target plant cells, and the selection of transformed cells for plant regeneration. This allows for whole plants to be regenerated back from the transformed single cells or groups of cells. Genetic engineering approaches offer the possibility of breaking species barrier to introduce new and beneficial genes from various resources to a variety of target plants for cultivar development, providing highly efficient useful tools for genetically modifying crops to withstand various abiotic stress factors to improve plant development and promote sustainable agriculture.

Larisa Johnston

WITH SAMAHA DUFFY, KATE MCCARTHY, AND DR. KERRY SMITH
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Makenzie Jones

WITH KATHLEEN KIDD, MERCY CRAPPS, RAYMOND KEAN, AND DR. ETHAN KUNG
DEPARTMENT OF MECHANICAL ENGINEERING

Taran Kavuru

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Kathleen Kidd

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DEPARTMENT OF MECHANICAL ENGINEERING

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Garrett Lewis

WITH LIA ANDERSON AND DR. SHUNYU LIU
DEPARTMENT OF AUTOMOTIVE ENGINEERING

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Kaden Liles

WITH SARAH OTTERBECK AND DR. MATTHEW VOIGT
DEPARTMENT OF ENGINEERING AND SCIENCE EDUCATION

The Relationship Between Racial and Gender Identity and Perceived Climate in Mathematics Classrooms

Student Engagement in Mathematics through an Institutional Network for Active Learning (SEMINAL) is a nationally funded program working to better understand the utilization of active learning techniques in introductory undergraduate mathematics courses. This research project investigated how different groups categorized by racial and gender identity perceived the climate of their mathematics courses from Precalculus to Calculus 2 at nine universities across the United States.

This was done by analyzing the survey responses (n=16,523) from the X-PIPS-M Survey Suite within Microsoft Excel in pivot tables, graphs, and heat maps. Responses were split up by a student's classification of institution, site, gender identity, and racial identity and contrasted to find potential relationships. Instructor data was also analyzed to contrast instructional practices with the students experiencing them. Hispanic serving institutions (HSIs) had the lowest rigor levels, yet the highest engagement and friendliness levels, while predominantly white institutions (PWIs) had the highest rigor levels and the lowest engagement and friendliness levels. Instructor data found the PWIs utilizing an autonomous system and the HSIs utilizing a team-based approach. Results of this study have implication of how groups of students relate to their math courses based on instructional practices and institutional characteristics.

Olivia Mathis

WITH LILLI HICKS AND DR. HONG LUO
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Plant Genetic Engineering for Enhanced Abiotic Stress Response

Adverse environmental conditions, especially drought, heat, salt, and nitrogen deficiency, are limiting factors for plant development and agricultural productivity. Plant genetic engineering using recombinant DNA technologies allows modification of genes and biological pathways involved in plant stress responses in important crops to produce new cultivars with enhanced abiotic stress tolerance and yield, alleviating the challenge of feeding the Earth's growing population.

Biotechnology techniques work to genetically engineer plants through the regeneration of plants from single cells harboring introduced foreign genes, a process engaging chimeric gene construction, gene transfer to target plant cells, and the selection of transformed cells for plant regeneration. This allows whole plants to be regenerated from the transformed single cells or groups of cells. Genetic engineering approaches offer the possibility of breaking species barriers to introduce new and beneficial genes from various resources to a variety of target plants for cultivar development, providing highly efficient and useful tools for genetically modifying crops to withstand various abiotic stress factors to improve plant development and promote sustainable agriculture.

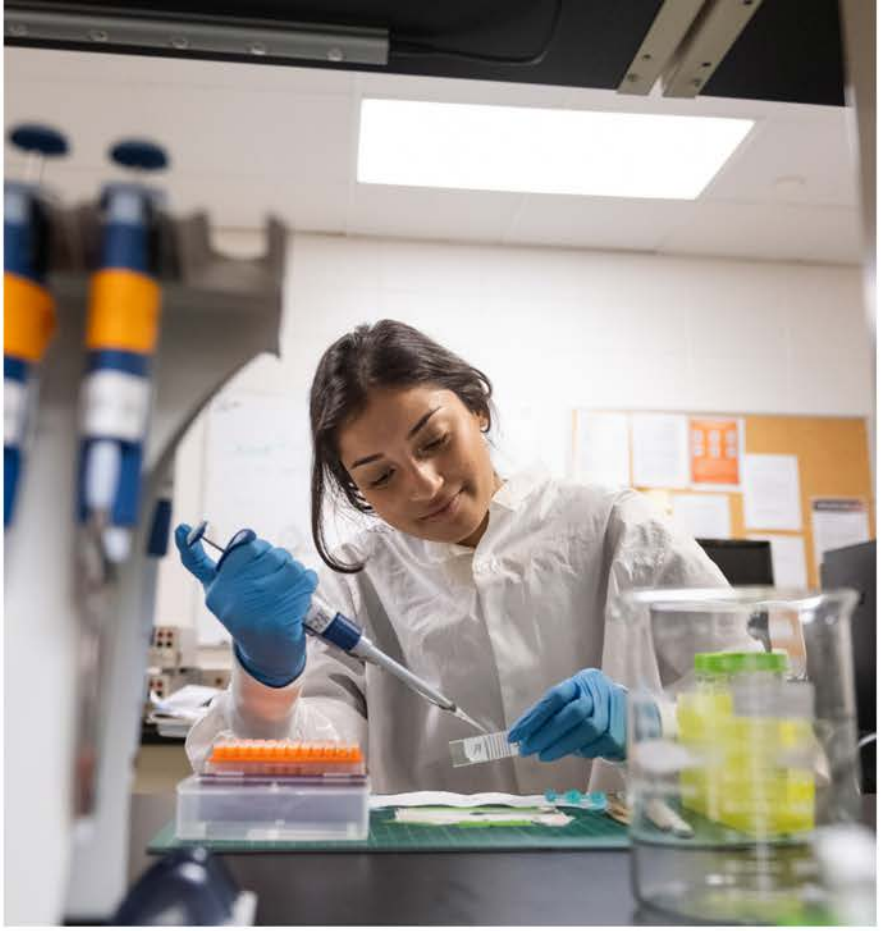
Kate McCarthy

WITH SAMAHA DUFFY, LARISA JOHNSTON, AND DR. KERRY SMITH
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

The Role of L-Carnitine Metabolism in the Pathogenesis of Cryptococcus neoformans and Other Fungi

Fungal infections kill one and a half million people per year worldwide. Cryptococcus neoformans, the leading cause of fungal meningitis, plays a large role in infection of immunocompromised patients, especially those in Sub-Saharan Africa and southeast Asia with HIV/AIDS. Lung macrophages, which present a first line of host defense against C. neoformans infection, provide a glucose-poor environment and nonpreferred carbon sources such as acetate are important early in establishment of a pulmonary infection. During growth on acetate or fatty acids, L-carnitine serves as an essential carrier for intracellular transport of acetyl units into the mitochondria for metabolism via the tricarboxylic acid cycle. Thus, it is likely the synthesis/transport of L-carnitine is vital during infection.

This study examines the biosynthetic pathway of L-carnitine in various pathogenic fungi and determines this pathway's role in the virulence of C. neoformans. Genomic databases describe which pathogenic fungi contain the pathway. Additionally, sequence alignment programs analyzed which amino acids are valuable for protein/enzyme function. Finally, theoretical mitochondrial targeting sequence programs determined the pathway's location. After examining the enzymes and transporters of the L-carnitine pathway one may use the data to predict virulence in pathogenic fungi and eventually develop antifungal treatments.



Omika Merchant

WITH KATHERINE WENTWORTH AND
DR. HUGO SANABRIA
DEPARTMENT OF PHYSICS AND ASTRONOMY

Evaluating the Effects of Post-Translational Modifications on the Motility of Trypanosoma Brucei

Trypanosoma brucei is unique in its motility morphology— its flagellum uses a bending waveform that shifts between base-to-tip and tip-to-base propagation, unlike other microbes that select just one direction. This mechanism is regulated through post-translational-modifications (PTMs) of alpha and beta tubulin. Its effects on the subpellicular microtubules that direct T. brucei's unique flagellum propagation, however, are unknown.

To test the effects of tubulin PTMs, Wentworth used an RNAi system to target the enzymes that dictate tubulin acetylation (alpha-tubulin-acetyltransferase) and detyrosination (vasohibin). After RT-qPCR and confocal immunofluorescence confirmed gene knockdown, Merchant ran flow chamber assays on each of the cell lines: vasohibin and alpha-tubulin acetyltransferase, along with their respective uninduced (wild-type) versions to analyze motility using cell-tracking.

When compared to the control cell line, wild-type, the assays presented a significant increase in motility in the non-acetylated cell line and a slight motility decrease in the highly tyrosinated cell line. These findings demonstrate that, in T. brucei, acetylation is a negative feedback mechanism in dynein-driven flagellar motility. Overall, this study supports that tubulin PTMs are highly conserved in T. brucei and other simple eukaryotes and, therefore, can be projected to similar Trypanosoma and Leishmania species that also follow this unique flagellum propagation.

Guaranteed Basic Income Pilot

Guaranteed Basic Income, known as GBI, is a government policy that grants unconditional cash payments to households or individuals on a regular basis. Unlike other welfare programs, eligibility is independent of employment status or household composition. Basic economic theory predicts that guaranteeing a stable source of income might, on the one hand, decrease labor force participation. On the other hand, GBI potentially releases individuals from poverty traps—traps that can lead to job loss, eviction, bankruptcy, or reduced health.

In recent years, several cities have launched GBI pilot programs. In these urban settings, GBI is shown to reduce the variability of consumption, improve mental and physical health, and increase career-related investments such as internships, classes, and job hunting. There is no evidence of a disemployment effect; in fact, recipients are more likely to be employed than non-recipients.

The purpose of this study is to examine the impacts of GBI in rural areas and compare them to those impacts in urban areas through a randomized controlled trial. There are key socioeconomic differences that lie between urban and rural areas that may impact the results of a GBI program in a rural setting, including educational, health, and financial outcomes.

Ryan Meyer

WITH SOPHIE BURHANS, DR. JORGE GARCIA, DR. PATRICK WARREN, AND MR. REED WATSON
DEPARTMENT OF ECONOMICS

Apurva Mitta

WITH NATALIA NORTZ, LAUREN REYNOLDS, DEENA WARID, AND DR. CHERYL INGRAM-SMITH
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

Bioinformatics Investigation of Metabolism and Encystation in the Intestinal Parasite Entamoeba histolytica

Entamoeba histolytica is a foodborne pathogen that causes amoebic dysentery in approximately 100 million people each year worldwide. E. histolytica exists as cysts and trophozoites. Cysts are ingested in contaminated food and convert to the trophozoite form which colonizes the large intestine to cause disease. The trophozoites can convert back into cysts to spread infection.

There is little information about how encystation (conversion from trophozoite back to cyst) occurs in E. histolytica. This has been well studied in the reptile pathogen Entamoeba invadens, including evaluation of gene expression during encystation and excystation. We used an online data resource to identify motifs present in the promoter region of genes that exhibited similar expression profiles. Our findings and the use of bioinformatics showed that there are significant motifs within the genome of E. invadens when analyzing patterns and locations. The gene expression of E. invadens was then compared to that of E. histolytica in order to discover more about the relationship between the pathogens.

Irtija Nazim

WITH JUNIOR LANGA AND
PROFESSOR KASRA SARDASHTI
DEPARTMENT OF PHYSICS AND ASTRONOMY

Design and Fabrication of Cryogenic Testbeds for Superconducting Quantum Devices

Superconductivity is a state a material enters when it reaches a critical temperature, generally involving cryogenics. In this state, materials obtain properties such as zero electrical resistance and the expulsion of magnetic fields.

The purpose of the project is to achieve and test these properties through a liquid-nitrogen dewar and probe system. Using this method, measurements can be made to find these characteristics in Thallium Barium Calcium Copper Oxide (TBCCO), Gold thin film, and Niobium thin film samples. The Niobium thin film and Gold thin film were grown using a Sputter Coater. The Sputter Coater has two parameters of current and pressure which was tested to find a relationship where increasing current and lowering pressure resulted in thicker, thin films. Establishing testbeds to reach superconductivity helps in the creation of new quantum devices. Quantum devices must be superconducting to have zero resistance and high functionality for quantum computers.

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Natalia Nortz

WITH APURVA MITTA, LAUREN REYNOLDS, DEENA WARID, AND DR. CHERYL INGRAM-SMITH
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Evelyn Plakal

WITH DR. SHARON BEWICK
DEPARTMENT OF BIOLOGICAL SCIENCES

Trade-offs Between Fecundity and Parental Investment in Salamanders Throughout Southeastern United States

Many aspects of salamanders' biology and ecology have been examined; however, few studies have examined trade-offs in life history traits. One common trade-off in other animals, for example frogs and mammals, is the relationship between fecundity and parental investment (number of eggs/offspring, clutch size, mature ova, and size of eggs/offspring). Whether these trade-offs are held in salamanders is poorly known.

The purpose of this study was to compile data sets on salamander reproductive traits from various credible sources (Petranka, Mitchell and Gibbs, Dodds Jr.) to understand the variation/trade-offs among salamander species. Histograms, linear regression analyses, and Mann Whitney U tests were conducted to determine overall variation in life-history traits, to assess whether life-history traits varied significantly across common Southeastern genera, and to observe correlation among the reproductive life-history traits for salamanders. The histograms displayed a large variation for each trait. The box plots illustrated significant differences among the traits for Plethedons, Desmognathus, Eurycea, and Ambyostoma. Moreover, through the linear regression lines, relationships were established with clutch size-egg size and mature ova-egg size being statistically significant, and eggs per nest-egg size being statistically insignificant potentially because eggs per nest is not an effective measure of individual female reproductive output.

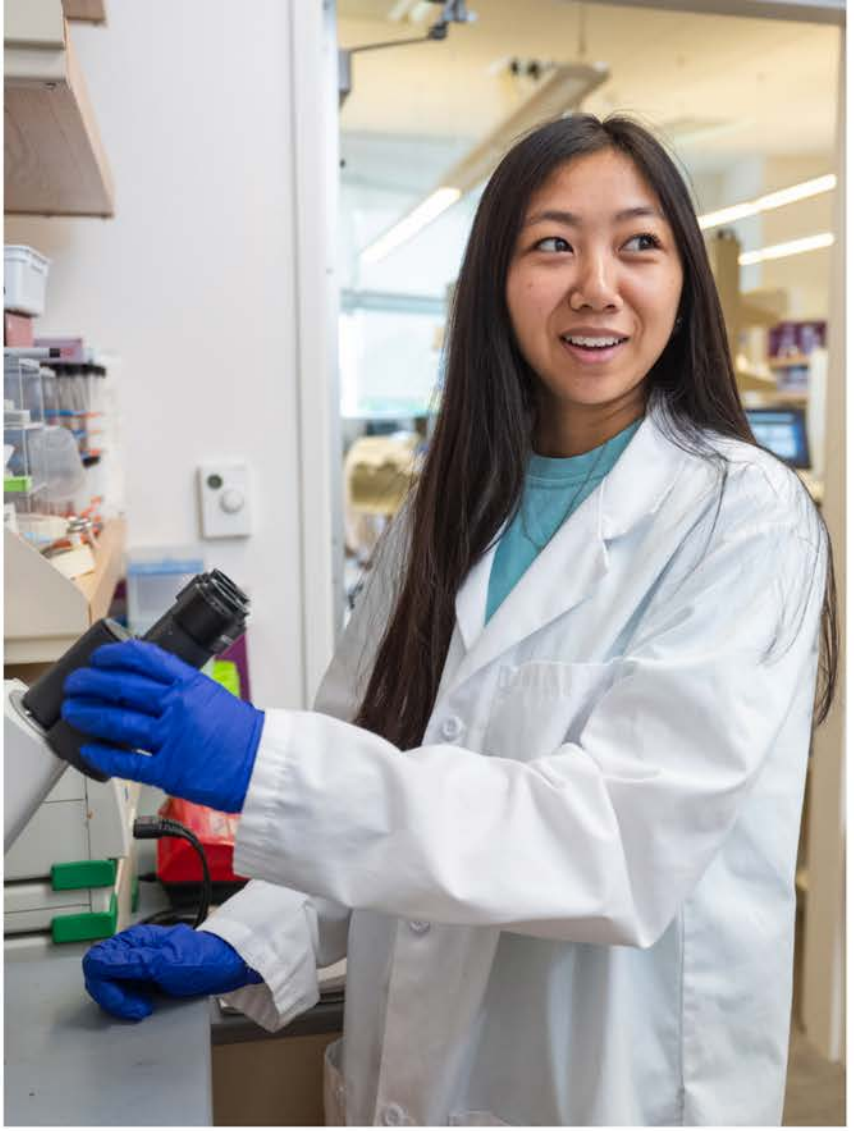
Samuel Quan

WITH AZADEH FAMILI, AND PROFESSOR YINGJIE LAO
DEPARTMENT OF BIOLOGICAL SCIENCES

On Explainability of Vision Transformers

With its robust pattern recognition and prediction capabilities, machine learning technology sees much use in various industries, including healthcare, banking, security, and even entertainment. Although the predictions made by most machine learning models are generally accurate, the reasoning behind them is not easily explainable. This opaqueness becomes problematic when assessing the validity of a model's predictions on data outside its training set. Moreover, by using explainability techniques on machine learning models, we can reveal issues with the training algorithm or hidden biases in the dataset. If left unchecked, these problems potentially lead to faulty models, such as automated loaning and credit algorithms that discriminate based on race or identification software that focuses on extraneous features.

Understanding how they make decisions is essential to ensure that machine learning models are accurate and equitable. This project uses explainability techniques on a vision transformer model proposed by Google researchers by visualizing each input pixel's relative importance to the model's classification.



Lauren Reynolds

WITH NATALIA NORTZ, APURVA MITTA, DEENA WARID,
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DEPARTMENT OF GENETICS AND BIOCHEMISTRY

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Brianna Sebastian-Olazabal

WITH ELIZA HAINES, DR. COLIN D. MCMILLEN, AND DR. WILLIAM T. PENNINGTON
DEPARTMENT OF CHEMISTRY

Cocrystal Formation Between Thiones and Organoiodines

Halogen and chalcogen bonding are versatile intermolecular forces involving electrophilic and nucleophilic regions that occur due to the anisotropic distributions of electrons on these atoms. Highly polarizable atoms, such as iodine or selenium, can participate in particularly strong interactions that enable the formation of stable, long-range crystalline lattices. This study examines several selenium- and iodine-containing systems to identify these intermolecular interactions and their structural trends in the context of crystal engineering. Broadly, this contributes to comparisons across the series of chalcogens, with extensions to oxygen and sulfur, and a better understanding of structure-property relationships toward materials design.

The Effects of Mediterranean Herb Extracts on a Variety of Breast Cancer Cell Lines

In the United States, breast cancer is the second most common cancer in women behind skin cancer. Current treatment options for breast cancer harm both healthy cells and cancerous cells. The purpose of this research is to compare two control breast cell lines exposed to a Mediterranean herb, versus doxorubicin, a form of chemotherapy. This research will further examine the effects of this Mediterranean herb extract on the metabolic growth of MCF-12A and MCF-12F cell lines. According to the Warburg Effect, cancer cells have increased metabolic rates in anaerobic pathways.

This project is specifically focusing on the Mediterranean herbs effect on the metabolic progression of MCF12-A and MCF12-F cell lines compared to doxorubicin, also examining the difference between MCF12A and MCF12F cell lines when treated with the Mediterranean herb. MCF-12A and MCF-12F are both non-tumorigenic cell lines, which allows inferences on whether Mediterranean Herb harms healthy cells.

Zoe Vickery

WITH MAGGIE KEARNS, ALEXANDER FIORENTINO, AND DR. DIANA IVANKOVIC
DEPARTMENT OF NURSING

Deena Warid

WITH APURVA MITTA, NATALIA NORTZ, LAUREN REYNOLDS, AND DR. CHERYL INGRAM-SMITH
DEPARTMENT OF GENETICS AND BIOCHEMISTRY

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Automatic Mixing of Chemicals for Measurement and Differentiation with Radio Frequency Microfluidic Sensors

Creating solutions and performing reactions at the micro scale has gained increased interest due to the benefit of using less reactant and being more easily manipulated. Materials on this scale also tend to show unique properties that can change based on the composition of a solution. As a result, it is very important that microfluidic systems are able to accurately and reliably control the flow of the liquids to ensure the proper volume is acquired. This can allow researchers to produce solutions with specific desired properties or identify the composition of unknown solutions.

This study attempts to develop and analyze the accuracy of a microfluidic system that can measure small volumes of liquid in microliters. A system was created using Fluigent machines that uses pressurized air and switches to pump the desired volume of a chosen liquid into a reservoir. The flow unit can be used to estimate the resulting volume of liquid in the reservoir and can be verified using a mathematical calculation. The true volume of the liquid can be determined using the mass of the sample and the density of each liquid, isopropyl alcohol and deionized water, at room temperature.

Amelia Weber

WITH DR. PINGSHAN WANG
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Preethika Yetukuri

WITH ETHAN ANDERSON, TARAN KAVURU, SONG LIAO, JEFFREY YOUNG, AND DR. LONG CHENG
COLLEGE OF ENGINEERING, COMPUTING, AND APPLIED SCIENCES

Data Analysis on User Reviews for Identification of a Common Alexa Issue

Voice assistants have grown rapidly in popularity. They use voice recognition to understand their user's commands and carry out, in the case of Amazon's Alexa, skills, which are auxiliary programs developed by a third party to add more functionality. These skills can be enabled by Alexa users from the skill store. Users are also able to leave reviews about the skill. Being able to quickly analyze these reviews enables a better understanding of the skill ecosystem and the problems being faced collectively across skills by users. One of these problems is when Alexa is unable to understand the user's commands, leading to frustrating interactions and a subsequent negative review, which we classify as an Alexa Understanding Review (AUR). Developing a methodology for detecting these reviews and applying this methodology to a large review data set has shown that about 0.6% of all reviews and 1.2% of all negative reviews can be categorized as an AUR.

Help us thank the EUREKA! team!

This and every year, we are so appreciative of the many dedicated Clemson Honors College staff 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.

Please also help us thank our counselors, who provided care and support for the program participants on a daily basis and served as ideal role models for our students (clockwise, starting with the lower left)

- Lia Anderson
- Ryan Meyer
- Sophie Burhans
- Omika Merchant
- Kaden Liles
- Lilli Hicks

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