STEM DAY

"Empowering Tomorrow Through Sustainable Innovation"

18th ANNUAL

STEM DAY 2025

Thursday, April 10, 2025 | 8:00 AM - 1:00 PM

The Event Center, Alabama A&M University

Alabama A&M University

College of Agricultural, Life and Natural Sciences

College of Engineering, Technology & Physical Sciences, Alabama A&M University

College of Education, Humanities & Behavioral Sciences

Alabama A&M University College of Business & Public Affairs

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Alabama Agricultural & Mechanical University

OFFICE OF THE PRESIDENT

4900 MERIDIAN STREET, NORMAL, ALABAMA 35762

March 28, 2025

Greetings, STEM Day Participants!

I am honored to welcome everyone participating in and attending Alabama A&M University's STEM Day 2025. This year, we proudly embrace the theme "Empowering Tomorrow Through Sustainable Innovation." It is a fitting tribute to the spirit of exploration and creativity that defines AAMU's commitment to science, technology, engineering, and mathematics.

Because of the determination of our founder, Dr. William Hooper Councill, and his unparalleled contemporaries, Alabama Agricultural and Mechanical University, a Historical Black College and University, has been able to accomplish much with often meager resources. Thanks to their drive and vision, Alabama Agricultural and Mechanical University was recognized as not only one of the top 50 colleges in the US for graduating African-Americans with bachelor's degrees in computer science, engineering, math and sciences, it is also one of the top 10 HBCUs for graduating black engineers and mathematicians (thehundred-seven.org). In the state of Alabama, AAMU enrolls and graduates the largest number of minority STEM majors. Alabama Agricultural and Mechanical University is a leading producer of African-American computer scientists, engineers, mathematicians and natural and physical scientists. AAMU continues to rank among the top institutions in the world in the production of minority physicists with Ph.D. degrees.

This is a time to celebrate the world of science, technology, engineering and mathematics and with that, I applaud the efforts of our faculty, staff and students in promoting the importance and relevance of the STEM disciplines. We are confident that the quality of the scientific presentations, along with the fervor of the program will instill further interest and growth.

Sincerely,

Daniel K. Wims, Ph.D.
President

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ALABAMA A&M UNIVERSITY

Academic Affairs
108 Patton Hall
Normal, Alabama 36756
(256) 372-5275 Office
(256)372-5278 Fax

April 2, 2025

Dear STEM Day Participants,

On behalf of Alabama Agricultural and Mechanical University, it is my distinct honor to welcome you to the 18th Annual Science, Technology, Engineering, and Mathematics (STEM) Day. I extend my sincere greetings and commend each of you for your commitment to academic excellence and innovation in the STEM disciplines.

STEM Day remains a vital platform for showcasing the outstanding scholarly achievements of our students, faculty, and staff. It also presents a unique opportunity to foster meaningful collaboration with esteemed faculty mentors and industry professionals from across the region. This event serves not only as a forum for sharing original research but also as a catalyst for advancing the frontiers of science, engineering, and technology.

This year's theme, ***"Empowering Tomorrow Through Sustainable Innovation,"*** underscores our university's dedication to interdisciplinary inquiry, the promotion of cutting-edge innovation, and the elevation of diverse perspectives in the pursuit of scientific progress. Through rigorous academic preparation and hands-on research, our students are developing the critical thinking skills, technical knowledge, and collaborative mindset essential for leadership in their respective fields.

As we come together to celebrate these achievements, I encourage each of you to take full advantage of this opportunity to engage with your peers, connect with faculty, and network with professionals. May your contributions today reflect not only your academic talent but also the promise of your future potential.

Once again, welcome to STEM Day 2025 at Alabama A&M University. I wish you all a successful and enriching experience.

Sincerely,

John D. Jones, Ph.D.
Provost and Vice President for Academic Affairs

Alabama A&M UNIVERSITY

Office of the Vice President for
Research and Economic Development
4900 Meridian Street
Patton Hall - Room 217
Normal, Alabama 35762
(256) 372-7010 Office
majed.eldweik@aamu.edu

April 10, 2025

Greetings, STEM Day Participants,

The Research and Economic Development Team, (R.E.D.), would like to welcome each and every participant to the Annual Science, Technology, Engineering and Mathematic (STEM) Day at Alabama Agricultural and Mechanical University. This event provides our participants with tremendous opportunities and knowledge to collaborate with industry and local businesses all over the United States.

Because of this event, students will definitely become familiar with how research and innovation play a significant part in societal challenges in the STEM program. As an advocate of Research and Economic Development it is indeed a pleasure to applaud, promote and support the STEM program. This office supports the vision of the faculty and staff members of this vital program.

This office will continue to support the STEM Day. I know that the presentations and exhibits that will be displayed will show the students the efforts and strong faculty members that are mentoring our students at AAMU.

The 2025 theme, "**Empowering Tomorrow Through Sustainable Innovation,"** STEM event will showcase the transformative role that research and innovation play in addressing complex societal challenges and shaping a sustainable future. In addition, show the students that here at Alabama A&M University you can "**Start Here and you can go Anywhere.**"

Sincerely,

Majed Dweik

Majed El-Dweik, PhD
Vice President of Research and Economic Development

Cultivating Diversity in STEM Solutions

March 28, 2025

"Never be limited by other people's limited imaginations." Dr. Mae Jemison, engineer and former NASA astronaut

The Division of Student Affairs is honored to support the STEM Day 2025 event. This year's theme, Cultivating Diversity in STEM Solutions, underscores the importance of STEM Day at Alabama A&M University (AAMU).

Diversity opens the doors to having unique perspectives shared within the workplace. Viewing and tackling problems from multiple viewpoints contributes to solutions that can change the world.

STEM Day prepares AAMU students to be well-rounded leaders. In preparation for showcasing the knowledge and skills being gained in our rigorous academic programs, the students work collaboratively, meet deadlines, and practice communicating clearly. To that end, congratulations to every student who took the initiative to participate in this event. Thanks to their faculty advisors for helping them prepare for this day.

Thank you to the 2025 STEM Day chair, Dr. Ebony Weems-Oluremi, and her co-chairs, Dr. Yinshu Wu, and Dr. Dana Indihar, and the STEM Day committee members for their tireless efforts to host this event. Thanks to Career Development Services, from the Division of Student Affairs, for adding diverse perspectives to this event by inviting representatives from industry and government to serve as sponsors and judges.

Eighteen years ago, Dr. Matthew E. Edwards launched STEM Day at Alabama A&M University. His vision has flourished. I look forward to seeing some of the concepts presented by students at STEM Day 2025 flourishing in industry and government.

Braque (Brock) Talley, Ph.D.

Braque Talley

Vice President, Student Affairs

START HERE. GO ANYWHERE.

ALABAMA A&M UNIVERSITY

Office of the Associate Vice President for Academic Affairs
Dean of Graduate Studies
300 Patton Hall
4900 Meridian Street N
(256) 372-8747

April 2, 2025

Greetings Bulldogs,

I want to take this opportunity to welcome you all to the **18th Annual Science, Technology, Engineering, and Mathematics (STEM) Day** at Alabama Agricultural and Mechanical University (AAMU)! I am honored to celebrate the exceptional achievements of our students, whose commitment to research and innovation continues to reflect the highest standards of academic excellence across STEM disciplines.

As the world grows more complex, it is critical that our students are prepared with the knowledge, skills, and adaptability to analyze information, solve problems, and make sound decisions based on evidence. These are the tools students develop through research and academic inquiry, and today's presentations are a testament to your dedication, perseverance, and vision, supported by our outstanding faculty mentors.

This year's STEM Day theme, **"Empowering Tomorrow Through Sustainable Innovation"**, speaks to our ongoing mission to develop diverse and inclusive solutions to some of the world's most pressing challenges. Whether through groundbreaking research, innovative design, or interdisciplinary collaboration, your work exemplifies the creativity and impact we strive for at AAMU.

As we continue to expand opportunities for advanced education, I encourage you, especially our graduating seniors, to consider the value of graduate studies as a pathway to further personal and professional growth. No matter the direction you choose, know that you are equipped with the tools to make meaningful contributions to the world around you.

I extend my best wishes to all STEM Day participants. Thank you for your hard work, your bold ideas, and your Bulldog spirit. Go Bulldogs!

Sincerely,

Tau Kadhi, Ph.D.
Associate Vice President for Academic Affairs and
Dean of Graduate Studies
School of Graduate Studies | Alabama A&M University256.372.5276 office
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ALABAMA A&M UNIVERSITY

College of Agricultural, Life, and Natural Sciences
College of Engineering, Technology and Physical Sciences

College of Education, Humanities and Behavioral Sciences

College of Business and Public Affairs

Office of the Deans

April 4, 2025

Dear Participants,

"Empowering Tomorrow Through Sustainable Innovation" is the 2025 STEM Day theme at Alabama A&M University (AAMU), and we are thrilled to welcome you to this year's celebration of innovation, scholarship, and discovery.

As STEM Day 2025 participants, your dedication to addressing today's pressing challenges through research, creativity, and collaboration continues to inspire us. This year's event will showcase the outstanding efforts of our science, technology, engineering, and mathematics communities, highlighting the critical role of sustainability in shaping a better future.

Our theme reflects a commitment not only to environmental and technological sustainability but also to building inclusive, equitable frameworks that foster long-term impact. The diverse perspectives and backgrounds represented in your work enrich the academic and social fabric of our university and beyond. We sincerely thank you for your passion, perseverance, and contributions.

STEM Day at Alabama A&M University has a rich tradition of excellence, made possible by the continued support of our faculty, researchers, advisors, and mentors. Your dedication empowers the next generation of thinkers and problem-solvers. We also extend heartfelt thanks to the organizers and volunteers whose efforts make this event a success each year.

Sincerely,

Lloyd T. Walker, Ph.D
Dean/1890 Research Director
College of Agricultural, Life
& Natural Sciences

Zhentao Deng, Ph.D
Dean
College of Engineering, Technology &
Physical Sciences

Peter Eley, Ph.D
Interim Dean
College of Education, Humanities,
& Behavioral Sciences

Timothy K. Mantz, Ph.D
Interim Dean
College of Business & Public Affairs

ALABAMA A&M UNIVERSITY

Dr. Matthew (Matt) Edwards
Department of Physics. Chemistry and Mathematics
P.O. Box 338
Normal, Alabama 35762
(256) 372-8119 Office
(256) 337-0340 Cell

Dear STEM Day Participants,

As the Founder of STEM Day at Alabama Agricultural and Mechanical University (AAMU), it is both an honor and a privilege to welcome you to the **18th Annual STEM Day Celebration**. Each year, this event offers an important occasion to reflect upon and showcase the research excellence and innovation demonstrated by our students, faculty, and academic community. In the eighteen years that STEM Day has been in existence, this year's theme, "**Empowering Tomorrow Through Sustainable Innovation**" continues to speak to the heart of our mission. It reflects our unwavering commitment to diversity, inclusion, and interdisciplinary collaboration within the STEM disciplines. Such themes underscore the importance of equipping students and faculty with the resources and opportunities to engage deeply in research, contribute to scientific solutions, and take on leadership roles within and beyond the university setting.

Throughout today's program, you will witness an array of student-led research presentations and scholarly work that exemplify the essence of STEM education, critical inquiry, innovation, and applied learning. STEM Day serves as a reflective space, one that encourages participants to explore the full trajectory of the STEM experience, from foundational education to real-world application. Our goal is that each student leaves this experience with a strengthened belief in their own potential, carrying forward the conviction that *"I can do this too."* It is in this moment of realization that we witness the beginning of a student's transformation into a scholar and future leader.

This theme also invites us to confront the broader challenges facing our global society, climate change, public health, food security, and energy demands, among others, and to affirm that solutions must include the perspectives and talents of all individuals. It is essential that students from all backgrounds, including women, minorities, persons with disabilities, and immigrants, see themselves as active contributors to the scientific enterprise. This vision, grounded in equity and access, is at the very core of what STEM Day represents.

I congratulate each of you on your participation and encourage you to embrace this opportunity to learn, collaborate, and grow. May your engagement today inspire continued excellence in research and a lifelong commitment to innovation, service, and discovery.

With best regards,

Matthew E. Edwards

Matthew (Matt) Edwards, Ph.D.
Founder of AAMU STEM Day
Professor of Physics
Vice President & Associate Executive Director, Alabama Academy of Science
Former Dean, College of Arts and Sciences

Alabama A&M University

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The Origination, Value, and Sustainability of STEM Day:

Before there was a STEM Day at Alabama A&M University (AAMU), I had attended numerous science and science education meetings, one of which was called Dynamic Days that considered chaos theory and differential equations. Moreover, I had worked previously at another institution, which at that time hosted an Annual Science Program. As an undergraduate student, I had worked at Argonne National Laboratory as a summer intern and later presented my first science talk at the Southeastern Section Meeting of the American Physical Society, while being a new graduate student. These experiences were all fulfilling, which further caused me to realize the significance of conducting research and sharing it with other individuals. In addition, I had previously organized science programs, and had taken students to government laboratories and to many science and engineering conferences. Although there can be no certainty of how or why it occurred, I believe that during the Fall Semester of 2006, somewhere between thinking about attending the Dynamic Days meetings, of presenting talks and posters at regional and national conferences, of taking students to meetings and government laboratories, of participating in previous Annual Science Programs, and of mentoring students at AAMU, the thought arose in my mind of the need for a yearly event at AAMU to be named "STEM Day."

Initially, not only did I contemplate the thought but also knew I had to tell someone about it. Therefore, I requested a meeting with then Provost Beverly Edmond. In a few days after my request, I arrived at the Provost's office and settled into a chair before the desk where she was seated. In order to buffer or assuage myself against a total rejection, I decided to offer two suggestions hoping that she would accept one, at least, and both if I were very lucky, and while not mentioning it earlier, I had been thinking also of how to deliver science content material better to students and how that process could be improved at AAMU. Thus, after exchanging pleasantries, I told Dr. Edmond that I had two ideas that I thought would benefit or be of value to the entire University. I stated that a need exists for a Center for Teaching and Learning to help early career and retooling faculty members to improve their teaching abilities, and secondly a need exists for an annual event called STEM Day to serve scholarly students and faculty members to illustrate the results of their research and individual studies. After a few other exchanges between us, and a brief moment in reflection, Dr. Edmond did not hesitate before replying that the two ideas were meritorious, so "let's make them happen." Thereby, with that simple statement, the goal was achieved, resulting in no rejection of my suggestions but in two positive outcomes all completed with one effort.

I departed from the Provost's office and returned to V. M. Chambers Hall knowing of her support to begin STEM Day and an educational center. The Center was established soon after my meeting with her, without my intervention, and near the end of Fall Semester 2006, I called the first STEM Day Organization Meeting; the meeting was held in the Physics Library with Dr. Edmond in attendance. Starting with that meeting, STEM Day had also begun, and all else about this organization since that time has been about its worth and sustainability.

STEM Day has now existed for many years! What a wonderful reality this is for the University to have some of its brightest students to conduct research and present their findings via posters to persons who have an interest in their work. Moreover, I am delighted to have participated in, have observed faculty members mentoring students in this manner, and have seen faculty and staff members taking leadership roles to make each STEM Day a success, all done with the support of the administration of the institution. Finally, it is each of you who will find the worth in STEM Day and help to sustain its existence at AAMU.

Very sincerely yours,

Matthew E. Edwards

Matthew E. Edwards, Ph.D., Professor of Physics
FRM. Dean, School of Arts and Sciences, and Founder of STEM Day

Biographical Sketch of Dr. Matthew E. Edwards, STEM DAY Founder at AAMU

Employment and Scholarly Activity: Since January 2002, Dr. Edwards has been a Professor of Physics at Alabama A&M University (AAMU) and served as the Dean of the School of Arts and Sciences from 2007 to 2011. Prior to 2002, academic positions he held included associate professorships at Spelman College and Fayetteville State University, and a visiting associate professorship and adjunct faculty position at the University of Pittsburgh, and an assistant professorship at the University of Arkansas at Pine Bluff. He has held summer-faculty-research positions at several Government Labs: the ROME Air Force Research Lab, NASA Langley Research Lab, and the Naval Research Lab. Dr. Edwards is a Condensed Matter physicist with expertise and interests in quantum physics/solitons wave theory, the materials of electrooptics, pyroelectricity, resistivity, and dielectric properties of crystals and nano-particles doped organic thin films, and in STEM Education. Dr. Edwards has more than 50-refereed papers and journal proceedings and has made greater than 55 professional and administrative presentations. He has guided seven students to advanced degrees: four to the Ph.D., and three to the Master's degree, has served on more than 20 dissertation and thesis committees, and has peer-reviewed greater than 25 research manuscripts. Currently, he is guiding two Ph.D.'s and one Master's degree student. Moreover, he sits on the Board of Directors of two science journals and one science education journal and serves on the executive committee of the Alabama Academy of Science.

Formal Training: Dr. Edwards graduated from Central High School in Goldsboro, North Carolina in 1965 and received the Master's and Ph.D. degrees in physics from Howard University, Washington, D.C, in 1975 and 1977, respectively, and received a B.S. degree in engineering physics from North Carolina A&T State University, in 1969. Additional studies included advanced physics courses at the University of North Carolina, Chapel Hill, North Carolina, in 1987, certificate studies at MIT, Boston, Massachusetts, in 2009, and Materials Science studies at the University of Alabama, Sumer 2000.

Honors and Awards: Dr. Edwards has received (1) the award of Fellow of Alabama Academy of Science, March 2022, (2) the award of Interdisciplinary Fellow of the International Institute of Informatics and Systemics (IIIS), July 2019 (3) The William Lesso Memorial Award for Excellence in Physics and Interdisciplinary Communications, July 2018 (4) Session Best Paper Awards, of the Proceedings of the International World Multi-Conference on Systemics, Cybernetics, and Informatics, in three years, July 2013, 2014, and 2016, (5) Top Faculty Award At Online Affordable HBCUs, 2013 & 2014, (6) Nuclear Research Commission (NRC) Faculty Research Participation Program Award, 2011 & 2012, (7) Madison Who's Who Recognition, 2011, (8) American Society for Engineering Education (ASEE) Fellowships, 1996, (9) Received the Noble Achievement Award from NAFEO, 2009, (10) The Special Recognition Award from Science Spectrum Magazine as a Top Minority in Research Science, September 2005, (11) Who's Who in American Colleges and Universities Recognition, 2004, (12) Presidential Award for Excellence in Teaching, from Spelman College, 2001, (13) Outstanding faculty of the year award from the Department of Natural Sciences, Fayetteville State University, 1994, (14) The Award from the National Institutes of Health (NIH)—National Institute of General Medical Sciences, 1991.

Achievements: Dr. Edwards was the Guest Editor of the special issue of the American Journal of Materials Science in 2015. He holds membership in several scientific and scholarly organizations. He has been the PI or Co-PI on more than 20 grants and contracts, totally more than 6.00 million dollars. He founded: (1) the Biomedical Research Program at Fayetteville State University, (2) the Interdisciplinary Center for Health Science and Health Disparities & Materials, at AAMU, and (3) STEM Day at AAMU,

Personal Information: Dr. Edwards's immediate family consists of wife, Glenda Robinson Edwards, a son, Matthew Edwards, Jr., with his significant other Rosalind Combs, two granddaughters, Megan and Misty Edwards, and their mother Shirley Haywood, a daughter, Natasha Hall with her husband Daniel, and two other granddaughters, Kaylie and Alexis Sellers, and Glenda's grandson, and great grandson, Courtland Cutler and Nicholas Cutler, respectively.

Welcome and Greetings!

On behalf of the 2025 STEM Day Organizing Committee, it is with great enthusiasm that we welcome you to Alabama A&M University's 18th Annual Science, Technology, Engineering, and Mathematics (STEM) Day. This special occasion continues to serve as a vibrant platform where our students shine, presenting the fruits of their hard work, dedication, and innovative research. Today marks a remarkable opportunity for AAMU to witness the display of your talents in innovative research, while simultaneously engaging the community in the professional dissemination of knowledge.

This year, we celebrate STEM Day with the inspiring theme: "Empowering Tomorrow Through Sustainable Innovations." In an era defined by rapid change and complex global challenges, sustainable innovation is no longer a choice, it is a responsibility. Through your ideas, your discoveries, and your resilience, you are shaping a future where science and compassion walk hand-in-hand to create lasting solutions for our communities and our planet.

As students, mentors, and scholars, we gather today to celebrate not only the knowledge gained but the journey taken. Your presence, your voice, and your work matter deeply. Let this day be a reminder that the seeds of innovation you plant now will grow into the breakthroughs of tomorrow.

We are inspired by the words of ***Marie Curie****, a pioneering* physicist and chemist who overcame immense adversity to become the first woman to win a Nobel Prize:

> *"I was taught that the way of progress was neither swift nor easy."*

Her words echo in every research endeavor, every sleepless night, and every bold idea that challenges the status quo. Let us walk together on this path of progress, with determination, collaboration, and heart.

We are deeply grateful to our sponsors, the President's Office, the Office of the Provost and VP of Academic Affairs, the Office of Student Affairs, The Graduate School, the Office of Research and Economic Development, Title III, and the Deans of the Colleges of Agriculture, Life & Natural Sciences; Engineering, Technology, and Physical Sciences; Education, Humanities, and Behavioral Sciences; and Business and Public Affairs. We also sincerely thank our guest speaker, judges, university administrators, and dedicated faculty mentors who uplift our students every step of the way.

As we embark on today's journey of innovation and discovery, may this STEM Day ignite your imagination, energize your passion, and remind you that you are the change-makers of the future.

Ebony I. Weems-Oluremi, Ph.D
Assistant Professor
Department of Biological Sciences
College of Agricultural, Life
& Natural Sciences

Yinshu Wu, Ph.D
Associate Professor
College of Engineering, Technology &
Physical Sciences

Dana Inidhar, Ph.D
College of Agricultural, Life
& Natural Sciences

Empowering Tomorrow Through Sustainable Innovation

18th Annual STEM Day 2025 Program
Founder: Dr. Matthew E. Edwards
Event Center
April 10, 2025

7:30 – 8:15 AM	**Breakfast**	
	Welcome & Opening Remarks	**Ebony Weems-Oluremi Ph.D.** Chair, 2025 STEM Day **Daniel K. Wims Ph.D.** President, Alabama A&M University
8:15 – 8:45 AM	**Provost Welcome Remarks**	**John Jones, Ph.D.** Provost, Alabama A&M University **Majed Dweik, Ph.D.** Vice President of Research & Economic Development, Alabama A&M University **Katelyn Boyle** Graduate Student, Food and Animal Sciences
8:45 - 9:15 AM	**STEM Day 2025 Speaker**	**Tawnya Laughinghouse** Director. Materials and Processes Laboratory Engineering Directorate
9:15 – 9:25 AM	**Special Presentations**	**Ebony Weems-Oluremi Ph.D.**
9:30 – 12:30 PM	**Student Poster Presentations**	**Viewing and Judging**
9:35 – 12:30 PM	**Graduate Oral Presentations** **High School Presentations**	
1:00 PM – 3:30 PM	**Closing Remarks** **Poster Removal and Cleaning**	**Ebony Weems-Oluremi Ph.D.**
4:00 PM	**Awards Banquet (Ernest L. Knight Center)**	**Lisa Dalrymple-McKitt Ph.D.**

Keynote Speaker

Tawnya Laughinghouse
Director, Materials and Processes Laboratory
Engineering Directorate
NASA Marshall Space Flight Center, Huntsville, AL

Tawnya Laughinghouse was appointed July 2024 to the Senior Executive Service position of director of the Materials and Processes Laboratory within the Engineering directorate at Marshall Space Flight Center. Ms. Laughinghouse previously served in the role of Program Manager for Technology Demonstration Missions within NASA's Space Technology Mission Directorate (STMD). During this role for STMD, Laughinghouse, a federally certified senior/expert program and project manager, was responsible for expanding the boundaries of the aerospace enterprise and led the TDM program with the launch of 10 advanced technologies to space between 2018 and 2024. She began her career at NASA's Marshall Space Flight Center in Huntsville, Alabama, in 2004 as a materials engineer supporting the Space Shuttle Reusable Solid Rocket Motor. Throughout her almost 21-year NASA career, Laughinghouse has enjoyed working in various capacities: Lead materials engineer for the Booster Separation Motor aft closure assembly; Lead of the Ceramics and Ablatives/High Temperature Materials Team; Acting Assistant Branch Chief for the Space Environmental Effects Branch, Acting Chief of the Nonmetallic Materials Branch, and Deputy Manager for the Technology Demonstration Missions program.

On a daily basis, Laughinghouse leads the Laboratory in providing research, technology, testing and engineering support for metallic and non-metallic materials, processes, and products that enable space exploration and NASA human spaceflight programs. Ms. Laughinghouse oversees an annual budget of $86 million and manages a highly technical workforce of approximately 340 civil service and contractor science and engineering experts, as well as several research and development efforts in world-class facilities, including the National Center for Advanced Manufacturing.

Laughinghouse is a graduate of several NASA and DOD leadership programs, including NASA Foundations of Influence, Relationships, Success and Teamwork (FIRST), US Army AMCOM Leader Investment for Tomorrow (LIFT), and NASA Mid-Level Leadership Program (MLLP). She is a May 2024 graduate of Leadership Greater Huntsville's Connect-26 Class.

A former NASA WISE collegiate scholar, Laughinghouse holds undergraduate degrees in Chemistry and Chemical Engineering from Spelman College and the Georgia Institute of Technology, respectively, and a master's degree in management (with a concentration in management of technology) from the University of Alabama in Huntsville. She has been recognized extensively in the community for mentoring and STEM advocacy. Laughinghouse has been awarded the NASA Exceptional Achievement Medal, the NASA Exceptional Service Medal, and a host of group achievement and external awards, including the distinguished Merit Award from the National Alumnae Association of Spelman College.

Born in Columbus, Ohio, Tawnya was raised in Huntsville, Alabama, and graduated salutatorian of her class at Sparkman High School in Toney, Ala. Tawnya and her husband are the proud parents of two teenage children.

STEM DAY 2025

ABSTRACT CATEGORIES

POSTERS	
Undergraduate	**Graduate**
Biological Sciences	Biological Sciences
Community and Regional Planning	Community and Regional Planning
Electrical Engineering and Computer Science	Environmental Sciences
Environmental Sciences	Family and Consumer Sciences
Family and Consumer Sciences	Physics, Chemistry, Math
Mechanical and Civil Engineering	
Physics, Chemistry, and Math	
Behavioral Sciences	

ORAL PRESENTATIONS
Biological and Environmental Sciences
Community and Regional Planning
Food and Animal Sciences
Electrical Engineering and Computer Science
Mechanical and Civil Engineering

ABSTRACTS

POSTERS

BIOLOGICAL SCIENCES

Undergraduate

Abstract # 101
Antimicrobial Effects of Extracts from *Liriodendron tulipifera* on AMR *Staphylococcus aureus*
Jamie Pearl Chea and Qunying Yuan
Mentor(s): Dr. Qunying Yuan
Department of Biological Sciences
The increase in the spread of antimicrobial resistant bacteria has become a public health threat. The goal of our study is to examine the antibacterial effects of extract from *Liriodendron tulipifera* against an antimicrobial resistant bacterium, *Staphylococcus aureus* and explore the underlying mechanisms. In this study, methanolic extracts of leaves of *Liriodendron tulipifera* were partitioned successively through hexane, chloroform, ethyl acetate, and the antibacterial activity of chloroform fraction from *Liriodendron tulipifera* was tested against *Staphylococcus aureus*. Our preliminary data demonstrated that the chloroform fraction of *Liriodendron tulipifera* exhibited about 105 times inhibition on the growth of an antibiotic-resistant bacterium, *Staphylococcus aureus*. We further investigated its possible antibacterial mechanisms. Our results indicated that the treatment of the chloroform fraction of *Liriodendron tulipifera* significantly increased the leakage of DNA from bacterial cells. SEM examination of the bacteria after treatment of chloroform fraction of methanolic extract from *Liriodendron tulipifera* identified cell membrane damages, implying that the plant extract may damage bacterial cell membrane and result in increased membrane permeability. We will continue to explore other possible mechanisms, such as inhibition on biofilm formation, efflux pump activity, that the chloroform fraction of *Liriodendron tulipifera* uses to kill bacteria. Our results suggested that extracts from *Liriodendron tulipifera* may be utilized to develop effective treatments tackling antimicrobial resistant bacteria.

Abstract # 102
Antimicrobial Effects of Extracts from *Quercus alba* on *Acinetobacter baumannii*
Alicia Owegi, Mojetoluwa Afolabi, and Qunying Yuan
Mentor(s): Dr. Qunying Yuan
Department of Biological Sciences
Acinetobacter baumannii, an aerobic Gram-negative bacterium, is an opportunistic bacterial pathogen that is primarily associated with hospital-acquired infections and later with battlefield wound infections. The threat of this bacteria increased significantly with the emergence of multiple drug-resistant strains. The goal of our study is to investigate the effects of extract from *Quercus alba* against *A. baumannii*, and possible antibacterial mechanisms. Methanolic extracts of the

leaves of *Q. alba* were partitioned successively through hexane, chloroform, ethyl acetate and the antibacterial activity of butanol fraction from *Q. alba* was tested against *A. baumannii*. We discovered that the butanol fraction inhibited the growth of *A. baumannii* by about 1 log and 3 logs at 1µg/µL and 4µg/µL, respectively. To characterize the underlying antimicrobial mechanisms, we measured total flavonoid and total polyphenols in the butanol fraction. Our results showed that the butanol fraction contains a high level of these antioxidants, which possess antibacterial activity. In addition, this butanol fraction exhibited strong free radical scavenging activity in DPPH assay. Crystal violet staining revealed that the treatment of A. baumannii with butanol fraction from *Q. alba* inhibited biofilm formation. We will further explore other possible mechanisms, such as cell membrane damage and inhibition on efflux pump activity that the plant extract uses to kill bacteria. Our results suggested that extracts from *Q. alba* is promising in serving as an antimicrobial agent to control infections caused by *A. baumannii*.

Abstract # 103

The Structures, Functions, and Evolution of CCR8; An Alternative Co-Receptor for HIV-1 Entry

Lydia Kennemer, Niyah Cameron, and Dana Indihar
Mentor(s): Dr. Dana Indihar
Department of Biological Sciences

HIV-1 entry into the host's cell is implemented by interaction between the viral envelope glycoprotein and the CD4 receptor (along with a co-receptor). These co- receptors are usually CCR5 or CXCR4. However, recent studies have shown that an alternative chemokine receptor such as CCR8 can facilitate viral entry but under poorly understood conditions. G-protein coupled receptors are integral membrane proteins that can recognize a large scope of signals ranging from photons, ions, proteins, neurotransmitters and hormones. These proteins can regulate cellular functions which includes cell growth, movement, and respond to stimuli. CCR8 is a G-coupled protein receptor with molecular functions that include coreceptor activity, C-C chemokine receptor activity and chemokine receptor activity. This means CCR8 (predominantly expressed in T cells) can act as a cell surface receptor that binds to specific chemokines and is also involved in immune responses and cell migration. Understanding why HIV-1 uses CCR8 as an alternative entry co-receptor will inform our understanding of complex viral entry mechanisms. Current literature has shown that CCR8 is expressed in low amounts on the surface of T cells. Thus, we hypothesize that the low expression of CCR8 on the surface of host cells affects its utility as an alternative HIV-1 entry co-receptor. The objectives of this project are: to characterize the structure, function, and evolution of CCR8 to elucidate why HIV-1 can use the protein as an alternative entry co-receptor. We will then compare the structure, function, and evolution of CCR8 to other known HIV-1 entry co-receptors to determine commonalities across the co-receptors that may contribute to their utility as HIV-1 entry co-receptors. The methods used in this project will consist of bioinformatics analysis, molecular docking and dynamics, and phylogenetic analysis. The purpose of this research is to understand the role of CCR8 in HIV-1 entry and how its use as an alternative entry co-receptor may impact the development of future antiviral therapy. This research contributes to the broader HIV-1 field by exploring different pathways of viral entry beyond the CCR5 and CXCR4 co-receptor.

Abstract # 104

"Unlocking the Mystery: The Role of CXCR6 as a Key Receptor in HIV-1 Infection"

Zyann Hoskin and Dana Indihar
Mentor(s): Dr. Dana Indihar
Department of Biological Sciences

HIV-1 entry into host cells is a multifaceted process, relying on the interaction between the viral envelope glycoproteins and host cell surface receptors. While the primary co-receptors, CCR5 and CXCR4, have been extensively studied, emerging evidence suggests that alternative receptors, such as CXCR6, play a significant role in facilitating viral entry, particularly into tissue-resident memory T cells. CXCR6, or C-X-C chemokine receptor type 6, is a member of the G protein-coupled receptor family. It is primarily expressed on immune cells such as T cells and natural killer (NK) cells and plays a pivotal role in the immune response and inflammation. This study aims to investigate the molecular mechanisms by which CXCR6 mediates HIV-1 entry, focusing on its structure, function, and evolutionary dynamics. We utilize bioinformatic techniques, including dynamic protein modeling and phylogenetic tree construction, to analyze publicly available data on CXCR6 and compare it to other alternative co-receptors. These methods allow for an in-depth examination of protein expression patterns and their implications in HIV-1 entry pathways. Previous research has shown that CXCR6 is expressed on immune cells, particularly memory T cells, and its interaction with HIV-1 envelope glycoproteins promotes viral attachment and fusion. Our comparative analysis of CXCR6 with other co-receptors reveals unique structural and functional attributes that may contribute to its ability to serve as an alternative entry point for HIV-1. This research highlights the importance of chemokine receptors in viral entry and suggests that targeting CXCR6 or its interaction with HIV-1 could offer new therapeutic strategies. By expanding our understanding of co-receptor-mediated HIV-1 entry, this study may elucidate potential therapeutic targets for anti-HIV therapies.

Abstract # 105

Preparing DNA for Southeastern Blueberry Pangenome

Ambreal White, Dr. Kendall Lee, Dr. Josh Clevenger, and Jeanette Jones
Mentor(s): Dr. Jeanette Jones
Department of Biological Sciences

Cultivated blueberries *(Vaccinium sect. Cyanococcu*s) are polypoid species that are tetraploid or hexaploid. This means that blueberries have more than two sets of chromosomes. In the south, two primary species are grown in the southeastern USA: Southern Highbush (4x) (*V. corymbosum L.*) and Rabbiteye (6x) (*V. virgatum Aiton*). Southern Highbush plants grow to look more like an actual bush, and Rabbiteye plants grow wild-looking. This study details genomic DNA extraction, quality assessment, and library preparation using a standardized workflow. Preparing high-quality DNA is critical in assembling a pangenome for cultivated blueberries (*Vaccinium sect. Cyanococcus*). High molecular weight (HMW) DNA was extracted from blueberry leaf tissue using a Takara DNA extraction kit, ensuring minimal fragmentation and contamination. The purity of the extracted DNA was assessed using a Femto Pulse, which provided precise sizing and concentration measurements. PacBio SMRTbell 3.0 library preparation was then performed to generate high-quality long-read sequencing libraries. This workflow enables the generation of accurate, high coverage sequencing data essential for assembling a comprehensive pangenome, facilitating genomic studies, and improving breeding efforts for cultivated blueberries.

Abstract # 106

Investigation of the AKT2 Gene in Type 2 Diabetes and Its Impact on Disease Severity

Osionela Ogiogwa and Ebony I. Weems-Oluremi
Mentor(s): Dr. Ebony I. Weems-Oluremi
Department of Biological Sciences

Type 2 Diabetes mellitus (T2D) is an inflammatory disorder characterized by insulin resistance in target tissues and a relative deficiency of insulin secretion from pancreatic β-cells. T2D is the 8th leading cause of death in the United States. High glucose consumption is associated with the early onset of T2D. The onset of T2D is multifaceted and attributed to individual behavior, lifestyle, and genetics. Mutations that occur in genes such as CAPN10, RBPJ, WFS1 and AKT2 have been shown to contribute to the development of T2D. The AKT2 gene was chosen for this study because it encodes RAC beta serine/threonine-protein kinase 2, which is crucial in regulating insulin signaling pathways. Single Nucleotide Variations (SNV) in the AKT2 gene have been implicated in disrupted β-cell function, leading to insulin resistance. A variant analysis was performed using bioinformatic prediction tools: SIFT, PolyPhen-2, MutPred2, PMut, and CADD to characterize genetic variations within the AKT2 gene and predict the potential impact of variants on protein structure. Additionally, a 3D protein structure analysis was conducted to evaluate how these variants might alter protein conformation and stability. To further enhance the predictive accuracy of pathogenic mutations, Bayesian networks were employed to model the probabilistic relationships between genetic variations and protein dysfunction. Three of the 49 variants analyzed from ClinVar were selected for a more detailed study: R274H, R15H, and D94P. Results indicate that the R274H variant has the potential to be disease-causing, while D94P is predicted to be benign. Further structural analysis revealed that R274H could significantly alter the protein's functional regions, whereas D94P had minimal impact. This study highlights the importance of integrating bioinformatic analyzing tools in understanding the genetic aspects of T2D. Further research will deepen our understanding of its clinical manifestations and pave the way for developing targeted therapies and improving patient care.

Abstract # 107

Integrating PAM50 Gene Expression with Tumor Subtypes for Outcome Prediction

Nancy Mbomson, Destiny Polk, Omotolani Bello, and Ebony I. Weems-Oluremi
Mentor(s): Dr. Ebony I. Weems-Oluremi
Department of Biological Sciences

Breast cancer is a heterogeneous disease with distinct molecular subtypes that influence prognosis and treatment response. It is the most commonly diagnosed cancer among women worldwide, accounting for 2.3 million new cases annually. Understanding its molecular characteristics is crucial for developing targeted treatment strategies and improving patient outcomes. One of the key tools for classifying breast cancer subtypes is the PAM50 gene expression signature, which categorizes tumors into Luminal A, Luminal B, HER2-enriched, and Basal-like based on gene expression profiles. These subtypes help predict disease progression and guide personalized treatment decisions. However, additional research is needed to refine these classifications and identify novel biomarkers that enhance precision medicine approaches. This study evaluates the correlation between PAM50 gene expression signatures and clinical outcomes, including tumor size, metastasis, and survival rates. We hypothesize that PAM50 classifications significantly differentiate tumor subtypes and provide insights into tumor progression, with aggressive subtypes

correlating with poorer survival outcomes and greater therapy resistance. To test this, we applied Kaplan-Meier survival analysis and Cox proportional hazards modeling to assess the association between PAM50 subtypes and survival outcomes. We developed machine learning models—including Random Forest and K-means clustering with K-fold validation—to classify tumor subtypes and predict treatment response. Chi-square and Pearson's correlation were used to analyze tumor subtype relationships with clinical variables. Pathway and network analysis further identified molecular mechanisms enriched in aggressive subtypes. Our results show that PAM50 gene expression patterns strongly correlate with patient survival rates and response to therapies such as endocrine therapy and chemotherapy, with machine learning models achieving high predictive accuracy. These findings underscore the potential of combining computational methods with genomic profiling to improve breast cancer subtyping and optimize individualized treatment plans.

Abstract # 108

Genomic Characterization of Microbial Isolates from the Mars 2020 Rover Spacecraft

Winner Igbogbo, Taniya Rainge, Tyhane Bedgood, and Tyesha L. Farmer, PhD

Mentor(s): Dr. Tyesha L. Farmer
Department of Biological Sciences

Fragile X syndrome is the most commonly inherited form of developmental and intellectual disability. This genetic disorder is caused by trinucleotide expansion of CGG repeats in the Fragile X Messenger Ribonucleoprotein 1 (FMR1) gene. Beyond the expansions, additional FMR1 mutations, such as single nucleotide variants, have been identified in affected individuals. However, the functional outcomes of these mutations and their roles in Fragile X syndrome remain unclear. The objective of this study is to survey the effects of the R138Q mutation in FMR1 using a suite of bioinformatics tools to determine whether this variant, which currently has unclear clinical significance, plays a role in the syndrome. The R138Q mutation substitutes an Arginine (a positively charged polar amino acid) with a Glutamine (a polar but uncharged amino acid) at the position 138. Analysis using Polyphen2 and SIFT suggests that this variant may not be well-tolerated, whereas metrics from CADD (23.3) and GERP (5.25) imply a likely tolerance within the protein's context. Moreover, FMR1 ranks among the 66.3% most tolerant human genes based on Residual Variant Intolerance Score (0.2584). The differing outcomes from these analytical tools underscore the complexity of interpreting variants of uncertain significance and the necessity for comprehensive computational assessments bolstered by empirical functional studies. The R138Q mutation was modeled in YASARA to locally visualize the impact of the variant on protein structure. Understanding the molecular and clinical consequences of variants of uncertain significance is critical for accurate diagnosis, prognosis, and the development of targeted therapeutic interventions for Fragile X syndrome.

Abstract # 109

Investigating Toxicity, Reproductive outcomes, and Antioxidant Potential of Selenium Nanoparticles on *Caenorhabditis elegans In Vivo*.

Paige Martin, Lisa Dalrymple-Mckitt, and Armitra Jackson-Davis

Mentor(s): Dr. Lisa Dalrymple-Mckitt
Department of Biological Sciences

Selenium nanoparticles (Se NPs) have gained attention due to their potential biomedical applications, yet their biological effects remain incompletely understood. This study investigates the toxicity, reproductive outcomes, and antioxidant potential of Se NPs in the nematode, *Caenorhabditis elegans* (*C. elegans*), a well-established model organism for toxicological and oxidative stress studies. *C. elegans* were exposed to varying concentrations of Se NPs (0.001 – 0.1 µg/mL) to assess acute toxicity, reproductive outcomes, and antioxidant potentials of Se NPs compared to control models with no exposure to nanoparticles. Reproductive outcomes were assessed by quantifying total progeny, egg-laying rates, and developmental abnormalities. Antioxidant potential was evaluated through quantification of the enzymes superoxide dismutase (SOD), and Catalase (CAT). Results indicate that while low concentrations of Se NPs exhibit negligible toxicity, organisms exposed to Se NPs at 0.001 and 0.01 µg/mL, respectively, show a decrease in progeny, decrease development with a halt at L2 stage, and give rise to aggregation of worms encased in a biofilm matrix. Worms exposed to Se NPs at 0.1 µg/mL exhibit a 2-fold increase reproductive success in progeny with multigenerational development as compared to the control. These findings contribute to understanding the dose-dependent biological effects of Se NPs and their implications for nanomedicine and environmental safety. Further research is needed to elucidate the mechanistic pathways underlying Se NP interactions within biological systems.

Abstract # 110

Evaluating the Viability and Antibacterial Activity of "On-The-Market" Fermented Products against *Escherichia coli* O157:H7, and *Salmonella typhimurium*

Eric Brannon, Nedra L. Montgomery II, Lisa Dalrymple-McKitt, Armitra Jackson-Davis, and Jeanette Jones
Mentor(s): Dr. Lisa Dalrymple-McKitt
Department of Biological Sciences

Fermented food products often advertise high concentrations of probiotics, which promotes competitive exclusion by introducing dominant microbiota in the gut that out compete harmful bacteria. These labels usually include large numbers of probiotics, notation of specific strains, and claims of inhibition against certain foodborne illnesses. Verifying these claims is vital as it has been found in past years that companies have made exaggerated claims about their probiotic products. In the United States, yogurt standard of identity includes products containing cream, milk, partially skimmed milk, skim milk, or the reconstituted versions of these ingredients may be used alone or in combination, a pH of 4.6 or below, and must contain lactic acid-producing bacteria, *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*. This study tests three "On-The-Market" fermented food products (Kefir, yogurt smoothie, and low-fat yogurt) for viability and inhibition against common foodborne pathogens, *Escherichia coli* O157:H7 and *Salmonella typhimurium*, using the Kirby-Bauer disk-diffusion method on nutrient agar. The products were enumerated on MRS agar. The Kefir product claimed 12 live and active cultures at 25-30 billion CFU at the time it was manufactured. The yogurt smoothie product contained four different cultures, but no specific CFUs count. The low-fat yogurt product contained four cultures and no specified number of CFUs. Results suggest that the kefir product CUF claims were accurate as the shelf-life of opened "yogurt" products is 3-7 days. The smoothie and low-fat yogurt displayed similar viability. The kefir product displayed the highest inhibition against *E. Coli* O157:H7 and *S. typhimurium*. The smoothie and low-fat yogurt product displayed similar inhibition which was lower than the kefir product. The results indicate that products containing many cultures, in combination, may have better health benefits and the inhibition of pathogens.

Abstract # 111

Investigating the Antibacterial Effect of Essential Oils on Foodborne Pathogens

Emarald Culbreath, Aaron, and Laricca London
Mentor(s): Dr. Laricca London
Department of Biological Sciences

The rise in bacterial resistance to conventional antibiotics has created an urgent need for alternative treatment strategies. Increasing research efforts focus on discovering novel antimicrobial agents derived from natural sources, including bioactive plant compounds. In this context, essential oils have emerged as promising candidates due to their antimicrobial properties. Essential oils, derived from natural plant sources, have gained attention for their potential antibacterial properties. This study evaluates the antibacterial efficacy of various essential oil components against common foodborne pathogens, with a focus on *Escherichia coli* and *Pseudomonas aeruginosa*. Antimicrobial activity was assessed using in vitro methods, including agar disk diffusion and minimum inhibitory concentration (MIC) assays, with nutrient agar and Luria-Bertani (LB) agar used to support bacterial growth. Here, we report on the antibacterial efficacy of each essential oil compound including peppermint, rosemary, lemon, and lemongrass, which have demonstrated promising antimicrobial activity against foodborne pathogens. Peppermint oil, primarily composed of menthol, disrupts bacterial cell membranes and exhibits moderate antibacterial effects against both Gram-positive and Gram-negative bacteria, including *Escherichia*, leading to cell death. Rosemary oil, containing 1,8-cineole, also disrupts bacterial membranes and has shown activity against *Enterobacter, Proteus, Citrobacter, and Pseudomonas aeruginosa* species. Lemon oil, rich in limonene, has antimicrobial effects against *E. coli*, *Salmonella enterica* serovar *typhimurium*, and *S. aureus*. Similarly, lemongrass oil containing citral exhibits moderate antibacterial activity against Gram-negative bacteria, including *Pseudomonas aeruginosa*. These findings emphasize the potential of essential oils as natural antimicrobial agents for controlling foodborne pathogens, particularly *E. coli* and *Pseudomonas aeruginosa*. Their ability to inhibit bacterial growth highlights their potential application as natural preservatives in the food industry, offering an alternative to conventional antibiotics and chemical preservatives.

Abstract # 112

Microbial Profiling of Embedded Space Materials Using Whole Genome Sequencing

Oluwatosin Jaiye-Williams, Taniya Rainge, Tyhane Bedgood, and Tyesha L. Farmer, PhD
Mentor(s): Dr. Tyesha L. Farmer
Department of Biological Sciences

While microbial contamination on spacecraft surfaces has been extensively studied, the presence and persistence of microbial populations within embedded spacecraft materials remain largely unexplored. Understanding these microbial communities is crucial for planetary protection and the development of more effective sterilization protocols. This study investigated the microbial diversity within embedded materials used in spacecraft construction, applying whole genome sequencing to characterize their taxonomic composition and genomic adaptations. Microbial samples were extracted from various embedded materials, including polymers, composites, and metallic components, to assess contamination levels and microbial survival strategies. Using Illumina sequencing and bioinformatics analyses, we identified a range of bacterial species, with a notable prevalence of spore-forming Bacillus species and metabolically versatile *Pseudomonas* species. These taxa exhibit adaptations such as biofilm formation, desiccation resistance, and oxidative stress tolerance, which may facilitate long-term survival in harsh spacecraft

environments. The presence of viable microbial populations within embedded materials raises important considerations for planetary protection, as these microbes could evade conventional sterilization methods and persist during space missions. These findings underscore the need for expanded microbial monitoring efforts beyond surface contamination assessments and support the development of more comprehensive decontamination strategies.

Abstract # 113

Medium Composition Modulates Curcuminoid Toxicity in *Saccharomyces cerevisiae*

Khalea Avery, Tanesha Hatchett, Tyesha L. Farmer

Mentor(s): Dr. Tyesha L. Farmer
Department of Biological Sciences

Curcuminoids, a class of polyphenolic compounds found in the spice turmeric (*Curcuma longa*), have been widely studied for their biological activities, including antimicrobial and antioxidant properties. In this study, we investigated the effects of a curcuminoid mixture—containing curcumin, desmethoxycurcumin, and bisdemethoxycurcumin—on the growth of *Saccharomyces cerevisiae*, using the wild-type BY4741 strain and a fet3Δ deletion mutant lacking the high-affinity iron uptake ferroxidase Fet3p. The yeast strains were spotted on YPD and SC agar plates supplemented with curcuminoid mix concentrations ranging from 0 to 300 µg/mL. Results revealed that the control strain was resistant to curcuminoids on SC medium but showed sensitivity at ≥50 µg/mL on YPD. The fet3Δ mutant displayed similar sensitivity on YPD but exhibited hypersensitivity on SC, with growth inhibition occurring at just 10 µg/mL. The increased sensitivity of the fet3Δ strain in SC medium suggests that curcuminoids may disrupt iron homeostasis, either by chelating iron, interfering with iron transport, or exacerbating iron starvation stress. Alternatively, curcuminoids may induce oxidative stress, which becomes more pronounced under iron-limited conditions in SC medium. These findings align with our previous observations that individual curcuminoids have distinct effects on yeast growth: curcumin and desmethoxycurcumin exhibit toxicity, whereas bisdemethoxycurcumin does not affect growth. Future studies will investigate potential mechanisms for these results.

Abstract # 114

Evaluating the Toxicological Impact of Selenium Nanoparticles on Mobility in Caenorhabditis elegans.

Jean-Pierre Adelo, Lisa Dalrymple-McKitt, Armitra Jackson-Davis, Qunying Yuan
Judith Boateng, and Tyesha Farmer

Mentor(s): Dr. Tyesha L. Farmer
Department of Biological Sciences

Curcuminoids, a class of polyphenolic compounds found in the spice turmeric (*Curcuma longa*), have been widely studied for their biological activities, including antimicrobial and antioxidant properties. In this study, we investigated the effects of a curcuminoid mixture—containing curcumin, desmethoxycurcumin, and bisdemethoxycurcumin—on the growth of *Saccharomyces cerevisiae*, using the wild-type BY4741 strain and a fet3Δ deletion mutant lacking the high-affinity iron uptake ferroxidase Fet3p. The yeast strains were spotted on YPD and SC agar plates supplemented with curcuminoid mix concentrations ranging from 0 to 300 µg/mL. Results revealed that the control strain was resistant to curcuminoids on SC medium but showed sensitivity

at ≥50 µg/mL on YPD. The fet3Δ mutant displayed similar sensitivity on YPD but exhibited hypersensitivity on SC, with growth inhibition occurring at just 10 µg/mL. The increased sensitivity of the fet3Δ strain in SC medium suggests that curcuminoids may disrupt iron homeostasis, either by chelating iron, interfering with iron transport, or exacerbating iron starvation stress. Alternatively, curcuminoids may induce oxidative stress, which becomes more pronounced under iron-limited conditions in SC medium. These findings align with our previous observations that individual curcuminoids have distinct effects on yeast growth: curcumin and desmethoxycurcumin exhibit toxicity, whereas bisdemethoxycurcumin does not affect growth. Future studies will investigate potential mechanisms for these results.

Graduate

Abstract # 115

Analyzing the significance of Uromodulin Thr469Met mutation in kidney disease

Rupert England, De'Travean Williams, Kyra Comfort, and Dana Indihar
Mentor(s): Dr. Dana Indihar
Department of Biological Sciences
Human immunodeficiency virus 1 (HIV-1) Envelope (Env) protein binds host cell surface CD4 and a co-receptor to enter target immune cells during transmission. Previous research has shown that HIV-1 entry efficiency into host cells may vary depending on HIV-1 subtype. HIV-1 subtypes are genetically distinct lineages of the virus that vary in transmission efficiency and pathogenicity, and there are 10 HIV-1 subtypes that are currently recognized. The Env protein varies across subtypes, and it has been hypothesized that the efficiency of Env-mediated cell entry during HIV-1 transmission may impact the establishment of clinical HIV-1 infection. However, the Env protein structures from only 4 out of the 10 subtypes have been solved. There thus remains a significant gap in our understanding of subtype-specific HIV-1 Env-mediated entry mechanisms. The goal of this work was to characterize the dynamicomes (the structure, function, and evolution) of HIV-1 Env proteins from subtypes without solved protein structures. Using publicly available datasets and informatic tools, the hypothetical protein structures, homologies, and phylogenetic relationships of these Env proteins from subtypes without solved structures were generated and analyzed. We identified which Env proteins shared the greatest structural homologies, documented the proteins with the most significant inferred evolutionary relationships, and characterized the dynamic movement of the atoms within the Env proteins over time. Our findings from this work will elucidate our understanding of subtype-specific HIV-1 Env-mediated entry mechanisms.

Abstract # 116

Unlayering Black Identity in America: The Influence of History, Culture, and Lived Experiences on Individuals Pursuing STEM Career Paths

Carmella Goree and Jeanette Jones
Mentor(s): Dr. Jeanette Jones
Department of Biological Sciences

Black identity in America has been shaped by a complex interplay of historical, cultural, and systemic factors and evolving social dynamics. These factors have significantly influenced career choices, particularly in Science, Technology, Engineering, and Mathematics (STEM) fields, where

Black representation remains disproportionately low. The historical context of exclusion, segregation, and systemic racism has left a lasting imprint on the educational and professional pathways of Black individuals in STEM. These challenges were met with the resilience of Black Americans, whose enduring legacy has paved the way for success in fields that once sought to exclude them. This research examines how historical and contemporary influences, along with identity and lived experiences, shape Black individuals' engagement in STEM education and careers. By utilizing an intersectional approach, this research aims to uncover the complex layers of Black identity that influence career choices and pathways in STEM. Through a mixed-methods approach, this study explores the evolution of Black identity in relation to educational access, lived experiences, and the development of culturally affirming STEM initiatives. Qualitative data will be collected through interviews and surveys with Black STEM students, professionals, and educators, while case studies of successful programs will highlight effective strategies for fostering inclusion and supporting individuals to their path of success in the STEM disciplines. The findings will provide a deeper understanding of the barriers and supports needed to create more inclusive STEM environments that acknowledge and address the multifaceted realities of Black individuals in these fields. The outcomes of this research will serve as a resource for educators, policymakers, industry leaders, and community organizations committed to improving stem education and fostering a more inclusive STEM ecosystem.

Abstract # 117

The Impact of Assisted Reproductive Technology on Embryo Gene Regulation and Epigenetic Modifications

Raven Allen, and Ebony I. Weems-Oluremi

Mentor(s): Dr. Ebony I. Weems- Oluremi

Department of Biological Sciences

One and six individuals worldwide experience infertility. As a result, the rising prevalence of infertility cases is propelling the demand for assisted reproductive technology (ART). Artificial reproductive technology (ART) refers to a medical procedure designed to address and combat infertility issues ranging from genetics, medical, and or unexplained factors in order to achieve pregnancy for individuals and couples. ART has led to the birth of millions of children worldwide, but emerging evidence suggests ART procedures may induce alterations in gene expression and epigenetic modifications. This technology involves manipulating and handling eggs, sperm, and embryos in vitro to facilitate conception. The three most common artificial reproductive technologies techniques with successful rates are in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI), and cryopreservation of gametes or embryos. Egg and sperm donation & even surrogacy is also a huge part of the ART world. This alternative is mainly for those who can’t conceive or carry a pregnancy to term but offer a greater chance to parenthood. Studies have reported changes in DNA methylation, histone modifications, and transcriptomic profiles in Art conceived embryos compared to naturally conceived embryos. However, comprehensive data-driven studies that utilize large-scale datasets remain limited. This study aims to analyze publicly available datasets to identify key differences and potential health implications. Specifically, we analyzed RNA-seq, whole-genome bisulfite sequencing (WGBS), and chromatin immunoprecipitation sequencing (ChIP-seq) data from ART-conceived and naturally conceived embryos to identify differentially expressed genes (DEGs) and epigenetic modifications. We hypothesize that ART procedures cause changes in gene expression and DNA methylation,

increasing susceptibility of metabolic and cardiovascular disorders later in life. ART has revolutionized reproductive medicine despite every obstacle or challenge this technology has advanced the reproductive world making being a parent more accessible. The purpose of this study is to highlight, inform, & explore a comprehensive understanding of the latest innovations and challenges regarding the advancement of artificial reproductive technology and its impact on those facing infertility. By understanding the role of artificial reproductive technology in modern healthcare and potential future developments we can advance our knowledge on this novel groundbreaking technology.

ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Undergraduate

Abstract # 118

Real-Time Disaster Analysis Using NLP and Social Media

Solomon Agyire and Terry Miller
Mentor(s): Terry Miller
Department of Electrical Engineering and Computer Science
In this century where effective disaster management has become more urgent than ever, social media plays a critical role in sharing information during crises. Disaster management is key to saving lives and reducing the impact of crises. This research focuses on extracting, classifying, and analyzing tweets using Natural Language Processing techniques such as BERT-based text classification, Named Entity Recognition, and sentiment analysis. The system supports dynamic, real-time monitoring. The paper describes the methodology employed, including dataset preprocessing, model training, and the development of an interactive dashboard for disaster monitoring. The results demonstrate the system's ability to categorize disaster-related posts, assess their urgency, and pinpoint affected areas. A brief discussion is provided on how these findings can help local communities and the authorities respond more effectively during emergencies. Future work is recommended to incorporate data from additional social media platforms, such as Facebook and TikTok, and to integrate multimedia analysis using Convolutional Neural Networks for satellite images and videos. This research lays the foundation for enhancing disaster response systems through insights drawn from social media and satellite images.

Abstract # 119

Leveraging Artificial Intelligence for Detecting Zero-Day Attacks

Tapiwa Musinga and Ed Pearson
Mentor(s): Dr. Ed Pearson
Department of Electrical Engineering and Computer Science
Zero-day attacks present a serious challenge in cybersecurity because they're unpredictable and able to exploit unknown vulnerabilities before patches are available. As attack methodologies become more sophisticated, traditional detection systems often fail to provide
a robust defense. This research explores the application of Artificial Intelligence (AI) for detecting zero-day attacks by leveraging advanced anomaly detection techniques. Several AI-based methodologies were analyzed to measure how effective they are in identifying threats and mitigating their risks. Some of the methods include K-Means clustering, Isolation Forests, Long Short-Term Memory networks, Autoencoders, Reinforcement Learning, and Generative Adversarial Networks. The evaluation of these methods using criteria like efficiency, recall, accuracy, and precision is the main goal of this work. The methods are also compared based on

their strength in detecting anomalies within networks and systems. The results provide details of how AI models adapt to evolving attack patterns and highlight the potential of combining AI approaches to create more effective hybrid techniques. The results emphasize the importance of continuous learning and adaptation in AI-driven security models. The research paves the way for future advancements in AI-based cybersecurity defenses, ultimately contributing to more adaptive security systems.

Abstract # 120

Pressure Sensoring Device for Individuals with Paralysis

Kendra Minniefield, Opeyeoluwa Olanipekun, Tavionne Stigger, Nia Thompson, and Raziq Yaqub

Mentor(s): Dr. Raziq Yaqub

Department of Electrical Engineering and Computer Science

This project focuses on developing a pressure-sensing device to help prevent pressure sores (pressure ulcers), which commonly affect individuals with limited sensation, such as those with paralysis. These sores form when prolonged pressure restricts blood flow, leading to skin and tissue damage. If untreated, they can result in infections, chronic pain, and severe health complications. Traditional prevention methods, including repositioning, specialized cushions, and routine skin checks, are difficult to maintain without continuous assistance. To address these challenges, we propose a seat cushion embedded with pressure sensors that notify users or caregivers when sustained pressure reaches dangerous levels. Our design integrates load cell sensors within the cushion, connected to an Arduino microcontroller that processes pressure data. If excessive pressure is detected for a prolonged period, the system triggers an email alert, prompting position adjustment. Initially, we tested FlexiForce A201 sensors, which performed well in lab conditions but failed to provide reliable readings under distributed pressure in real world seating. Switching to load cells with a higher-pressure range significantly improved accuracy and consistency, making them more suitable for detecting harmful pressure levels. Although we are still in the building and testing phase, our goal is to include a functional prototype, documentation of the testing process, and a real time alertsystem. Designed to be affordable, compact, and user-friendly, this device promotes independence for individuals at risk of pressure sores. By continuously monitoring pressure and providing timely alerts, it enhances comfort, health, and quality of life. This project offers a practical solution for individuals with sensory loss, empowering them to manage their health more effectively while equipping caregivers with an additional tool to improve care and well-being.

Abstract #121

Efficient Real–time Video Processing on FPGA

Maya Bragg, John Brown IV, Woodrow Bullock IV, and Sita Kondamadugula

Mentor: Dr. Sita Kondamadugula

Department of Electrical Engineering and Computer Science

Video processing is integral to numerous fields such as healthcare, machine vision, broadcasting, and entertainment, requiring systems that deliver high performance, scalability, and energy efficiency. Field Programmable Gate Arrays (FPGAs) have been widely adopted in these applications due to their inherent flexibility and parallel processing capabilities. However, existing FPGA-based video processing systems often suffer from suboptimal hardware resource utilization,

resulting in increased device sizes, higher costs, and excessive power consumption. These inefficiencies pose significant challenges for industries requiring compact, cost-effective, and energy-efficient solutions. This project addresses these challenges by developing an optimized image and video processing system utilizing FPGAs. The design focuses on efficient hardware resource allocation while maintaining high processing performance and adaptability. Key methodologies include the implementation of hardware description language (HDL) for video processing blocks, integration of Video Graphics Array (VGA) interfaces, and application of optimization techniques to enhance performance and reduce gate usage. The project also leverages MATLAB Simulink for code generation and deployment on the ZYBO Zynq-7000 board, ensuring a streamlined and scalable approach. The findings demonstrate that targeted optimization techniques can significantly reduce FPGA resource utilization without compromising image and video quality. The developed system achieves a balance between hardware efficiency, processing speed, and flexibility, offering a cost-effective alternative to existing solutions. The prototype showcases real-time video processing capabilities while operating within a reduced device footprint and lower power budget. This work is critical for advancing video processing technologies by addressing the inefficiencies of current systems. The proposed solution not only lowers costs and energy consumption but also enhances system scalability and performance, providing significant benefits for applications across industries. By contributing to sustainable and efficient technology development, this project offers a blueprint for the future of video processing systems.

Abstract # 122

Blue Horizon

Brandon Ramadan, Da'Quandalon Daniel, Yana Dhamija, Riley Roberts, Oluwabukunmi Balogun, and Ed Pearson

Mentor(s): Dr. Ed Pearson

Department of Electrical Engineering and Computer Science

Access to clean water and sanitation is a fundamental human right, as outlined in United Nations Sustainable Development Goal 6. Despite progress, challenges persist in ensuring safe water sources globally. The Blue Horizon project proposes a solution leveraging AI and cybersecurity to enhance water quality monitoring, adaptation, and secure data transmission. The AI component integrates machine learning models with Internet of Things (IoT) sensors to continuously monitor key water quality parameters such as pH levels, turbidity, and impurities like lead or bacteria. AI predicts contamination trends by analyzing real-time data, enabling proactive intervention strategies to maintain water safety. Cybersecurity measures are crucial to safeguarding this sensitive data. Sensor data is encrypted using robust encryption protocols to prevent unauthorized access and cyberattacks. Furthermore, blockchain technology is employed to securely store and validate water quality records, ensuring data transparency, integrity, and traceability throughout its lifecycle. This integrated approach enhances the accuracy and timeliness of water quality assessments and establishes a resilient infrastructure against cybersecurity threats. The project aims to contribute significantly to achieving Sustainable Development Goal 6, advancing global efforts towards sustainable water management and public health improvement by addressing these challenges.

Abstract # 123

Design and Simulation of Microwave Subsystems

Darius Howlett, Letodric Jordan, Amber Jackson, Jaylan Hayes-Fain
Mentor(s): Dr. Shujun Yang
Department of Electrical Engineering and Computer Science

Our senior design project aims to create and simulate various microwave subsystems. Unlike low-frequency AC, where a single wire can carry the signal without changes in voltage and current along its length, microwave/RF signals behave differently. At frequencies above 1 GHz, the signal wavelength is similar to or smaller than the size of the circuit conductors. Therefore, these signals must be managed as traveling waves using transmission lines like coaxial cables and microstrips. This project involves designing and simulating microwave components such as microstrips, coplanar waveguides, and microstrip band stop filters, which operate on principles distinct from those of low-frequency AC circuits.

Abstract # 124

Fabrication of Nanostructured Molybdenum Disulfide (MoS2) Thin Film–Based Electronic Devices

Elton Mawire, Kevin Qian, Ibraheem Giwa, Fabian Sanchez, Elton Mawire, Sherwood Dong, Eric Smith, Qunying Yuan, and Zhigang Xiao
Mentor(s): Dr. Zhigang Xiao
Department of Electrical Engineering and Computer Science

We report the fabrication of molybdenum disulfide (MoS2) thin films–based electronic devices. Nanostructured molybdenum disulfide (MoS2) thin films were grown as the active semiconducting channel material for the fabrication of MoS2-based field-effect transistors using plasma-enhanced atomic layer deposition (ALD). MoS2–based electronic devices such as MoS2 field-effect transistors and inverters were fabricated with the ALD-grown MoS2 film using the clean room-based micro- and nano-fabrication techniques. Hydrogen sulfide (H2S) gas was used as the S source in the growth of molybdenum disulfide (MoS2) while molybdenum (V) chloride (MoCl5) powder was used as the Mo source. The MoS2 film and fabricated device wafer was annealed at high temperatures at 900 degrees Celsius for 8 min, The MoS2 film was analyzed by the high-resolution tunnel electron micrograph (HRTEM), scanning electron micrograph (SEM), X-ray photoelectron spectroscopy (XPS) analysis and Raman spectrum analysis, and the electrical property of the MoS2–based electronic devices was
measured using the semiconductor analyzer.
semiconductor analyzer.

SUMMARY
1. Nanostructured molybdenum disulfide (MoS2) thin films were using PE-ALD. The MoS2 film was analyzed by HRTEM, SEM, EDA, XPS), and Raman spectrum analysis. The composition of the ALD-grown MoS2 film has the ideal ratio of 1 (Mo) to 2 (S); The Raman measurement shows that the film has the E1 2g and A1g peaks corresponding to the in-plane and out-plane Mo-S bond vibration, and the HRTEM analysis shows that the MoS2 film has crystalline structures.
2. MoS2 field-effect transistors (FETs) and inverter were fabricated using the clean room-based microfabrication, and the fabricated devices were analyzed with SEM and TEM.

3. The current-voltage (IV) curves of fabricated MoS2 field-effect transistors and the transfer characteristics of the fabricated MoS2 Inverters were measured using a semiconductor analyzer. Excellent IV curves of FETs and transfer characteristics of inverter were demonstrated.

Abstract # 125

SMRT CMS

Dipin Dawadi and Yujian Fu
Mentor(s): Dr. Yujian Fu
Department of Electrical Engineering and Computer Science

This research focuses on developing a customized Course Management System (CMS) tailored for our university using Django. Unlike generic platforms like Blackboard, this system offers greater flexibility with features designed specifically for our school's needs. Key enhancements include analytics for tracking student performance and engagement, as well as research into seamless attendance tracking methods to improve efficiency. The goal is to create an intuitive, scalable, and user-friendly platform that enhances both teaching and learning experiences. By integrating these features, the CMS aims to streamline course management while addressing institution specific challenges in online education.

I am in the process of deploying the website. It's fairly slow right now.

Check it out here: https://smrt-cms.onrender.com

Abstract # 126

Design and Simulation of Microwave Subsystems

Darius Howlett, Letodric Jordan, Amber Jackson, and Shunjun Yang
Mentor(s): Dr. Shunjun Yang
Department of Electrical Engineering and Computer Science

Our senior design project aims to create and simulate various microwave subsystems. Unlike low-frequency AC, where a single wire can carry the signal without changes in voltage and current along its length, microwave/RF signals behave differently. At frequencies above 1 GHz, the signal wavelength is similar to or smaller than the size of the circuit conductors. Therefore, these signals must be managed as traveling waves using transmission lines like coaxial cables and microstrips. This project involves designing and simulating microwave components such as microstrips, coplanar waveguides, and microstrip bandstop filters, which operate on principles distinct from those of low-frequency AC circuits.

Abstract # 127

Smart Sensei: An AI-Powered Learning Assistant for Quality Education

Jackson Cooper, Chasity Harris, Cameron Mahand, and Ed Pearson

Mentor(s): Dr. Ed Pearson
Department of Electrical Engineering and Computer Science

Education is a fundamental right, yet many students lack access to quality learning resources, especially in underprivileged areas. To bridge this gap, we propose Smart Sensei, an AI-powered virtual tutor designed to provide personalized learning support in subjects like math, science, and programming. Smar Sensei leverages Artificial Intelligence (AI) to understand student queries, deliver tailored explanations, and recommend educational materials based on individual progress. To ensure a secure and safe learning environment, Smart Sensei incorporates essential cybersecurity features, including user authentication, encrypted communication, and data privacy protocols. By integrating AI-driven recommendations and real-time student assistance, our solution enhances accessibility, engagement, and inclusivity in education. Smart Sensei can be implemented as a chatbot, web application, or mobile app, making it accessible across different devices and learning platforms. The project aligns with United Nations Sustainable Development Goal #4 (Quality Education) by promoting inclusive and equitable learning opportunities for all. Our prototype will demonstrate how AI can revolutionize digital education while ensuring a secure, interactive, and effective learning experience for students worldwide.

Abstract # 128

Methane Leak Detection System

Ruvarashe Nyabando, John Adeyemo, Mauyon Wusu, Haroon Tabassum, and Raziq Yaqub

Mentor(s): Dr Raziq Yaqub

Department of Electrical Engineering and Computer Science

Gas leaks are common in natural gas pipelines, posing a challenge for companies invested in oil and natural gas operations. Natural gas leaks, primarily consisting of methane gas, pose a significant safety and environmental risk to the production and distribution of natural gas. Detecting methane leaks quickly and efficiently is crucial to avoiding fire hazards and reducing greenhouse gas emissions. While existing leak detection technologies, such as infrared absorption spectroscopy, gas imaging sensors, and Light Detection and Ranging (LIDAR), offer effective solutions, there is a growing demand for more precise and efficient detection methods. This research presents the development and testing of a drone-based methane leak detection system capable of real-time monitoring. The system integrates methane sensors with GPS mapping to enhance the accuracy and reliability of methane leak identification in industrial environments. This research will aid in more accurate and reliable mapping of methane leaks in an industrial environment, ultimately supporting safer and more sustainable industry operations.

Abstract # 129

AsthmaAssist: A Machine Learning approach to Smart Asthma Management using No2 concentration and Geographical data

Mauyon Wusu, Opeyeolowa Olanipekun, and Terry Miller

Mentor(s): Ms. Terry Miller

Department of Electrical Engineering and Computer Science

With the recent growth of industrialization and urbanization, air pollution has become a major societal issue, significantly affecting people with asthma. Nitrogen dioxide (NO_2), a significant air pollutant from vehicles and industrial activities, is linked to worsening asthma symptoms and increased emergency crises among asthma patients. This research presents AsthmaAssist, a smart mobile asthma management system that integrates a predictive model that uses NO_2 concentration with geographic data to provide real-time health recommendations for asthma patients. AsthmaAssist leverages two machine learning techniques, Binary Classification and Support Vector Regression (SVR), to predict asthma risk levels based on NO_2 concentration exposure. By combining air quality data with GPS location, AsthmaAssist delivers personalized alerts, recommends safe routes, and identifies nearby

pharmacies or medical facilities for inhaler access when an asthma patient is in crisis. This research focuses on integrating environmental data with machine learning to provide asthma patients with proactive decision-making and personalized asthma management tools.

Abstract # 130

Media Influence on AI Perception: A Sentiment Analysis of News Narratives

Thabo Ibrahim Traore and Terry Miller

Mentor(s): Ms. Terry Miller

Department of Electrical Engineering and Computer Science

Media portrayals of artificial intelligence (AI) influence public perception, policymaking, economic trends, and industry adoption. In this study, we utilize natural language processing (NLP) techniques to analyze news articles related to AI and classify sentiment trends, media bias, and technology-specific discourse over time. We labeled headlines neutral, mixed, optimistic, and fear-based (anxious, critical, fearful) through VADER sentiment analysis and explored their distribution in mainstream and technology-focused sources. Our dataset comprises thousands of AI-related headlines, categorized by sentiment polarity and classified into finance, manufacturing, healthcare, and education domains. Findings reveal that AI media coverage skews toward neutral and mixed sentiment, with sporadic surges in fear-based narratives, particularly in job-related discussions. We observe that industries like finance and manufacturing receive more negative AI sentiment, reflecting concerns over automation and workforce displacement. Additionally, mainstream media is more inclined toward fear-mongering headlines than tech-focused publications, which maintain a more balanced tone. A stacked sentiment analysis of top news sources highlights disparities, with Forbes and The Guardian showing more significant sentiment variability than TechCrunch or The Verge. These differences underscore how media ecosystems frame AI advancements, influencing public trust and regulatory responses. We propose targeted recommendations to foster more balanced AI narratives based on these insights. Strategies include responsible journalism guidelines, increased transparency in AI risk reporting, and interdisciplinary collaboration between policymakers, technologists, and media professionals. This study contributes to a more informed and responsible discourse on AI, mitigating the influence of hyperbolic reporting on public trust, market behavior, and policy decisions.

Abstract # 131

Fabrication and Analysis of 3D Printed Devices

Eshaunti Davis, Baraka Chimba, Destiny Dixon, Kylee Cambric and Chance Glenn

Mentor(s): Dr. Chance Glenn

Department of Electrical Engineering and Computer Science

In the modern era of wearable technology, real-time health monitoring has become increasingly important. This project explores the development of a temperature-sensing wearable device that can continuously measure an individual's body temperature, analyze real-time data, and provide alerts or significant changes that may indicate potential health concerns. The device, designed as either a wristband or a ring, aims to improve personal health tracking and assist in early medical intervention. To construct the device, 3D printing technology is leveraged to create a lightweight, durable, and customizable structure. The project delves into the principles of 3D printing, specifically focusing on Fused Deposition Modeling (FDM), which uses thermoplastic filament to form three-dimensional

objects layer by layer. Additionally, the material selection process is explored, incorporating a

proprietary graphene/graphite polymer mixture. This advanced material offers enhanced conductivity and durability, making it ideal for integrating temperature sensors within the wearable. The project also highlights key 3D printing methodologies, including Stereolithography (SLA) and Selective Laser Sintering (SLS), comparing their advantages in precision, speed, and material compatibility. By integrating innovative materials with cutting-edge manufacturing techniques, this STEM project not only demonstrates the practical application of 3D printing in healthcare but also emphasizes the potential of wearable devices in improving medical diagnostics and personal wellness monitoring. Through this initiative, students gain hands-on experience in engineering, material science, and biomedical technology while developing a functional prototype that aligns with the future of personalized healthcare.

Abstract #132

Machine Learning-Based Cyberattack Detection in IoT

Johnny Moore and Xiang Zhao

Mentor(s): Dr. Xiang Zhao

Department of Electrical Engineering and Computer Science

The rapid expansion of Internet of Things (IoT) devices has significantly transformed industries, smart cities, and daily life, but it has also exposed networks to a rising number of security threats. Cyberattacks on IoT devices can lead to data breaches, service disruptions, and, in some cases, severe physical damage to critical infrastructure. These vulnerabilities, coupled with the complex nature of IoT systems, have made ensuring their security a daunting challenge. Traditional security protocols often fail to address the dynamic and diverse threats targeting IoT networks, making automated anomaly detection crucial for real-time protection. This project explores the use of machine learning for identifying cyberattacks within IoT-based smart city applications. The approach involves the development of a Python program that loads a dataset containing labeled instances of benign and attack-related activities. The dataset is preprocessed and used to train a Random Forest classifier to differentiate between normal and malicious behaviors, where 0 represents benign activity and 1 denotes an attack. The classifier's ability to make accurate predictions is evaluated based on a series of tests, with a focus on its robustness in detecting various types of attacks. The results demonstrate that the Random Forest classifier effectively detects IoT cyberattacks, providing a scalable and efficient method for improving security in smart city infrastructures. This approach highlights the importance of integrating machine learning into IoT security frameworks, offering a proactive and automated solution to combat the growing threats to IoT networks. The research concludes that the adoption of advanced machine learning techniques is essential for securing IoT systems and preventing potential cyber threats in the future. In conclusion, leveraging machine learning enhances the security of IoT-based smart city applications by effectively detecting cyber threats. This study emphasizes the necessity of integrating AI-driven approaches to safeguard IoT ecosystems against evolving cyber risks.

Abstract # 133

Optimizing ACAT siRNA Delivery for Targeted Gene Silencing in Neurodegenerative Diseases

Jayden Boatwright, Osionela Ogiogwa, and Terry Miller

Mentor(s): Ms. Terry Miller

Department of Electrical Engineering and Computer Science

RNA interference (RNAi) is a set of pathways that inhibit gene expression in an organism. It can either encourage or silence gene activity. It is a phenomenon where small pieces of RNA can shut down protein translation by binding to the messenger RNAs (mRNAs) that code for those proteins. RNAi is a potential therapeutic approach for neurodegenerative diseases like Alzheimer's disease, Huntington's disease and Parkinson's disease. Small interfering RNA (siRNA) molecules can target specific genes, suppressing their expression and thereby affecting disease progression. In previous research, Acyl-coenzyme A cholesterol acyltransferase (ACAT), an enzyme responsible for breaking down fats, protein and also regulating cholesterol is used as an siRNA molecule by silencing specific gene expressions.

The purpose of this study is to discover how ACAT siRNA can be delivered effectively to target areas in the brain that codes for specific proteins related to these diseases across the blood-brain barrier (BBB) through lipid nanoparticles. In Parkinson's disease, ACAT siRNA targets VPS35 to reduce SNCA aggregation. In Huntington's disease, it gets to the HTT mutation through cholesterol metabolism. While in Alzheimer's disease, ACAT siRNA regulates APP mutation through lipid metabolism. The application of ACAT siRNA in neurodegenerative diseases shows the importance of RNAi-based therapies in targeting disease-specific pathways. Optimizing the potential of ACAT siRNA in treating neurodegenerative diseases shows its promise as a therapeutic intervention.

Abstract # 134

K.E.P App Quality Education: Learning for student benefit: AI-based Solutions to maintain quality education.

Trenton Moore-lee, Saron Dubale, Makiya Bunch, Taniya Rainge, and Ed Pearson
Mentor(s): Dr. Ed Pearson
Department of Electrical Engineering and Computer Science

There tends to be a pattern throughout the school system, that information is taught in a "one size fits all" fashion. This has proven to be both an inefficient way to teach and especially, a way to learn. Given that many individuals may learn differently through various methods such as learning visually, audibly, through reading/writing, or kinesthetically, the need for diversity in learning approaches has to improve and expand. Approximately, 55% of college students, in the U.S., are unaware of how to study and struggle to stay engaged or alert in class. In addition, the average adult has lost approximately 40% of the content they have learned, while only utilizing 37% in their day-to-day lives. This project aims to provide an easier and more accessible channel for individuals to get quality education and/or get the most knowledge out of their current educational system. To elaborate, this mobile application is to be utilized as a tool to determine the user's learning style, while also providing techniques that can help improve conceptual learning and retention of information. The results of this project have been determined through preliminary testing, showing that AI-driven learning techniques can positively impact content retention. When the application is fully implemented and deployed, a study will further evaluate its effectiveness through surveys of Alabama A&M students across various academic levels, majors, and age groups. This platform will be accessible to anyone seeking to enhance their learning experience, ultimately providing valuable insights for future improvements. Over time, it aims to contribute to a more effective education system by helping individuals retain critical knowledge and skills.

Abstract # 135

Careers in Your Inbox: Personalized Job Alerts via Automated Web Scraping

Asia Harris, John Adeyemo, and Terry Miller
Mentor(s): Ms. Terry Miller

Department of Electrical Engineering and Computer Science

In a saturated job market, the search for meaningful positions can be especially daunting for Historically Black College and University (HBCU) students pursuing technology roles. This project addresses that challenge by developing a two-stage automated pipeline to collect, curate, and deliver relevant job opportunities. In the first stage, Python-based web scraping tools including Selenium, were employed to navigate dynamic websites such as LinkedIn and Indeed. We defined target job categories, handled complex interactions like pagination and scrolling, and extracted pertinent information (titles, companies, locations) into a structured CSV. An automated email system, smtplib, was then implemented to regularly disseminate these consolidated listings to HBCU students, minimizing the time and effort spent on repetitive job searches. The second stage focused on building a mobile application that seamlessly integrates the curated job data. By leveraging user profiles, the app delivers personalized job recommendations and enables interactive features for timely updates. Additionally, this research explored the strategies websites use to resist scraping, most notably the frequent updating of CSS classes, to inform more robust scraping methodologies. Results demonstrate the feasibility of end-to-end automation for technology-focused job searches. The scraper reliably handles both static and dynamic content, while the integrated email and mobile app framework ensures relevant opportunities are promptly accessible to students. Future work will refine recommendation algorithms, enhance platform compatibility, and investigate emerging counter-scraping techniques to sustain data integrity. This automated approach promises to ease the job search burden and empower HBCU technology students to focus on professional development rather than manual listings.

Abstract # 135

Careers in Your Inbox: Personalized Job Alerts via Automated Web Scraping

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integrity. This automated approach promises to ease the job search burden and empower HBCU technology students to focus on professional development rather than manual listings.

Abstract # 136

Audible Climbing Holds

Lauren Williams, Timothy Turney, Adreona Whittington, and Raziq Yaqub

Mentor(s): Dr. Raziq Yaqub
Department of Electrical Engineering and Computer Science
People with visual impairments face many challenges in their daily lives, especially when it comes to physical activities. Not being able to see well or at all can make it difficult to participate in sports like biking or baseball, limiting their ability to explore new hobbies. These challenges are not just physical but can also lead to feelings of isolation and loneliness due to reduced social interaction. Many individuals with visual impairments struggle to find activities that are both enjoyable and accessible. This project was created to make rock climbing more inclusive by helping visually impaired climbers navigate routes independently while feeling confident and engaged in the sport. To achieve this, we developed an assistive technology system specifically designed to improve accessibility in adaptive sports. At the core of this project is a Python-based program running on a Raspberry Pi, which powers a text-to-speech interface. A climber wears an RFID reader on their wrist that scans RFID tags placed along the climbing route. As they ascend, the system provides real-time audio feedback, informing them of their position and guiding them to their next move. The program also generates a modular record of the climb, allowing routes to be reviewed, analyzed, and stored for future use and improvement. By addressing some of the key obstacles visually impaired climbers face, this project aims to enhance accessibility, increase safety, and foster a more inclusive environment for adaptive athletes. The goal is not just to make rock climbing possible for those with visual impairments but to ensure it is a fulfilling, rewarding, and life-changing experience. Through advancements in technology, we hope to create new opportunities that empower individuals with disabilities to participate in activities they may have never thought possible. This innovation represents a significant step toward a more inclusive future in adaptive sports.

Abstract # 137

Development of AI Agent for Audio Classification

Gabrielle Wade, Marcus Hooks, Tremonti Lattimore, Antoine McNeail-Grace, Kaveh Heidary, and Raziq Yaqub

Mentor(s): Dr. Kaveh Heidary and Dr. Raziq Yaqub
Department of Electrical Engineering and Computer Science
Speech recognition is crucial in a variety of applications like assistive technologies, telecommunications, and security systems. However, accurate identification of spoken phonetic alphabets and digits is difficult due to inconsistencies in pronunciation, accents, and speaking styles. This kind of variability can significantly influence the performance of AI-based speech classification systems, and therefore there is a requirement for robust solutions that account for various styles of speech. The aim of this project is to design an AI-driven speech recognition system capable of classifying phonetic alphabets and numbers from a wide range of speakers efficiently with high accuracy. To achieve this, we are developing a heterogeneous dataset by taking speech samples of 60 adult volunteers divided evenly by gender. Each volunteer will utter 36 words 20 times to cater to variations in pitch, inflection, and pronunciation. The data captured will be preprocessed and labelled

for supervised machine learning training. Sophisticated speech processing, such as feature extraction through Mel-Frequency Cepstral Coefficients (MFCCs) and deep learning architectures such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), will be used to enhance classification performance. Initial results indicate that feature extraction and model architecture optimization can be used to improve the accuracy of recognition without compromising computational efficiency. The project is also included in the effort to develop more precise speech recognition systems to resolve real-world problems in phonetic and numeric classification. As AI-powered speech processing is improved, the study can be used to advance voice-controlled applications and communications systems in various industries.

Abstract #138

System Design for VLSI ASIC Chip Test

Nehemiah Edison, Brandon Fleming, Jaylon Fraser, and Zhigana Xiao
Mentor(s): Dr. Zhigang Xiao
Department of Electrical Engineering and Computer Science

The objective of this project is to design and build a test system for testing very large-scale integration (VLSI) application-specific integrated circuit (ASIC) chips. Our research project will use an amplifier which is the fundamental component of all electrical engineering to accomplish this feat by making printed circuit boards (PCB) to test the projects from the EE350 VLSI Design and Test I class. We will make an operation amplifier circuit board and characterize it to measure the operation amplifier difference from the ideal amplifier. Our goal is to understand everything we have learned in our engineering courses and apply them in this project creating a 2 Stage Complementary Metal Oxide Semiconductor Operation Amplifier which we will use to get our results. One of the many things this op-amp circuit is good for is because of its relative closeness to the ideal amplifier which enables applications in feedback. With this feedback we receive from the op-amp, we can control errors which is invaluable to helping engineers approve many different applications. Also, we will build an 2 Stage Bipolar Junction Transistor Operational Amplifier to test the chip from EE-350, to see the difference between 2 Stage CMOS and 2 Stage BJT PCB's. This project has two outcome goals, one is to learn about all the real-world implications of Operation Amplifiers so we can become more effective electrical engineers. With this knowledge and understanding of Operational Amplifiers, we will be able to get jobs in the electrical engineering industry because in today's world, the semiconductor and chip industry is about to boom in America's economy. The last outcome of this project is to make us knowledgeable on Printed Circuit Board (PCB) Design through PCB, lab, and measurement experience. From there our advisors hopes that we as Alabama A&M students will spread our knowledge from this project to other upcoming engineers at the university and they will spread the knowledge to others after we have graduated from college to pursue other endeavors.

Abstract # 139

IOT Sensor For Methane Detection in an Apartment Complex

Sunday Ochigbo, Ogheneobukome Ejaife, Tatenda Joseph, Haroon Tabassum, and Raziq Yaqub
Mentor(s): Dr. Raziq Yaqub
Department of Electrical Engineering and Computer Science

Natural gas leaks present severe safety risks, contributing to fires, explosions, and harmful methane exposure. According to a 2018 report by the National Fire Protection Association (NFPA), U.S. fire departments respond to approximately 125,000 residential gas leaks annually. Given the urgency of

early detection, this research aims to develop an innovative, IoT-based methane detection system that not only identifies leaks in real time but also autonomously alerts both homeowners and emergency responders.

The system leverages strategically placed MQ-4 sensors to detect methane concentrations, transmitting signals to a microcontroller upon detection. Once a leak is identified, the system instantly notifies the homeowner via a mobile alert and simultaneously triggers an automated distress call to relevant authorities. This real-time response mechanism bridges the critical gap between sensor detection and emergency action, significantly reducing the likelihood of fatal accidents.

A key innovation of this project is its emphasis on sensor calibration and adaptability to environmental variations such as temperature, pressure, and ambient conditions. Additionally, by refining algorithmic thresholds, the system ensures accurate and dynamic responses to gas leaks, preventing false alarms while maximizing safety. Unlike conventional detectors, this solution is

uniquely designed for seamless user interaction, making it highly effective in apartment complexes where risks are amplified.

This research presents a groundbreaking approach to domestic gas leak prevention, merging IoT technology with real-time communication to mitigate disasters. By integrating precise detection with swift emergency response, this project has the potential to revolutionize residential safety and significantly reduce casualties caused by methane leaks.

Abstract # 140
Plastic Reducers

Jordan Fleming, Evette Wherry, Jordan Wren, Tyson Wren, and Raymond Egson, and Ed Pearson
Mentor(s): Dr. Ed Pearson
Department of Electrical Engineering and Computer Science

Plastic waste is a major environmental concern, and many people are unaware of their personal contribution to recycling efforts. Plastic Reducers is an innovative approach for tracking and quantifying individual contributions to plastic recycling. Our technology offers users real-time information about how much plastic they have recycled, what products can be manufactured from it, and how much more is required for sustainable production. Our project is aligned with various UN Sustainable Development Goals (SDGs), promoting responsible consumerism (Goal 12), supporting sustainable cities and communities (Goal 11), and contributing to climate action (Goal 13) through plastic waste reduction. Furthermore, our project contributes to the protection of life below water (Goal 14) and life on land (Goal 15) by reducing plastic pollution in natural habitats.

We hope to stimulate community recycling by installing Plastic Reducers in high-traffic areas. Our solution promotes environmental awareness and economic progress (Goal 8) through sustainable practices. This project aims to build a cleaner, more sustainable future by providing individuals with the knowledge and resources they need to make a real difference.

Abstract # 141
Analysis of Net-Zero Buildings for Green Construction

Jayden Head and Tamara Chowdhury
Mentor(s): Dr. Tamara Chowdhury
Department of Electrical Engineering and Computer Science

Buildings have a significant impact on energy use and the environment. Commercial and residential buildings use almost 40% of the primary energy and approximately 70% of the electricity in USA. Net-Zero Energy Building, NZEB significantly reduces the requirement of operational energy. In such

buildings, efficiency gains have been made such that the balance of the energy needs can be compensated by renewable technologies. A net zero energy buildings (NZEB) produces as much heat and electricity as it consumes on an annual basis. The energy performance of an NZEB can be defined in several ways. Different definitions may be appropriate, depending on the project goals and the values of the design team and building owner. Four commonly used methods are Net-Zero Site Energy, Net-Zero Source Energy, Net-Zero Energy Costs, and Net-Zero Energy Emissions. Each definition uses the grid for net use and has different applicable renewable energy (RE) sources.

Net-Zero Site Energy: Energy produced by Renewable Energy Sources in a year on a particular site is enough to consume to produce NZEB.

Net-Zero Source Energy: A source NZEB produces or purchases at least as much Renewable Energy RE it uses in one whole year. Source energy refers to the primary energy used to extract, process, generate, and deliver the energy to the site.

Net-Zero Energy Costs: The total cost for NZEB, is the amount of energy/money the building owner exports to the grid, generated by the RE at the site of the building, should be equal to the amount, the owner pays the utility for the energy services and used energy over the year.

Net-Zero Emissions: A net-zero emissions building produces or purchases enough emissions-free RE to balance emissions from all energy used in the building annually. Carbon, nitrogen oxides, and sulfur oxides are common emissions that NZEBs balance.

Abstract # 142

Video Processing on FPGAs

Goodwill Kwenda and Jaylan Hayes-Fain
Mentor(s): Dr. Sita Kondamadugula
Department of Electrical Engineering and Computer Science

Field-Programmable Gate Arrays (FPGAs) provide an efficient platform for real-time video processing due to their parallelism, low latency, and reconfigurability. This research explores video processing on the Zybo Z7: Zynq-7000 board, focusing on capturing, processing, and displaying video from an external camera module. The project establishes a real-time video passthrough system before implementing mean and median filtering to reduce noise and improve video quality. The design integrates AXI4-Stream to Video Out IP for video output, Direct Memory Access (DMA) for optimized data transfer, and synchronization logic for stable frame processing. Real-time filtering is implemented using hardware-efficient techniques such as line buffers and Multiply-Accumulate (MAC) units within custom VHDL/Verilog modules. A finite state machine (FSM) efficiently manages data flow between video input, processing, and display. The FPGA’s parallel processing capabilities allow for low-latency operation, making it well-suited for real-time applications. Preliminary performance analysis indicates that the FPGA-based approach offers significantly lower latency and higher efficiency compared to software-based implementations. This research highlights the potential of hardware-accelerated video processing in applications such as embedded systems, surveillance, and medical imaging. Future enhancements include integrating more advanced techniques such as edge detection, object tracking, motion detection, and deep learning-based

inference for intelligent video processing.

Abstract # 143

Bulldog Supply

Zantasia Baldwin, Aniah Cosby, Joseph Johnson, Samya Whiteside

Mentor(s): Dr. Ed Pearson

Department of Electrical Engineering and Computer Science

Hunger remains a critical global issue. The UN Sustainable Development Goal 2: Zero Hunger aims to end hunger and improve food security by 2030. Millions still face hunger, with challenges like climate change and population growth making it harder to address. The goal is to ensure everyone has access to enough nutritious food.

Our Project: Bulldog Supply is an AI-powered website that predicts food shortages and helps distribute food where it's needed most. By analyzing factors like population and supply chain data, the website helps ensure food is delivered efficiently, reducing waste and improving food security. This website supports the Zero Hunger goal by helping communities get the food they need. It also uses cybersecurity measures to keep data safe, ensuring trust in the system. Bulldog Supply helps local governments and food organizations efficiently fight hunger and improve food access.

Abstract # 144

Design, Fabrication, and Characterization of Thermoelectric Devices from Bi2Te3/Sb2Te3 Thin Films

Essence Carter, Cole Cooper, Kristen Harris, Zaria Weeks Ibraheem Giwa, Zhigang Xiao, and Satlimis Budak

Mentor(s): Dr. Satilmis Budak
Department of Electrical Engineering and Computer Science

Thermoelectric devices are energy conversion devices that convert heat difference to electricity. One of the advantages of the thermoelectric devices is not having moving parts. Thermoelectric devices have two types; thermoelectric generators (TEG) working with Seebeck Effect, and thermoelectric cooling devices (TEC) working with Peltier Effect. The efficiency of the thermoelectric devices is given with the figure of merit, ZT. ZT values of the devices are quite low and this project aims to improve the efficiency and performance of integrated thermoelectric devices. To fabricate integrated thermoelectric (TE) devices with the nano-layered super-lattice thin films using the standard semiconductor microfabrication. The following steps were performed: Initial growths on Bi2Te3 and Sb2Te3, and Bi2Te3/Sb2Te3 thin films for characterizations. The team was trained on the characterization instruments including thin film thickness measurement, thermal treatment furnace, four probe van der Pauw measurement system for resistivity, mobility, density, sheet resistance, Hall effects and type of carrier measurements. Students are being trained on the other techniques related to the fabrication and characterization procedures. The characterizations have been performed on the thin film samples. The results will be shared during the STEM Day 2025 meeting."

Abstract # 145

Horizontal Axis Wind Turbines (HAWT)

Corion Holloman, Isaiah Thompson, Tyra Ravenell, and Destiny Brand

Mentor(s): Dr. Showkat Chowdhury

Department of Electrical Engineering and Computer Science
Wind energy is a clean, renewable power source that harnesses the kinetic energy of moving air, which is (incoming wind), to generate electricity. Among the various wind turbine designs, the horizontal-axis wind turbine (HAWT) is the most widely used due to its efficiency and adaptability. HAWTs feature blades that rotate around a horizontal shaft, capturing wind energy and converting it into mechanical power, which is then transformed into electricity. This technology plays a crucial role in reducing dependence on fossil fuels, which contribute to environmental degradation, greenhouse gas emissions, and resource depletion. Compared to fossil fuels, wind energy is sustainable, produces no direct emissions, and relies on an abundant natural resource. However, while fossil fuels provide a consistent and high-density energy supply, they come at the cost of pollution and long-term environmental harm. HAWTs, on the other hand, depend on wind availability, making energy output variable but significantly cleaner, and cheaper.

Abstract # 145

Sentinel

Jordyn Johnson, Roy Stallworth, Rudaruis Anthony, Terrence Bagget, and Dewayne Maye
Mentor(s): Dr. Yujian Fu and Dr. Ed Pearson
Department of Electrical Engineering and Computer Science

Facial recognition technology has become an essential component of modern security systems, enhancing access control mechanisms with automated and intelligent verification processes. This project integrates a Facial Recognition Access Control System with the XGO Mini2 Quadruped Robot Dog, creating a mobile and interactive security solution.

The system utilizes a camera module attached to the XGO Mini2 to capture real-time facial data, which is processed using an AI-driven facial recognition model developed with OpenCV and deep learning frameworks. Authorized individuals are identified from a pre-trained dataset, granting them access through predefined robotic responses such as movement gestures or auditory feedback. In contrast, unrecognized or unauthorized individuals trigger security alerts, prompting the robot to deny access or notify administrators.

To enhance security, the project incorporates liveness detection to prevent spoofing attacks, data encryption for storing facial embeddings, and real-time logging to monitor access attempts. The system is designed to be adaptive and scalable, making it suitable for deployment in controlled environments such as offices, laboratories, and restricted facilities.

This project demonstrates the potential of cyber-physical security systems by combining AI-driven facial recognition with robotic mobility, paving the way for innovative advancements in autonomous access control solutions.

Abstract # 146

“Travel Safe” Public Wi-Fi Security app designed for travelers

Rachel Harris and Raziq Yaqub

Mentor(s): Dr. Dr. Raziq Yaqub
Department of Electrical Engineering and Computer Science
Public Wi-Fi networks are essential for travelers, enabling access to navigation, communication,

and travel resources in airports, hotels, and cafes. Yet, these networks are prone to security risks,

including data breaches and cyberattacks that threaten sensitive information. To counter this, we introduce "Traveler's Wi-Fi Bubble with Safe Spot Finder," an innovative feature in our "TravelSafe" Public Wi-Fi Security app designed to protect travelers on Android and iOS. Unlike traditional VPNs that focus solely on encryption, this feature offers a dual approach: it detects risky Wi-Fi networks and provides a user-friendly "safety bubble" indicator green for safe, yellow for protected, and red for risky while suggesting nearby secure Wi-Fi alternatives. Developed with Flutter for cross-platform efficiency, "TravelSafe" simplifies security with a visual toggle that activates protective measures, requiring no technical expertise. Its standout "Safe Spot Finder" uses location data currently a curated list, with future crowdsourcing potential to recommend trusted spots like cafes or libraries with encrypted Wi-Fi, addressing both digital and physical travel needs. For instance, a traveler on a risky airport network might be guided to a nearby secure coffee shop. This blend of proactive protection and solutions sets it apart from existing tools, which rarely consider a traveler's context" Traveler's Wi-Fi Bubble" redefines mobile security for modern nomads, merging intuitive design with real-world utility. By empowering users to stay connected safely, it transforms a common vulnerability into a travel-enhancing feature. "TravelSafe" is here to help, making it easier to tackle a common problem while traveling in a simple and user-friendly way.

Abstract # 147

Energy Consumption — Analyzing and Predicting Usage in Alabama

Taniya Rainge, Ruvarashe Nyabando, and Terry Miller

Mentor(s): Ms. Terry Miller

Department of Electrical Engineering and Computer Science

The increasing energy consumption poses a significant threat to our environment, energy infrastructure, and economic stability. As energy is a key component of our everyday lives, its consumption rate can often be overlooked or underestimated. Each state has its own ranking of energy consumption, with Alabama ranking 7th highest among the 50 states. Notably, the industrial sector accounts for approximately 44.1% of this energy consumption.

The aim of this project is to analyze the patterns of energy consumption in Alabama's industrial sector and predict future consumption rates. This analysis will assist companies in lowering or conserving energy usage. Additionally, it will provide insights into future energy demands, offering more efficient strategies to minimize environmental impact, improve and maintain energy infrastructure, and enhance planning for clean energy initiatives.

Using data from sources such as the Energy Information Administration (EIA) and other relevant sources, the program will employ machine learning techniques to generate predictive insights. Applications such as Jupyter Notebook, along with the Python programming language and its libraries, will be utilized for program development. The expected results of this project indicate an increase in energy consumption within Alabama's industrial sector.

Abstract # 148

AI-Powered Deciphering of Medical Images: A Deep Learning Approach

Amarachi Ezekiel and Michael Ayokunmi

Mentor(s): Dr. Michael Ayokunmi
Department of Electrical Engineering and Computer Science

Medical image analysis plays a critical role in disease diagnosis, but challenges such as misinterpretation and a shortage of specialists hinder accurate and timely diagnosis. Recent advancements in artificial intelligence (AI) offer promising solutions for automating medical image analysis. This research explores the application of deep learning models to decipher medical images, similar to how AI classifies handwritten digits in the MNIST dataset. The study investigates the effectiveness of convolutional neural networks (CNNs) in identifying abnormalities in medical scans such as X-rays, MRIs, and CT scans. A dataset of labeled medical images is used to train and evaluate the model. Performance metrics such as accuracy, precision, recall, and F1-score are employed to assess the system's effectiveness compared to traditional diagnostic methods. Existing literature highlights AI's potential in radiology and pathology, but concerns remain regarding reliability, bias, and interpretability. This research aims to address these issues by optimizing model architecture, incorporating explainability techniques, and evaluating real-world applicability. Experimental results demonstrate that AI models can achieve high diagnostic accuracy, potentially reducing human error and assisting healthcare professionals in decision-making. The findings of this study contribute to the growing field of AI in medical imaging by providing insights into model performance, challenges, and future enhancements. Further work will explore hybrid AI-human collaboration and real-time deployment in clinical settings. This research underscores the transformative potential of AI in medical diagnostics, paving the way for improved patient outcomes and healthcare efficiency.

Abstract # 149

Statistical Database for Composite Panel Testing

Jaiden Green

Mentor(s): Dr. Showkat Chowdhury
Department of Electrical Engineering and Computer Science

The Statistical Database for Composite Panel Testing aims to create a centralized database for composite panel test data. Upon completion, the database estimates future composite panel test data using current test data. The composite panels were split into two groups: aluminum honeycomb (AHC) and foam core (FC). The two groups were further broken into Half Power (154dB) and Full Power (157dB) tests. Half-power and full-power tests were divided into weight groups consisting of no weights one or two weights added to the test article. The composite

Abstract # 150

Variable Multilayer Insulation Project

Kermit Booker

Mentor(s): Dr. Showkat Chowdhury
Department of Electrical Engineering and Computer Science

The Variable Multiple Layer Insulation Project at NASA MSFC is a passive thermal control technology that uses an optimization analysis to vary its effective emissivity and turndown ratio.

Traditionally, the purpose of a multilayer insulation (MLI) blanket is to limit the amount of radiative heat transfer through multiple layers of spacer materials. The VMLI takes a different approach by acting as both an insulative material and a non-insulative material. The VMLI's objective is to take mylar perforated sheets and set them together. When the perforated sheet's holes are aligned, the layers act non-insulative, allowing more radiative heat transfer. When the perforated sheet's holes are misaligned, the layers act as a traditional MLI, limiting the flow of radiative heat transfer. The project's objective is to achieve effective emissivity values ranging from 0.01 to 0.001, with a turndown ratio of 10. Experimental testing will be conducted in a vacuum chamber to evaluate performance and validate this innovative thermal management approach.

Abstract # 151
Mass Mitigation Project (MMP)

Wesley Cotton and Showkat Chowdhury

Mentor(s): Dr. Showkat Chowdhury
Department of Electrical Engineering and Computer Science
The Mass Mitigation Project (MMP) sets out to reduce the structural mass of spacecrafts by utilizing the dynamic strength of materials. Traditionally when components are analyzed or tested the loads, they experience are considered to be static loads. While this approach works, and it time effective, it is a conservative approach that can lead to spacecrafts being far heavier than they need to be. The goal of the MMP is to discover a new approach to analysis and testing that takes into consideration that materials behave differently under dynamic conditions then they do statically. From 2011 to present day test have been conducted in order to prove the merit of this project, and these tests led to two observations that formed the key ideas behind MMP. The first idea is the relationship between strain and frequency. Test Conducted in 2019 showed that while under a static load plastic deformation occurred once tip of the cantilever deflected an inch. However, an near identical cantilever was able to experience ±6 inches of displacement without any plastic deformation occurring. The second idea is that materials can withstand a higher dynamic load than it can statically. The same test used in 2019 showed that plastic deformation occurs at 80lbs, however in 2020 it was proven that a near identical cantilever was able to withstand 320 pounds while being excited to 40Hz. The physics behind MMP has been proven, and further test have been conducted on welds, and fasteners in order to prove this idea affects variables when it comes to structural mass. Further analysis and tests on flight components are being conducted in order to show just how far this idea can be taken.

Abstract # 152

The Fraudulent Fingerprint: Developing a Dynamic Scam Detection System Through Machine Learning and Network Analysis

Daniel Lambo and Ed Pearson

Mentor(s): Dr. Ed Pearson

Department of Electrical Engineering and Computer Science

Phishing remains a pervasive threat, with malicious emails accounting for a significant portion of data breaches. This research demonstration presents an advanced email scanner that harnesses machine learning and real-time API checks to proactively identify and mitigate phishing attempts. By integrating the Hunter.io API to detect suspicious email addresses, the VirusTotal API to scan embedded links, and a Random Forest Classifier (achieving 93.1% accuracy) to analyze message content, the system offers robust, multi-layered protection. Through this combined approach, users receive real-time alerts about potentially harmful emails, empowering them to safeguard sensitive information. Future enhancements include refined sentiment analysis to detect manipulative language, contextual awareness of sender-recipient relationships, and user-friendly browser extensions. This work underscores the potential of research-driven solutions to address the evolving nature of cyber threats, illustrating how practical tools and informed strategies can significantly reduce email-based attacks and bolster overall digital security.

Abstract # 153

The Smart Learning System

Zizwe Mtonga, Olayiwola Ajibode, and Yujian Fu

Mentor(s): Dr. Yujian Fu

Department of Electrical Engineering and Computer Science

In tertiary institutions, one of the leading causes of poor performance and failing grades among students can be attributed to knowledge gaps and lack of understanding of basic course concepts. According to the National Research Council, "Learning is cumulative and relies on students' ability to draw on prior knowledge. Misunderstandings or missing prerequisite knowledge can create barriers to new learning" (National Research Council, 2012). To address this problem, we are developing a Smart Learning System, a front-end platform to support reinforcement learning-based personalized learning recommendations. This system will enhance student comprehension, facilitate large-scale data collection, and provide statistical analysis and visualization of learning outcomes. The Smart Learning System will accomplish this by performing the following main functions: 1) Allowing students to take tests and quizzes similar to conventional university testing platforms; 2) Grading work with pre-set answers, such as multiple-choice or short-answer questions, while also enabling instructors to grade work that requires manual assessment; 3) Utilizing Machine learning-driven performance analysis, generating a dynamic knowledge score to identify learning gaps.; 4) Personalized learning recommendations, guiding students through adaptive learning pathways based on assessment data 5) Data-driven statistical analysis & visualization, offering insights into learning trends for students and faculty. Already developed technical features include a PHP based front-end framework with an interactive user interface and automated testing & grading for multiple-choice, short-answer, and coding-based questions. As a result, this project will contribute to improving university graduation rates. The Smart Learning System will enhance the quality of education and reduce dropout rates by providing students with a structured study and improvement plan and a comprehensive test-taking experience, preventing them from becoming overwhelmed by failed assignments or tests.

This collaborative research is supported by the NSF IUSE program and INSPIRE program.

Abstract # 154

Embedded Systems and Robotics: From Microcontrollers to Intelligent Machines

Mercy Akinyemi and Yuijan Fu

Mentor(s): Dr. Yujian Fu

Department of Electrical Engineering and Computer Science

Embedded systems serve as the backbone of modern robotics, enabling efficient control of modern robotics and automation. A research project explores the STM32F407VGT6 Discovery Board, a powerful ARM Cortex-M4-based microcontroller, to understand its architecture, peripherals, and role in embedded applications. Through hands-on experimentation and embedded C programming, the study delves into how microcontrollers process inputs, execute real-time computations, and control external hardware components. This project is supported by INSPIRE research. Another research focuses on programming the Robotis Bioloid Premium, a modular humanoid robot, to achieve autonomous movement and interactive behavior with the R+ software. The robot's CM-530 controller serves as the central processing unit, handling real-time execution of motion algorithms and sensor feedback. A key aspect of this project is understanding the communication between the CM-530 and the Dynamixel actuators, which operate through a daisy-chained TTL serial communication protocol. By implementing structured motor commands and feedback mechanisms, precise motion control and coordinated movements can be achieved. Additionally, the Bioloid integrates sensors such as gyros for balance detection and infrared sensors for obstacle avoidance. These sensors play a crucial role in environmental perception, allowing the robot to make data-driven adjustments during movement. Along with programming, the project emphasizes system design and coordination of tasks to ensure an efficient workflow, with milestones that ensure the system functions effectively. This study bridges theoretical understanding with real-world applications, demonstrating how embedded programming enables intelligent robotic systems. This project is supported by the NSF EiR project.

Abstract # 155

Enhancing Autonomous Navigation in Zumi Robot through Machine Vision and Infrared Sensing

Emily Omezi and Yujian Fu

Mentor(s): Dr. Yujian Fu

Department of Electrical Engineering and Computer Science

Autonomous robots utilizing artificial intelligence (AI) techniques have gained increasing importance in areas ranging from transportation to education. This project focuses on enhancing the Zumi car's ability to simulate real-world driving scenarios by achieving two primary objectives: (1)training a machine learning model using Zumi's camera input to recognize standard traffic signal colors (red, yellow, green)—to assess the necessary actions correctly, and (2) employing Zumi's infrared (IR) sensors for path recognition during road testing. This will be done by using some of its' pre-defined programs. The first objective involves designing and implementing a machine vision algorithm to enable accurate traffic signal detection and response. For the second objective, We utilize the IR sensors to identify and track pre-defined paths, improving Zumi's navigation accuracy and obstacle detection. This will be done by using Zümi's

camera to detect and follow lines on a path. Together, these efforts aim to elevate Zumi's capabilities in autonomous navigation, providing a hands-on platform for students and researchers to explore concepts in robotics, machine learning, and AI. This work demonstrates a cost-effective and accessible approach to teaching core concepts in robotics and AI through hands-on experimentation with autonomous systems.

Abstract # 156

Enhancing Object Detection and Motion Planning in the XGO Mini Quadruped Robot

Jada Haley and Yujian Fu

Mentor(s): Dr. Yujian Fu

Department of Electrical Engineering and Computer Science

The XGO Mini robot is a quadruped robot dog. This project explores two core areas: improving the robot's object detection capabilities and optimizing motion planning in real-world environments. Using XGO's built-in AI for object detection, I encountered limitations such as hazy imagery and reduced detectability for certain colors, which hindered the robot's accuracy. By researching several AI models and cameras, I will explore these challenges and identify potential refinements to the robot for future models. Motion planning required extensive experimentation, as the robot's wide range of movement involved accounting for each servo's position and speed in the XYZ plane. By studying pre-established functions, I tailored the robot's motion to navigate complex environments effectively. While exploring the stride lengths, I discovered inconsistencies in the distance traveled. Extending the execution time of the move function results in a nonlinear increase in distance traveled. This inconsistency in the distance per second suggests that timing and internal motion functions may require calibration. I used iterative learning to examine the AI and coordinate motion planning in order to bridge the information gap between the preprogrammed functions and the real-life execution of the code. This research highlights the importance of iterative testing and fine-tuning in real-world robotics. The insights gained can support future developers in understanding XGO Mini's control systems and reducing the trial-and-error phase in programming complex behaviors.

Graduate

Abstract # 157

A User Interface For Seismic Monitoring of Underground Hydrogen Storage

William Seawright, Jake Parsons, Neala Creasy, Muhammad Mehana, Shaowen Mao, and Ziang Zhao

Mentor(s): Dr. Xiang Zhao

Department of Electrical Engineering and Computer Science

Academic advising has been found to be highly beneficial for college students. The ability to ensure accurate college degree progression, transition assistance, and professional assistance with academic challenges are some vital roles that academic advising has provided over the years, leading to better college trajectories for students and higher graduation rates. However, the quality of academic advising in colleges has been significantly affected by several factors, including

unrealistic student-to-advisor ratios. To address this problem, the main aim of this project is to develop a platform that increases the quality of academic advising in institutions by reducing the workload placed on advisors per student. This Smart Academic Advisor web application will accomplish this task by performing the following four functions: 1) Providing continuous advising based on Performance monitoring, 2) Checking if Prerequisite courses have been completed successfully before new courses are advised, 3) Running course enrollment possibilities with database of university rules, including maximum and minimum credit hours per semester, course availability per semester, Credit hours required for graduation, and Major Concentration Track requirements, and 4) Generating recommended students' schedules for the upcoming semester based on the current course completion. As a result, this project will significantly drive students' success toward graduation, reduce advisors' workload, increase continuous advising, and increase accurate advising, thereby increasing graduation rates and reducing rates of delayed graduation. Overall, this project will increase the institutions' academic advising quality.

NATURAL RESOURCES AND ENVIRONMENTAL SCIENCES

Undergraduate

Abstract # 157

Effects of Low-Temperature Plasma on Seed Germination of Two Microgreen Crops

Payton Edwards, Sravan Kumar Sanathanam, and Srinivasa Mentreddy
Mentor(s): Dr. Srinivasa Mentreddy
Department of Natural Resources and Environmental Science

Low-temperature plasma (LTP), a partially ionized gas with unbound electrons, ions, ultraviolet light, and reactive oxygen and nitrogen species, is emerging as a non-chemical tool for breaking seed dormancy, hastening seed germination, and improving crop growth, among other uses. Microgreens are immature seedlings grown from grains, vegetables, and herbs with notably higher nutrient levels than mature seeds. However, uneven seedling establishment due to poor germination because of seed dormancy or disease is a significant challenge for microgreen production. This research aimed to assess LTP gas type and time of exposure for improving seed germination using two microgreen crop species. The seeds of fenugreek (Trigonella foenum-graecum) and kale (Brassica oleracea var sabellica) were treated with argon gas LTP for 30 and 60 seconds, and helium gas LTP for 60 and 90 seconds; untreated seeds served as Control. The LTP operating conditions were voltage at 7kV, 1.50 standard liters per minute flow rate, and 1 microsecond pulse width. The treated and untreated seeds were grown in Petri dishes @ 25 seeds/dish and watered with deionized water. The daily seed germination was recorded until it ceased. The seeds exposed to LTP germinated earlier than the Control. Argon and helium LTP for 60 seconds and He LTP for 90 seconds increased fenugreek's initial germination percentage (IGP) by 18.8%, 25.3%, and 13.2% over the Control, respectively. Argon or He LTP did not influence seed germination in kale. All LTP treatments except Ar for 30 seconds in fenugreek increased the final germination percentage

(FGP). In kale, Ar LTP for 30 seconds and He LTP for 60 seconds increased the FGP. In this experiment, LTP had variable effects on seed germination parameters, indicating the need to assess the interaction of LTP source gas and exposure time on seed germination of a greater range of seed germination.

Abstract # 158

Impact of Climate Variability on Pathogen Persistence and water quality in the Indian Creek Watershed

Jalen Whisenhunt, Ajani Brooks, Dr. Elica Moss
Mentor(s): Dr. Elica Moss
Department of Natural Resources and Environmental Science

Water pollution is a critical issue with significant implications for biodiversity, human health, and the economy. Water quality in the State of Alabama is of great concern due to population migration as industries move into the state and agricultural lands are irrigated to increase production. This could further exacerbate the State's polluted surface waters, thus limiting their usefulness to humans and ecological systems. Studies have shown that E. coli numbers vary significantly by season, with the highest concentrations typically occurring during the warmer summer months due to optimal growth conditions at higher temperatures, implying that E. coli populations are larger in summer than in winter. To better monitor and protect the water quality of waterways, we use water quality standards to monitor impaired and improved waterways. This includes monitoring physiochemical parameters such as pH, Dissolved Oxygen (DO), turbidity, temperature, and specific conductivity, which may serve as indicators of the presence of fecal indicator bacteria, (Escherichia coli, Enterococcus faecalis, and Pseudomonas aeruginosa) and threaten overall health of the water system. This study evaluates the water quality of the upper and lower Indian Creek Watershed in the Tennessee River Basin which is listed on the EPA's §303d list for impaired waterbodies, specifically for pathogens. The sources of the impairment are collection system failures, pasture grazing, and urban runoff/storm sewers. Results indicated that the concentration of physiochemical parameters as well as seasonal climatic factors had significant impacts on the presence of E. coli, E. faecalis, and P. aeruginosa, which were enumerated using the IDEXX method. This analysis contributes to studies conducted by the Alabama Department of Environmental Management and provides more insight into understanding the prevalence and persistence of pathogens in the Indian Creek Watershed.

Abstract # 159

Examining the Relationship Between Income Disparities, Housing Market Dynamics, and Homelessness in Census Tracts within Los Angeles City

Annabeth Defoe, Heather Howell, and William Stone
Mentor(s): Dr. William Stone
Department of Natural Resources and Environmental Sciences

A survey of the insects from three ecotypes (agriculture, grassland, and forest) was conducted over a span of ten days at the Winfred Thomas Agricultural Station (WTARS) in Hazel Green, Al. during June of 2024. Samples were obtained both using Malaise traps and sweep (butterfly) nets for comparison. The three habitats consisted of a regularly mowed, warm-season grassland, an agricultural cornfield and a pine stand. The sweep nets were utilized once per site with one hundred passes swept through the air and across vegetation at sunset. The insects gathered from each collection were identified using a field guide and then diversity was calculated using the Shannon

Weiner Diversity Index to determine the species diversity each habitat contained. The results of this study demonstrated that forests contained the highest value of diversity with second highest in the cornfield and finally, the lowest diversity in the grassland. Monitoring human impact on biodiversity is critical for determining the effectiveness of conservation policy and management strategies. The decline of insect's effect ecosystems to a great extent because of their use as food for many animal species. They can also be significant pests and are indicators of change to overall biodiversity.

Abstract # 160

Revitalizing Rural Alabama: A Study on Brownfield Remediation and Redevelopment in North Alabama

Karter-Alexander Woods, William Garrett, Keyshawn Johnson, and Elica Moss

Mentor(s): Dr. Elica Moss

Department of Natural Resources and Environmental Sciences

Many rural areas in Alabama have prime land available for redevelopment, however many of these sites are Brownfields, which are former industrial or commercial sites that may be contaminated due to past uses. It remains unknown how having such locations redeveloped could impact the economic and environmental health of the area. This study serves as an initial investigation into Brownfield remediation and redevelopment in the context of rural Alabama, with an emphasis on North Alabama. This cross-state study utilized Alabama Department of Environmental Management (ADEM) Remediation strategies and data, along with community visionings to guide our analyses. Windshield surveys were also utilized to investigate potential locations. The suggested remediations and redevelopments are guided by the suggestions of local stakeholders and standard environmental planning frameworks. Findings indicate that there are several locations in the state of Alabama that can be categorized as a Brownfield, with North Alabama cities, such as Scottsboro, having as many as 15 within the urban area. The findings also indicate that there is a need and want by local stakeholders to improve upon these locations through focused planning. The findings call for the development of a statewide Brownfield Inventory, similar to the county level booklets currently in development through ADEM. As well as calling for reinvestment into these rural areas.

Abstract # 161

Assessing the Relationship Between Tree Age, Size, and Spatial Distribution in the Amazon Rainforest

Qawiy Jooda, Oluwatimileyin Ogundele, and Daniela Granato De Souza
Mentor(s): Dr. Daniela Granato De Souza
Department of Natural Resources and Environmental Sciences

Understanding the interactions and dynamics of tree growth and spatial distribution is pivotal for advancing ecological knowledge and informing forest management strategies. This research investigates the relationship between tree age and size (DBH), as well as the spatial distribution of trees within a closed-canopy Amazon rainforest. Data from 47 tree samples were analyzed, revealing a moderate positive correlation between age and size ($r = 0.377$), suggesting that growth rates are influenced by localized environmental conditions rather than a uniform trend. The spatial analysis demonstrated distinct clustering of younger trees in areas likely associated with regeneration events, while older trees exhibited a more dispersed pattern, possibly reflecting long-term stability or competitive pressures. These findings shed light on the complex relationship of growth dynamics and spatial distribution within tropical forests, offering valuable insights for

conservation and sustainable forest management.

Abstract # 162

The Effects of Loblolly Pines on Tree Biodiversity

Tanner Herring and Dr. Shaik Hossain
Mentor(s): Dr. Shaik Hossain
Department of Natural Resources and Environmental Sciences

This research presents how loblolly pine trees can potentially be toxic to other tree species, particularly in municipal areas such as parks and playgrounds due to their competitive nature in relation to sunlight. A local park was analyzed for loblolly pine concentration and characteristics by measuring growth, basal area, and the stand's light level. These measurements allow the basis of understanding for sunlight competition among plant species. The analysis shows the amount of light level at the forest floor and therefore how available light is to new tree species or saplings. The results show that loblolly pine trees utilize and block large amounts of light, not allowing much to reach shorter tree species. This study suggests that if a high level of biodiversity is wanted in recreational areas, loblolly pine trees are not helpful as they can overtop other trees and the competition limits biodiversity. Future research could evaluate how to keep loblolly pines from growing to full height and outcompeting other species for natural resources.

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Abstract # 163

Identifying and characterizing aluminum-responsive genes in tolerant and sensitive soybean lines

Robert Carr, Asima Bibi, Sowmya G. Kommireddypally, Sravan K. Sanathanam, and Venkateswara R. Sripathi
Mentor(s): Dr. Venkateswara R. Sripathi
Department of Natural Resources and Environmental Sciences

Academic advising has been found to be highly beneficial for college students. The ability to ensure accurate college degree progression, transition assistance, and professional assistance with academic challenges are some vital roles that academic advising has provided over the years, leading to better college trajectories for students and higher graduation rates. However, the quality of academic advising in colleges has been significantly affected by several factors, including unrealistic student-to-advisor ratios. To address this problem, the main aim of this project is to develop a platform that increases the quality of academic advising in institutions

by reducing the workload placed on advisors per student. This Smart Academic Advisor web application will accomplish this task by performing the following four functions: 1) Providing continuous advising based on Performance monitoring, 2) Checking if Prerequisite courses have been completed successfully before new courses are advised, 3) Running course enrollment possibilities with database of university rules, including maximum and minimum credit hours per semester, course availability per semester, Credit hours required for graduation, and Major Concentration Track requirements, and 4) Generating recommended students' schedules for the upcoming semester based on the current course completion. As a result, this project will significantly drive students' success toward graduation, reduce advisors' workload, increase continuous advising, and increase accurate advising, thereby increasing graduation rates and reducing rates of delayed graduation. Overall, this project will increase the institutions' academic advising quality.

Graduate

Abstract # 164

Genetic and Phenotypic Understanding of Stem Quality and Leaf Abscission in *Miscanthus*

Joshua Stanley, Pradeepa Hirannaiah, Therese Mitros, Wren Jenkins, Jer'Michael Nix, Dr. Xianyan Kuang, Jesse Morrison, Charis Harrison, Kerrie Barry, Chris Plott, Jerry Jenkins, Jeremy Schmutz, Jane Grimwood, Ernst Cebert, Brian S. Baldwin, Erik J. Sacks, Daniel S. Rokhsar, and Kankshita Swaminathan

Mentor(s): Dr. Xianyan Kuang

Department of Natural Resources and Environmental Sciences

The study of stem quality traits and leaf abscission is essential to improve new selections of *Miscanthus*, a relatively new biomass crop for bioenergy and bio-product manufacturing. *Miscanthus* is a broadly adapted C4 perennial grass. *M.sinensis* varieties are commonly used as an ornamental in gardens. The commercially grown Miscanthus is an excellent lignocellulosic feedstock and is typically an interspecific hybrid between *M.sinensis* and *M.sacchariflorus* (*Miscanthus x giganteus*). At the time of harvesting, *Miscanthus* biomass consists of stems and leaves; however, the industry prefers a higher stem-to-leaf ratio. A higher ratio contributes to more fiber and less ash. In addition, a high stem-to-leaf ratio means that the chemicals for deconstructing are not used up by the leaf biomass, decreasing the amount of chemicals needed for the same quantity of useful end product. As a result, leaf abscission is essential, in addition to several stem quality traits. We will use *Miscanthus* populations that are segregating for these traits to identify genetic loci contributing to these phenotypes. We will also use comparative genomics to compare these regions to what is known in other grasses.

Abstract # 165

Innovative Farming Techniques for Superior Okra Yield in Chitwan, Nepal: The Benefits of Plastic Film Mulch and Pest Exclusion Net on Soil Properties, Growth, Quality and Profitability

Prashna Budhathoki, Swastika Chauhan, Bikas Basnet, Shree Krishna Adhikari, Arjun Kumar Shrestha, Srinivasa Rao Mentreddy, and Dedrick Davis

Mentor(s): Dr. Srinivasa Rao Mentreddy, Dr. Dedrick Davis

Department of Natural Resources and Environmental Sciences

Okra (Abelmoschus esculentus) is a nutritious, commercial fruit vegetable crop in tropical and subtropical regions in Nepal. Modified growing conditions through pest exclusion nets (PEN) and types of mulch on okra might be effective techniques to enhance yield and marketable production. Research is performed to investigate the effects of PEN and plastic film on the performance and yield of okra. An experiment laid out single factorial randomized complete block design with four replications and five treatments consists of: a) Control (No net + no mulch), b) Organic mulch (Rice straw mulch), c) Black plastic mulch, d) Silver plastic mulch, e) Pest exclusion net + black plastic mulch; on Swastik-2 F1 variety. The data were analyzed R software at the ($p \leq 0.05$) level

of significance and mean comparison is done using (Dunken Multiple Range Test) DMRT. This study revealed that silver plastic mulch and black plastic mulch treatment statistically resulted in pars & significantly higher yield (30.74 and 29.39 mt ha^{-1}), leaf number/plant (27.98 and 26.73), branch number/plant (5 all), fruit number/plant (33 & 29) and the lowest days to flowering (39 & 40 days) compared to control; while PEN+black plastic mulching treatment resulted in higher plant height (212.93 cm), stem diameter (2.54 cm), fruit length (18.26 cm), fruit diameter (1.73 cm), fruit weight (32.80 g), longest days to flowering (43 days) and lowest leaf number per plant (15.58), branches/plant (4), yield (20.4 mt ha^{-1}), light intensity (110.32 lx) which is undesirable yield perspectives but insect pest population is significantly lower in PEN results superior quality than other treatmets. Black plastic films and PEN+ black mulch raise soil temperature (max 34.89 ◦C) and increase soil moisture (18.15% vol) during germination. Plant inside PEN +black plastic mulching received low light intensity had higher vegetative growth but found with low yield. Plants in control and straw mulch treatments were found to have low vegetative growth and yield (22.7 and 24.4 tons/ha). Farmers can use silver and Black plastic plastics mulch, which are economically more viable and Productive as compared to other treatments for commercial cultivation of okra.

Abstract # 166

Evapotranspiration Estimates using Satellite Remote Sensing Data

Bikash Ghimire and Ranjani Kulawardhana

Mentor(s): Dr. Ranjani Kulawardhana

Department of Natural Resources and Environmental Sciences

Evapotranspiration (ET) is the process by which water is transferred to the atmosphere from soil, vegetation, and other surfaces. It is an essential phenomenon to understand water balance, irrigation efficiency, and climate interactions. In the past, lysimeters and eddy covariance systems were used for ET measurement, however, these methods are costly, labor-intensive, and limited in spatial coverage. This study uses Surface Energy Balance Algorithm for Land (SEBAL) model to produce ET maps using Landsat 8 satellite data. Optical and thermal data necessary for calculating Land Surface Temperature (LST), net radiation, soil heat flux, sensible heat flux, and Latent heat flux are derived from the Operational Land Imager (OLI), and Thermal Infrared Sensor (TIRS) of the Landsat satellite. These parameters are used to generate high-resolution ET maps, which will help in analyzing spatial variations in water loss, without requiring intensive ground-based data, making it cost-effective method for regional water resource assessment. In this study satellite remote sensing data from Landsat 8 was used to derive ET data at 30m spatial resolution to capture spatial variability in water loss across various land cover types over the North-East Alabama region. The resulting ET maps will quantify ET rates for various land cover types, including agriculture, deciduous and mixed forests, water, and urban areas. Findings of this work will help improve large-scale water resource management decisions, advance remote sensing-based ET monitoring, optimize irrigation techniques, evaluates crop water stress, and enhances regional water management to support sustainable water resource management in North-East Alabama by utilizing satellite data and energy balance modeling. Furthermore, the ET estimates will be verified from the nearby eddy covariance station for its reliability.

Key Words: Evapotranspiration, SEBAL, Landsat Data, North-East Alabama

Abstract # 167

Enhancing Canopy Tree Species Mapping in Dense Temperate Forests Using Aerial Hyperspectral Data and Machine Learning

Evan Tenorio, McKenzie Davis, Dr. Dawn Lemke

Mentor(s): Dr. Dawn Lemke

Department of Natural Resources and Environmental Sciences

Remote sensing of forest systems is inherently complex, as it involves a variety of variables that must be carefully considered. Understanding how forest conditions and classification methods influence data gathered from hyperspectral sensors is vital, particularly as the scientific community explores the correlation between different physiological traits and remote sensing data. This understanding is essential for refining remote sensing techniques and enhancing our knowledge of forest ecosystems and their broader environmental impacts. While a significant body of research has compared canopy tree mapping accuracies across various sensors, platforms, and algorithms, there is a gap in studies that explore the use of machine learning methods in conjunction with aerial hyperspectral data to predict and map canopy tree species in dense temperate forests, such as those in the southeastern United States. This study aims to apply machine learning techniques to predict and map tree species in the Paint Rock Forest Dynamic Plot, a 20-hectare censused deciduous forest plot. The plot includes detailed census data for tree species, diameter at breast height, and location for trees larger than 1 cm in diameter, which will serve as ground truth labels for evaluating the hyperspectral data. By integrating aerial hyperspectral with advanced machine learning algorithms, this research seeks to improve the accuracy and efficiency of tree species mapping in forest systems.

Abstract # 168

Factors Influencing the Natural Regeneration of Shortleaf Pine (Pinus echinata) in the Cumberland Plateau

Cory Null, Dr. Shaik Hossain

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The natural regeneration of shortleaf pine (Pinus echinata) is essential for maintaining biodiversity and forest sustainability in the southeastern United States. However, a >50% decline in regeneration over recent decades has threatened the species' long-term viability. This study examines key environmental factors influencing shortleaf pine regeneration, focusing on overstory density and climate variables within the Cumberland Plateau region. Initial data collection involved establishing 0.4-hectare plots at multiple sites to assess overstory composition and seedling density. Climate data from local weather stations were integrated with field measurements to evaluate their impact on regeneration success. Preliminary results indicated that moderate canopy openness (15–30%) and overstory densities below 80 ft^2/ac correlated with the highest seedling recruitment. Seedling counts varied significantly, with some plots exceeding 100 seedlings, while others exhibited minimal regeneration. Additionally, litter type and thickness

impacted seedling density, as pine-hardwood litter with thinner layers fostered greater recruitment. These findings contribute to sustaining this ecologically and economically valuable species by identifying optimal conditions for its natural recovery, with a particular focus on forests in Alabama and Tennessee. This study provides valuable insights into shortleaf pine restoration, offering guidance for conservation strategies and forest management techniques such as selective thinning to enhance regeneration.

Abstract # 169

Seasonal Growth Dynamics of Sugar Maple Using Automated Dendrometer Bands in Paint Rock, Alabama

Keshav Ghimire and Dawn Lemke

Mentor(s): Dr. Dawn Lemke

Department of Natural Resources and Environmental Sciences

Tree growth is a vital indicator of forest productivity and health. Understanding the precise growth of trees within a short frame of time compared to years can provide deeper insights into the mechanisms that shape stem growth patterns. Dendrometer measurements give a time series that captures the patterns of water storage fluctuations throughout the year and seasonal tree growth in trees. Sugar maple (Acer saccharum) is a shade-tolerant late successional species. It is increasingly encroaching into drier upland environments raising questions about its physiological plasticity and resilience to changing climatic conditions. This study aims to quantify the seasonal growth dynamics of sugar maple by utilizing high resolution dendrometer band measurements to monitor stem diameter fluctuations at an hourly scale. We used automated band dendrometers on six mature sugar maple trees from diverse micro sites in Paint rock forest dynamic plot for measurement. They were installed at 1.3 meters height to capture continuous stem growth patterns. Climate data from nearest weather station Scottsboro including temperature, and precipitation was obtained to assess their influence on growth. The data will be analyzed to see the difference between diurnal stem fluctuations driven by water storage dynamics and actual radial growth identifying critical growth phases and assessing the influence of climatic factors on stem expansion patterns. This will be achieved by applying different time scales and analytical approaches to dendrometer measurements allowing for a refined interpretation of growth onset and seasonal variability in sugar maple growth responses.

Keywords: sugar maple, dendrometer band, seasonal growth, climate, measurement

Abstract # 170

Validating Candidate R Genes and Transforming *Arachis hypogaea L.* for Aflatoxin Resistance

Elijah Nix, Sueme Ueno, Renan Souza, Walid Korani, Anthony Trieu, Kankshita Swaminathan, Josh Clevenger, and Xianyan Kuang

Mentor(s): Dr. Xianyan Kuang

Department of Natural Resources and Environmental Sciences

Peanut, *Arachis hypogaea*, is an essential crop for food production and economic development in certain parts of the world. In the U.S., the peanut crop is ranked as the seventh most valuable crop and heavily impacts many nations globally. Aflatoxin contamination, caused by fungi like *Aspergillus flavus*, is a significant problem for peanut production, processing, and

commercialization: exposure to aflatoxin can lead to illnesses in humans and cause stunted growth, liver disease, and poor immune system development. High levels of exposure can even cause cancer or death. Traditional breeding methods have proved challenging as *A. flavus* resistance is a multifactorial trait influenced by multiple genetic factors and the environment. Previous studies have identified QTL qPSIIB10 as a locus that confers some resistance to *A. flavus* contamination. By examining this locus in resistant and susceptible cultivars using comparative genomics tools we expect to uncover resistant (R) genes responsible for this trait. *Agrobacterium rhizogenes*-mediated transformation allows for the perturbation of gene expression and exploration of gene function. We will transform peanuts with *Agrobacterium rhizogenes* strain K599 to overexpress candidate genes in our locus of interest for conferring aflatoxin resistance. Finding methods to combat aflatoxin contamination is essential for human and animal health, ensuring the safe cultivation and consumption of peanuts.

Abstract # 171

Virus-Enabled Transformation and Gene Editing in C4 Grasses

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Mentor(s): Dr. Xianyan Kuang
Department of Natural Resources and Environmental Science

Many plants have inadequate gene function annotation due to the lack of experimental data for that specific species or even one closely related to it. Most functional annotations come from data in model systems, which are often only distantly related to the species of interest. The perennial panicoid grasses are a great example of this. This group of grasses consists of switchgrass, miscanthus, and sugarcane, which are important for sustainable bioenergy, bioproducts, and biomaterials. Plant transformation and gene editing are important tools that can make it possible to analyze gene function and genetics in your species of interest. However, commonly used plant transformation methods depend on tissue culture, which is technically challenging, has difficult-to-replicate protocols, is inefficient, has low throughput, and is genotype-dependent. *Panicum virgatum L*. is a high-performing C4 perennial grass biomass crop native to North America. Switchgrass is self-incompatible with varied ploidy levels, which makes breeding difficult. *Panicum hallii* is a perennial grass that is closely related to switchgrass but has a shorter generation time, self-fertilizing mating system, and moderate-sized genome, making it a great model for switchgrass. Thus, *P. hallii* is an excellent model for switchgrass to understand gene function and engineering genetic and metabolic pathways. To further this goal, I am working on developing traditional A*grobacterium*-mediated transformation as well as virus-enabled transformation and gene editing in *P. hallii*. I will increase transformation efficiency and editing ease and throughput by using plant viruses to deliver gRNAs as cargo into *P.hallii* lines that were previously transformed using agrobacterium to contain Cas9 or a Cas9-based Synthetic transcription factor. I will begin with genes that confer an easily detectable phenotype like the lemon white gene, Magnesium chelatase, or phytoene desaturase (PDS).

Abstract # 172

Assessment of Barley and Dry Bean Varieties for Optimizing Crop Rotation Systems in Northern Alabama

Andrion Erves, Kaitlyn Williams, Jeremy Schmutz, Xianyan Kunang, and Ernst Cebert

Mentor(s): Dr. Xianyan Kunang

Department of Natural Resources and Environmental Sciences

Crop rotation is a sustainable agricultural practice that enhances land use efficiency. This study presents a three-year evaluation of dry beans as a summer crop and barley as a winter crop in northern Alabama (34.90° N, 86.56° W, Hazel Green, AL). A randomized complete block design was employed to assess crop performance. For dry beans, we evaluated 45 black bean and 96 pinto bean varieties in 2021 based on yield, lodging, and maturity. In 2022, the selection was refined to 24 cultivars per bean type, and in 2023, the top 12 cultivars of each type were identified for further testing and potential scale-up production. For barley, we assessed 25 cultivars in the 2020–2021 season and 34 in 2021–2022, focusing on yield, winterkill, disease resistance, and maturity. Northern cultivars exhibited severe winterkill, whereas southern cultivars showed mild or no winter damage, underscoring the importance of cold tolerance in barley production for this region. The most promising barley cultivars for further scale-up and quality testing included Avalon, Marouetta, Secretariat, and Thoroughbred. Top-performing dry bean cultivars—Zorro, T-39, Bandit, and PR-0443-151—yielded between 782.45 and 822.22 pounds per acre. The findings from this three-year field study support the viability of a new rotational cropping system in northern Alabama, contributing to the diversification and sustainability of the region's agricultural sector.

To further evaluate trait variability and performance in both barley and dry bean crops, future analyses will include detailed statistical methods such as Principal Component Analysis (PCA), ANOVA (Analysis of Variance), and Duncan's Multiple Range Test. The findings from this three-year field study support the viability of a new rotational cropping system in northern Alabama, contributing to the diversification and sustainability of the region's agricultural sector.

Abstract # 173

Genetic and environmental factors impacting Flowering time of Hemp (*Cannabis sativa*)

Abiodun Adeniyi, Blake Long, Xinhua Xiao, Zach Stansell, and Xianyan Kuang

Mentor(s): Dr. Xianyan Kuang

Department of Natural Resources and Environmental Sciences

Hemp (*Cannabis sativa L.* < 0.03%THC) is a diverse agricultural crop significantly known for its fiber, seed, oil, and cannabinoid production. Flowering is an essential trait that influences yield and adaptation to different environmental conditions. Understanding the genetic and environmental factors impacting hemp flowering time is very important for agronomic practices, yield improvement, and providing a model to expand breeding and cultivation. In this work, 135 hemp accessions were grown in six different geographic locations (AAMU, PGRU, UC Davis, LSU, WSU, and OSU), and flowering time data was collected at each location for both male and female plants, in AAAMU and collaboration with other institutions. Female plants flowering day length ranges from 10.87 to 15.5, 85% flowers at 13 to 14 hours and typically flowering within 39 to 167 days after planting, with 60% flowering at 95 days after planting. In contrast, male plants' day length ranges from 10 to 14 hours with 80% of them flowering at 14.77 hours. the male peak

flowering period is between 74 to 81 days after planting. Interestingly, the data shows that Notably, 73 accessions displayed significant variation in flowering time (15% coefficient of variation or >20-day difference) within or across locations, suggesting the presence of subtypes. Weather and bioclimatic data were compiled to analyze their relationship with flowering time. Subtyping, correlation analysis, regression, and PCA will be conducted to quantify genetic and environmental contributions to flowering time variation. This work will allow identifying accessions of day-neutral and other flowering types suitable for different latitudes and growing seasons, providing a foundation for enhancing hemp production through precision breeding.

Abstract # 174

Genetic Mapping of Leaf Area Traits in Miscanthus and Sorghum, Two Closely Related Andropogonae Grasses

Friday Zakari, Xianyan Kuang, Xinhua Xiao, and Ernst Cebert

Mentor(s): Drs. Xianyan Kuang, Ernst Cebert

Department of Natural Resources and Environmental Sciences

Miscanthus is a promising bioenergy crop with great potential for producing bioenergy due to its impressive biomass yield and adaptability. However, while leaf morphological traits such as length, width, perimeter, and area are crucial for photosynthesis and biomass production, the genetic mechanism regulating traits in Miscanthus remains unknown. This study aims to address this gap by identifying the genes for these leaf traits using an interspecific F2 population and validating the finding using a genome-wide association study of diverse sorghum accessions. A well-established trial utilizing a randomized complete block design with 4 replicates was conducted for this population at the Winifred Thomas Agricultural Research Station in Hazel Green, AL, to collect phenotypic data. A non-destructive laser leaf area meter measured the largest fully extended leaf from 3 to 5 representative stems for each plot during the reproductive stage for late-flowering entries. The mean area, length, perimeter and width are 122.0 ± 34.4 cm^2, 67.4 ± 11.0 cm, 2.7 ± 0.5 cm and 138.5 ± 26.8 cm. The ranges for area, length, perimeter and width are 33.0-249.0 cm^2, 23.0-106.0 cm, 47.8-256.3 cm and 1.3-4.9 cm, respectively. Leaf perimeter showed strong positive correlations with leaf area (0.77) and length (0.79). Leaf area has the strongest correlation with length (0.94), indicating these two traits are highly interdependent. The preliminary phenotypic analyses revealed variations in leaf area, length, width, and perimeter across a diverse population, which is promising for further exploration of the data and genetic mapping. Genetic mapping will also be performed to link the phenotypic data with existing genomic information, including high-resolution SNP markers and resequencing data, to identify important genetic loci and candidate genes. GWAS will be conducted study of leaf area traits in sorghum as a comparative study for the QTLs and candidate genes identified in Miscanthus.

Abstract # 175

Evaluating the Effects of Cold Atmospheric Plasma on an Agricultural Soil Microbiome

Gianna Porter and Elica Moss

Mentor(s): Dr. Elica Moss

Department of Natural Resources and Environmental Sciences

As global populations rise and agriculture expands, crops are exposed more and more to pathogenic microorganisms that can lead to serious illness if ingested. Current soil decontamination methods, both chemical and physical, can be harmful to the soil microbiome. This can cause soil degradation and impair plant growth. However, atmospheric plasma, a relatively new treatment method in the field of agriculture, shows promising results in both amending contaminated soil and eliminating harmful bacteria. Efficient and environmentally safe, cold atmospheric plasma eliminates bacteria through a multitude of processes, most notable being the generation of reactive chemical species. The influence of these treatments on the overall soil microbiome is not well understood. In this study, soil samples were collected from the Winfred Thomas Agricultural Research Station and analyzed using next-generation sequencing (NGS) by Zymo Research Laboratory to determine absolute abundance, community composition and microbial diversity. The first trial evaluated the optimal duration of treatment using argon as the carrier gas. The second trial analyzed the effects of using helium and nitrogen as the carrier gas. Next, the third trial evaluated different soils with additives such as cow manure, chicken manure, and synthetic fertilizer that were then analyzed to determine their original microbiome and the resulting microbiome after cold atmospheric plasma sterilization. The results from these trials were compared to the original microbiome data collected previously. Findings from this study will offer valuable insight into the effects of atmospheric plasma treatment on the soil microbiome as well as advise potential strategies for optimizing treatments for specific agricultural needs.

Abstract # 176

Studying the Microbial Diversity Associated with Individual and Pooled Reniform Nematodes in Highly Infested Cotton Soils of North Alabama

Sowndarya Karapareddy, Leopold Nyochembeng, Lloyd Walker, Kathy Lawerence, and Venkateswara R. Sripathi

Mentor(s): Dr. Venkateswara R. Sripathi

Department of Natural Resources and Environmental Sciences

Reniform nematodes (*Rotylenchulus reniformis*) are a major soil-borne pest in cotton fields. Plant parasitic nematodes (PPNs) severely affect plant health and crop yield. This study evaluated the microbial diversity associated with the reniform nematode (RN) samples isolated from heavily infested soils. We analyzed the microbiomes of individual and pooled nematodes to assess the RN organism-specific microbiome. Also, we analyzed Optiprep-treated and Untreated Single and pooled nematodes to assess the cuticle-specific microbiome. Soil samples were collected at a depth of 15 cm near the root zone from cotton fields with an auger in Limestone County of North Alabama, which was morphometrically classified as Highl Infested with RN. Microbial DNA was extracted from six treatments: Highly Infested Reniform (HIR), Single Reniforms (SIRN), Single Reniform_Treated (SIRN_Treated), Pooled Reniforms (PIRN), Pooled Reniform_Treated (PIRN_Treated), and Reniform-Free Control (RNCR) using ZymoBIOMICS Kit, followed by amplicon sequencing (Illumina MiSeq) paired-end libraries of the 16S rRNA (V3-V4) and ITS2 genes. Microbial community analysis was carried out using phyloseq after sequencing. The results revealed >35,000 amplicon sequence variants (ASVs) and showed significant shifts in microbial diversity across the treatment groups. Specifically, the Single Reniforms and Single Reniform_Treated groups showed a higher prevalence of Proteobacteria, Firmicutes, Actinobacteria, Bacteroidetes, Acidobacteria, Deinococcus-Thermus, Cyanobacteria, and Chlorobi. In contrast, the Pooled Reniforms and Pooled Reniform_Treated groups exhibited a more consistent microbial composition, dominated by Proteobacteria, Firmicutes, Bacteroidetes, and Deinococcus-Thermus. The Highly Infested Reniform group displayed the highest abundance of Actinobacteria, Proteobacteria, Acidobacteria, Gemmatimonadetes, Nitrospirae, and Verrucomicrobia. The Reniform-Free Control group consisted primarily of Proteobacteria,

Firmicutes, and Actinobacteria. These findings indicate that microbial communities in cotton soils exhibit significant variability among reniform-infested soils, reniform-free controls, and OptiPrep-treated and untreated single and pooled RNs. Understanding RN organism-specific and cuticle-specific microbiomes offers valuable insights for more effective management of RNs in cotton fields.

Abstract # 177

Comparative Transcriptome Profiling of Salt Sensitive and Tolerant Cultivars of Soybean using RNA Sequencing

Asima Bibi, LaMont Croom, Dr. Srinivasa R. Mentreddy, Zachary Gossett, Dr. Venkateswara R. Sripathi

Mentor(s): Dr. Venkateswara R. Sripathi

Department of Natural Resources and Environmental Sciences
Soil salinity is a major agricultural stressor, affecting around 20% of irrigated lands worldwide and hindering crop growth and yield. Soybean (Glycine max) is an important food and oil source both in the U.S. and globally, but high soil salinity significantly reduces agricultural productivity. This study aims to elucidate the molecular mechanisms underlying salt tolerance through transcriptome analysis, employing RNA sequencing in two soybean genotypes: Lee 68 (salt-tolerant) and Dare (salt-sensitive). Soybean plants were cultivated under controlled conditions and subjected to three NaCl treatments (0 mM, 150 mM, and 300 mM). Leaf samples were collected at different time points (0 days after treatment, DAT; 7 DAT; and 14 DAT), with three biological replicates assigned to each treatment (R1, R2, R3), resulting in 54 RNA libraries. RNA sequencing was performed using the NextSeq 550 platform (Illumina), generating high-quality sequencing data comprising approximately 648 million reads. The quality reads were assembled after trimming and filtering, yielding high-quality (Q30) reads ≥92.35%. The DESeq2 analysis was performed to identify over 1,500 differentially expressed genes (DEGs) associated with salinity tolerance by comparing transcriptomes across the various treatments. Notably, around 300 DEGs were exclusively observed in the salt-tolerant Lee 68 genotype, indicating a genetic basis for enhanced stress resilience. Principal component analysis (PCA) and hierarchical clustering further illustrated distinct gene expression patterns across treatments. In the Lee 68 genotype, genes associated with ion transport, antioxidant responses, and osmotic balance were significantly upregulated. Conversely, stress-related pathways were markedly disrupted in the Dare genotype, underscoring its vulnerability to salinity stress. Plant hormones and various metabolic processes may be key to how soybeans respond to salt stress. These findings provide valuable insights into the genetic mechanisms that confer salt tolerance in soybeans, which may help breeding programs develop soybean genotypes with improved adaptability to saline conditions.

Abstract # 178

Identification and Characterization of Genes Associated with Salt Stress Tolerance in Cotton

Sowmya G. Kommireddypally, Dr. Sravan K. Sanathanam, Sowndarya Karapareddy, Govind C. Sharma, and Venkateswara R. Sripathi

Mentor(s): Dr. Venkateswara R. Sripathi

Department of Natural Resources and Environmental Sciences
Salt stress is a significant issue in agriculture, especially for *Gossypium hirsutum* (Upland cotton),

which is essential for global fiber production. High salinity from sodium chloride (NaCl) in soils negatively impacts growth, yield, and fiber quality. As soil salinity rises due to climate change and agricultural practices, studying molecular responses to salt stress is vital for breeding resilient cotton cultivars. Identifying key genes for salt tolerance is essential for developing stress-tolerant varieties, which is a priority for food security. This study aimed to identify key salt-tolerant genes by molecular screening with gene-specific primers and to identify differentially expressed genes (DEGs) using RNA-Seq by comparing transcriptomes of two contrasting cotton species. This study examines the responses of salt-tolerant and salt-sensitive cotton species exposed to NaCl concentrations of 0 mM (control), 150 mM, and 300 mM, with leaf samples collected at 0, 24, 48, and 72 hours after treatment with three replicates (2 contrasting species x 3 treatments x 4 collection time points x 3 replicates = 72). DNA/RNA was extracted from the leaves of treated and untreated 30-day-old seedlings and analyzed using PCR/qPCR with 43 primer pairs targeting stress-responsive genes. RNA-seq analysis included quality control, trimming, alignment, counting, normalization, differential gene expression (DGE) analysis, and functional enrichment analyses using GO, COG, and KEGG pathways. This study identified important genes that regulate osmotic pressure, ion balance, and protection against oxidative damage. It also identified key gene families linked to plant stress resistance, such as protein kinases, glutathione S-transferases, the CAZy family, and expansion proteins. Further, pathways related to salt tolerance, including carbon metabolism, glutathione metabolism, and amino acid biosynthesis, were identified. The findings from this study on salt-tolerant materials provide a crucial basis for identifying potential breeding parents for salt tolerance in cotton.

Abstract # 179

Functional Annotation and Meta-Analysis of Cotton Transcriptomes Reveal Key Genes and Pathways Involved in Abiotic Stresses

Sravan K. Sanathanam, Sowndarya Karapareddy, Sowmya G. Kommireddypally, Dr. Lloyd T. Walker, and Venkateswara R. Sripathi

Mentor(s): Dr. Venkateswara Sripathi

Department of Natural Resources and Environmental Sciences

Cotton (*Gossypium spp*.) is an important crop in tropical and subtropical regions, primarily grown for its natural textile fiber, which makes up 35% of global fiber production. All parts of the cotton plant, including seeds and lint, have economic importance. Cotton is cultivated in over 80 countries, with the U.S. being the second-largest producer after China. In 2024, cotton was produced on approximately 33.1 million hectares, yielding about 117 million bales, or an average of 770 kg/ha (~687 pounds/acre). Although the genotypes have been identified for heat, drought, and salt tolerance, their underlying mechanisms for tolerance are poorly understood. A detailed understanding of the mechanism and identification of critical factors participating in multiple abiotic stress tolerance is essential. In the present study, to identify key genes and pathways commonly triggered under multiple abiotic stresses (drought, salinity, heat, abscisic acid signaling, and pH changes), we analyzed RNA-Seq datasets publicly available. Most of the stress experiments included in the analyses used two contrasting (tolerant vs. sensitive) genotypes, two treatment (stressed and unstressed) conditions, collection time points (0, 24, 48, and 72 hours after treatment), and three biological replicates. This study identified the role of transcription factors (TFs) in regulating stress-responsive gene expression. A phylogenetic classification was conducted on key

stress-related genes, including TF families like MAPK, DREB, WRKY, NAC, bZIP, HSP, and MYB. Nucleotide and protein sequences were obtained from NCBI GenBank and CottonGen, followed by multiple sequence alignment and phylogenetic tree construction. The results showed distinct functional clustering and conservation of regulatory mechanisms across related species, including *Gossypium, Theobroma, Arabidopsis, Brassica,* and *Oryza*. Further, the genes associated with the stress pathways were functionally annotated and enriched using GO, KEGG, and COG. The findings suggest using these potential candidate genes and TFs to enhance abiotic stress resilience through genetic engineering and breeding.

Abstract # 180

The Impact of Biopolymer Amendments, Cork and Extracellular Polymeric Substances (EPS) on the Microbial Communities in Decatur Soils

Obaloluwa Soyinka, Sowndarya Karapareddy, Alexis K. Craft, Varsha C. Anche, Madhusudhana R. Janga, Seloame T. Nyaku, Dr. Zachary Senwo, and Venkateswara R. Sripathi

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Soil microbes play a crucial role in plant growth and development. Biopolymer amendments, such as cork and extracellular polymeric substances (EPS), may improve soil health but can affect soil DNA extraction and subsequent analysis. Thus, it is important to validate extraction methods before sequencing. This study evaluated 48 soil samples from Decatur, Alabama, subjected to four treatments: unamended soil (soil.control), soil with cork (soil.cork), soil with EPS (soil.EPS), and soil with both cork and EPS (soil.cork.EPS). Samples were collected at four time points (0, 24, 48, and 72 hours-after-treatment) with three biological replicates per treatment. We first measured various physicochemical properties of soils, including pH, salinity, electrical conductivity, organic matter content, and available nutrients such as carbon, nitrogen, phosphorus, and potassium. The FastDNA Spin kit was the most effective among the six tested DNA extraction methods. Microbial biodiversity was assessed by amplicon sequencing (Illumina/NextSeq) targeting the ITS region for fungi and the 16S rRNA for bacteria and archaea. The raw reads obtained were filtered and analyzed using Qiime2/PhyloSeq programs to identify 62,996 amplicon sequence variants (ASVs), with 513 and 467 ASVs commonly present across time points and treatments, respectively. The microbial community was primarily composed of Actinobacteria, Proteobacteria, and Acidobacteria, with Actinobacteria being the most abundant phylum. At the class level, Actinobacteria, Alphaproteobacteria, Bacilli, and Betaproteobacteria contributed to microbial diversity, while families such as Bacillaceae, Gaiellaceae, Micromonosporaceae, and Streptomycetaceae showed treatment-dependent variations. Core microbiome analysis identified Bacillus and Gaiella as dominant genera, playing key roles in soil ecosystem stability and nutrient cycling. These microbes contribute to carbon sequestration, nitrogen fixation, phosphorus solubilization, improving soil fertility, and plant-microbe interactions. These findings show how organic amendments affect microbial biodiversity and composition, impacting soil fertility and microbial ecosystem stability. These findings contribute to valuable information for enhancing soil quality and agricultural productivity.

Abstract # 181

Seasonal Growth Dynamics of Sugar Maple in Paint Rock, Alabama

Keshav Ghimire and Dawn Lemke

Mentor(s): Dr. Dawn Lemke

Department of Natural Resources and Environmental Sciences

Tree growth is an indicator of forest productivity and health. Understanding the precise growth of trees within a short frame of time compared to years can provide deeper insights into the mechanisms that shape stem growth patterns. Dendrometer measurements give a time series that captures the patterns of water storage fluctuations throughout the year and seasonal tree growth. Sugar maple (Acer saccharum) is a shade-tolerant late successional species. It is increasingly encroaching into drier upland environments raising questions about its physiological plasticity and resilience to changing climatic conditions. This study quantifies the seasonal growth dynamics of sugar maple by utilizing high-resolution dendrometer band measurements to monitor stem diameter fluctuations at an hourly scale. We used automated band dendrometers on six mature sugar maple trees from diverse micro sites in Paint Rock Forest Dynamic Plot. They were installed at 1.3 meters height to capture continuous stem growth patterns. Climate data from the nearest weather station, Scottsboro, was obtained to assess the influence of temperature and precipitation on growth. The data was analyzed to see the difference between diurnal stem fluctuations driven by water storage dynamics and actual radial growth identifying critical growth phases and assessing the influence of climatic factors on stem expansion patterns. This was achieved by applying different time scales and analytical approaches to dendrometer measurements allowing for a refined interpretation of growth onset and seasonal variability in sugar maple growth responses.

Keywords: sugar maple, dendrometer band, seasonal growth, climate, measurement

Abstract # 182

Stopover Ecology of Migratory Avian Species at Chapman Mountain Nature Preserve in Huntsville, AL

Kira Williams and Dr. Yong Wang

Mentor(s): Dr. Yong Wang

Department of Natural Resources and Environmental Sciences

The conservation of migratory songbirds is challenging due to their life-history characteristics and the spatial scales that they traverse. Events during migratory stopovers may have important consequences in determining the population status of migratory songbirds. The purpose of this study is to examine how migratory birds utilize Chapman Mountain Nature Preserve (CMNP) in Huntsville, Alabama, as a stopover site during fall migration. The CMNP is a 472-acre preserve within the Cumberland Plateau and has become a high interest area to birding communities, due to frequent migratory bird sightings. Our specific goals of this project is to study (1) the avian species richness and relative abundance, (2) temporal patterns of the stopovers, (3) energetic conditions and stopover length, and (4) age and sex related variations of the stopover parameters. During 2023 and 2024 field seasons, we captured 2530 birds of 75 species. The majority of species were

Neotropical migrants (47 species), followed by temperate (20) and resident (13) species. Neotropical migrants also accounted for 62.3% captures, followed by temperate migrants (23.6%)

and residents (14.1%). The most abundant migratory species was White-Throated Sparrow (*Zonotrichia albicollis*) (n =344), followed by Magnolia Warbler (*Setophaga magnolia*), Hooded Warbler (*S. citrina*), and Kentucky Warbler (*Geothlypis gormosa*) (n = 204, 164, and 149, respectively). Of all the captures, 70.4% were hatch year birds, 22.5% females, 20.0% males, and 57.4% with unknown sex. Over 67% of the birds had no or small amount of subcutaneous fat (22.0%, 30.6%, 15.1% in fat class 1, 2, and 3, respectively) upon initial capture. Neotropical migrants moved through the study site significantly earlier than that of temperate migrants (Julian day = 257.8 (mean) + 21.5 (SD) and 306.4 + 9.5, respectively, t = 72.7, df = 2122, p = 0.001). White-Throated Sparrow, Magnolia Warbler, Hooded Warbler, and Kentucky Warbler all showed a positive trend between body mass and capture time in a day, though this trend was only significant for White-Throated Sparrow (p = 0.015). This suggests that these migrants were able to forage successfully and accumulate the energy needed to continue their migration during stopover. Our results showed the importance of urban green spaces as the stopover sites for migratory birds.

Abstract # 183

Bacterial Community Microbiology of Surface and Subsurface Irrigation Water at the Winfred Thomas Agricultural Research Center.

Ajani Brooks, and Elica Moss

Mentor(s): Dr. Elica Moss

Department of Environmental Sciences

The microbial quality of irrigation water is impacted by wildlife and human inputs including runoff from manure and pasture lands, fecal deposition from wildlife, and discharge from sewer infrastructure. Due to these factors, irrigation water has been identified as a potential source of contamination in several disease outbreaks. Limited databases on microbial quality of irrigation water have been compiled, most notably in the southeastern United States, however, excluding the state of Alabama. Historically, irrigation water has not been monitored as closely as drinking and recreational water unless there is an outbreak. The objective of this study was to identify the potential relationships between pathogenic and indicator bacteria and physiochemical properties such as pH, dissolved oxygen (DO) and temperature in both the surface and subsurface water at the Winfred Thomas Agricultural Research Station. The pond analyzed for this study has the potential to be used as irrigation water for the various crops and vegetation grown at the research station. When the irrigation water is monitored, indicator organisms such as Escherichia coli and total coliforms are measured via the most probable number (MPN) using the IDEXX Colilert System. High concentrations of these indicator bacteria potentially indicate significant fecal contamination and, therefore, facilitate an elevated probability that potential pathogens are present. Results revealed relatively low MPN for both total coliforms and E. coli, while temperature and pH remained constant and DO varied significantly.

Abstract # 184

Plasma-powered Agriculture: A Cutting-Edge Strategy to Enhance Germination, Growth, and Biomass of Microgreens

Sravan K. Sanathanam

Mentor(s): Drs. Trang Pham, Judith Boateng, Ogechukwu Tasie, Srinivasa R. Mentreddy

Department of Food and Animal Sciences

Low-temperature plasma (LTP) comprises reactive oxygen and nitrogen species that trigger biochemical changes, breaking seed dormancy, and enhancing seed germination and seedling growth. Nutrient and antioxidant-rich microgreens offer significant health benefits but face challenges such as poor germination, and seed and humidity-related diseases. This study evaluated the LTP's potential for addressing these challenges using mustard greens. The objectives were to assess the effects of: (1) Argon (Ar) and Helium (He) LTP seed treatments for 0 (Control), 30, 60, and 90 seconds on seed germination (laboratory study); (2) direct plasma treatment combined with plasma-activated water (PAW) on germination (laboratory), seedling growth, biomass, and nutrient composition (greenhouse); and Objective 3: species-specific responses of 11 microgreens to LTP (laboratory). Seed germination was assessed by placing the treated and untreated seeds in Petri dishes @ 25 seeds/dish. Seedling growth and biomass were assessed by planting the treated and untreated seeds in pots containing potting mix. Seed germination efficiency (GE), mean germination time (MGT), shoot height (SH), root length (RL), and biomass (BM) were recorded. Antioxidant capacity and total phenolics were determined using published protocols. In Objective 1, Ar 60-seconds increased GE and SH by 13.8% and 46.0%, respectively, while He 60-seconds significantly increased SH, RL, and BM by 233.3%, 134%, and 155.1%, respectively over Control. In Objective 2, He 60 seconds + Ar or He PAW 30 seconds increased FGP by 21.4%, and Ar 90 seconds + Ar PAW 90 seconds increased RL by 140%. BM increased by 140% in Ar 30 seconds + DI water, while TPC (32.4%) and FRAP (55.8%) improved with Ar 90 seconds + Ar PAW 30 seconds over Control. In Objective 3, buckwheat and mustard responded to both gases; kale responded exclusively to Argon, and radish, scallion, spinach, and cilantro responded to He LTP. Thus, LTP and/or PAW treatments improve plant stand, accelerate seedling growth and biomass yield.

Abstract # 185

Urban Feature extraction using Geo-AI tools and Satellite Remote Sensing data over Huntsville, Alabama

Sudeep Joshi, Ranjani Kulawardhana, and Marvin Lotsah

Mentor(s): Dr. Ranjani Kulawardhana

Department of Natural Resources and Environmental Sciences

Urban expansion is an evolving, multidimensional process with far-reaching impacts on infrastructure, environmental sustainability, and land use. Traditional methods of monitoring urban development rely on extensive field data, which are often time-consuming and provides only limited capabilities for predictive modeling. This research integrates machine learning algorithms (deep neural network architectures), GeoAI tools and time series of satellite remote sensing data

to evaluate spatial patterns and temporal trends in urban expansion over rapidly developing Huntsville Metropolitan area of Alabama that span two counties: Madison, and Limestone. Our methodological approach involves: 1) pre-processing of high-resolution aerial images from National Agricultural Imagery Program (NAIP) and Landsat derived Land-Use/ Land-Cover (LULC) data, 2) urban feature extraction from NAIP and LULC data using semantic segmentation techniques, and 3) predictive modeling of urban expansion using supervised machine learning algorithms. We will extensively use in-built Geo-AI tools and Python geospatial libraries available in ArcGIS pro-

software for urban feature extraction, and automated classification of developed/ urban and natural/ non-urban area classification, spatial analyses, and time-series analysis of urban growth patterns. Accuracy assessments of urban feature extraction and mapping will be based on ground-truth

information from other open-data sources (i.e. google earth, and other secondary data sources). Our findings will help us understanding the applicability of Geo-AI and ML algorithms and satellite RS data for spatially mapping and predicting Urban developments to understand their impacts on urban climates and communities. Outcomes of our work will also help guiding future research to develop robust data-driven geo-AI framework for sustainable land-use planning and decision-making.

COMMUNITY AND REGIONAL PLANNING

Undergraduate

Graduate

FAMILY AND CONSUMER SCIENCES

Undergraduate

Abstract # 186

Sustainable Shades: Exploring Food-Based Dyes for Ethical Fashion

Tatiana Bohannon and Carol Hall

Mentor(s): Dr. Carol Hall
Department of Family and Consumer Sciences

The fashion industry is a major contributor to environmental pollution, with synthetic dyes significantly impacting water contamination and human health. This project explores the viability of food-based natural dyes as a sustainable alternative for textile dyeing. Using the scientific method, various food-derived dyes including turmeric, avocado pits, and berries. They are tested on natural fabrics such as cotton, linen, wool, and silk. The study evaluates color absorption, wash resistance, and the effects of mordants like vinegar and salt on dye retention. A garment is designed using sustainably sourced fabric and dyed with the most effective natural dyeing method identified. Results indicate that while natural dyes produce unique and aesthetically pleasing colors, their longevity varies based on fabric type and mordant application. The research also highlights the toxic chemicals in fast fashion dyes, their environmental impact, and the potential for integrating natural dyeing methods into mainstream fashion. This project aims to raise awareness of the need for sustainable textile dyeing practices and inspire innovation in eco-friendly fashion production.

Abstract # 187

Examining the Medical Mistrust Among Alabama A&M Students and their Perception of the Health Care System.

Alea Williams, Alaylia Brown, Alea Williams, Emrald Culbreath, Lenese Vaughner, and Rhona Miller-Cebert

Mentor(s): Dr. Rhona Miller-Cebert
Department of Family and Consumer Sciences

Access to healthcare and the utilization of health resources are heavily influenced by the trust individuals have in healthcare systems. For young adults, particularly African Americans, this trust is critical in shaping health-seeking behaviors. Medical mistrust is a key factor contributing to racial health disparities; however, limited research has focused on healthcare perceptions and medical mistrust among students at Historically Black Colleges and Universities (HBCUs). This study sought to (1) examine the factors contributing to medical mistrust among students at Alabama A&M University (AAMU) and identify key influences shaping their perceptions of the healthcare system, and (2) evaluate the impact of medical mistrust on healthcare access. An online survey instrument was developed using questions from peer-reviewed studies on medical mistrust, with modifications specific to this population. The study received approval from the Institutional Review Board at AAMU. Students were invited to participate by scanning a QR code that directed them to the survey, which included informed consent. A total of 311 students participated, and data were analyzed using the R-Studio statistical package to identify trends and insights regarding medical mistrust and healthcare perceptions among AAMU students. Results revealed notable differences across academic years. Freshmen had a median score of 3 (neither agree nor disagree), indicating moderate agreement with statements about medical mistrust, while sophomores showed more variability with a slightly higher median. Juniors exhibited outliers, suggesting a broader range of responses similar to sophomores. Seniors had the highest median score, indicating stronger agreement, leaning toward mistrust. Overall, the data suggest that as students' progress through their academic years, their likelihood of agreeing with statements about medical mistrust increases. These findings could inform targeted interventions and support strategies for students at different academic stages to address healthcare access and medical mistrust.

FOOD AND ANIMAL SCIENCES

Undergraduate

Abstract # 188

Sex- Specific Physiological and Hematological Profiles in Mature Rabbits

Madison Duval, Ray Johnson, Gregory Lunn, Kennedy Prim, Nathaniel Ogunkunle, and Miriam Garcia
Mentor(s): Dr. Miriam Garcia
Department of Environmental Sciences

Understanding sex-specific physiological and hematological differences in rabbits is essential for

improving health assessments, breeding strategies, and research accuracy. This study compared vital signs, blood parameters, and performance metrics between mature male (n = 4) and female (n = 4) rabbits to identify potential metabolic and physiological variations. Key parameters included body weight, heart rate, respiratory rate, hemoglobin, hematocrit, glucose, and triglycerides. Prior to blood collection, animals were weighed to determine body weight, and heart and respiratory rates were recorded to assess vital signs. Blood samples were collected from the auricular artery using a butterfly needle; whole blood was analyzed for hemoglobin and hematocrit using a hemoglobin meter, while plasma was assessed for glucose and triglyceride levels with commercial colorimetric kits. Data were statistically analyzed using the PROC MIXED procedure in SAS, with significance set at $P \leq 0.10$ and tendencies at $0.10 < P \leq 0.25$. The findings revealed notable sex-based differences in several parameters, though most were numerical rather than statistically significant. Female rabbits exhibited higher triglyceride levels (+63.5%, P = 0.35) and respiratory rates (+17.4%, P = 0.45), while males showed a tendency for higher hemoglobin (+12.1%, P = 0.17) and hematocrit (+12.0%, P = 0.17) levels. Body weight was similar between male and female rabbits (3.31 vs. 3.40 kg, respectively, P = 0.65), as were heart rate and glucose levels. Although some parameters differed by more than 10%, the small sample size likely limited statistical significance. Despite this limitation, the observed trends suggest potential sex-specific biological variations that merit further investigation. Establishing sex-specific baseline values for vital signs and blood parameters is crucial for improving clinical care and welfare in rabbits. Future research with larger sample sizes is recommended to validate these trends and explore the underlying metabolic and physiological mechanisms.

Abstract # 189

Rheological Analysis of Cookie Dough Incorporating Soy Protein Isolate for Enhanced 3D-Printing

Ta'Kira Whitt, Vinay Madala, Lamin Kassama, and Armitra Jackson-Davis

Mentor(s): Drs. Vinay Madala, Lamin Kassama & Armitra Jackson-Davis

Department of Family and Consumer Sciences

Soy protein isolate is a complete protein source that contains all essential amino acids, enhancing both food quality and health benefits. Incorporating soy protein isolate into cookie dough enhances the availability of essential amino acids, improving the protein quality and enhancing the 3D-Printability of cookies. Additive Manufacturing facilitates the construction of intricate solid structures layer by layer. Hence, a thorough understanding of the rheological properties of the cookie dough formulation is essential for successful 3D printing. The study's objective was to determine thSoye Rheological Properties of Cookie Dough Formulated with Soy Protein Isolate for 3D Printing. The cookie dough was formulated using all-purpose flour, soy protein isolate, water, butter, eggs, baking powder, xanthan gum, and vanilla flavoring. Four formulations were developed with ratios of all-purpose flour to soy protein isolate as ratios of 100:0, 90:10, 80:20, and 70:30. The rheological properties, including shear stress, shear rate, and viscosity, were measured across shear rates from 0 to 100 s^{-1} using a Discovery Hybrid Rheometer (DHR-2) at 25°C. Data analysis was conducted using SPSS 27 software, with an analysis of variance (ANOVA) performed at a 5% significance level. The results indicate that all samples exhibit shear-thinning, which occurs when an increase in shear rate decreases viscosity as protein molecules align with the flow and reduce internal resistance. This property makes the dough less viscous under higher shear, facilitating processing and handling. Upon hydration soy protein isolate forms a gel-like structure. While all

samples displayed shear-thinning behavior, the control sample showed significantly greater shear-thinning due to the absence of soy protein isolate. Shear-thinning behavior benefits smooth extrusion and is particularly suitable for 3D printing cookies.

Abstract # 190

Age-Related Changes in Body Weight and Physiological Parameters in Turkeys from 3 to 59 Days of Age

Kaylyn Green, Jadyn Frederick, Kennedy Prim, Nathaniel Ogunkunle, and Miriam Garcia

Mentor(s): Dr. Miriam Garcia
Department of Family and Consumer Sciences

Understanding age-related physiological changes in turkeys is crucial for optimizing meat production and ensuring animal welfare. The objective of this study was to assess age-related changes in turkeys over time. Three-day-old turkey poults (n = 8) were monitored for 56 days and fed commercial diets ad libitum. Body weight was recorded weekly to monitor growth. Vital signs (heart and respiratory rates) and blood samples for hemoglobin, hematocrit, glucose, and triglycerides were collected on days 28 and 56. Data were statistically analyzed using the PROC MIXED procedure in SAS, with significance set at P ≤ 0.10 and tendencies at 0.10 < P ≤ 0.25. Results revealed a substantial increase in weekly body weight from 95.4 g on day 0 to 4,453.8 g on day 56 (P < 0.05), reflecting expected growth patterns. Hemoglobin levels tended to decrease with age (8.49 and 8.10 g/dL at days 28 and 56, respectively, P = 0.24), with hematocrit showing a similar trend. Heart rate showed a slight numerical decrease (-7.8%, P = 0.53), while the respiratory rate numerically increased (+25.2%, P = 0.28) from day 28 to 56. Blood glucose levels tended to increase with age (244.2 and 259.8 mg/dL at days 28 and 56, respectively; P = 0.20). Conversely, triglyceride levels tended to decrease (117.8 and 98.7 mg/dL at days 28 and 56, respectively P = 0.24). These findings demonstrate that turkeys reached targeted weights and exhibited physiological trends aligning with meat production goals, offering valuable insights for optimizing their performance, health, and welfare.

Abstract # 191

Development and Quality Evaluation of Buckwheat-All Purpose Flour Breakfast Muffins with Varying Levels of Carrot Puree

Zoe Jackson, Kristian Gooden, Ogechukwu Tasie, and Martha Verghese

Mentor(s): Drs. Kristian Gooden, Ogechukwu Tasie, and Martha Verghese
Department of Family and Consumer Sciences

With the increasing emphasis on nutrient-rich and functional baked goods, alternative flours and vegetable-based ingredients have become more prevalent. Buckwheat flour, recognized for its high nutritional content, can be effectively paired with carrot puree. This combination presents a promising opportunity to enhance the quality of breakfast muffins. This study aimed to develop and evaluate muffins that incorporate a blend of buckwheat and all-purpose flour with varying levels of carrot puree, evaluating their effects on physicochemical properties and sensory acceptability. The study included three formulation groups: (1) a control group containing only buckwheat and all-

purpose flour, (2) a treatment group with buckwheat and all-purpose flour plus 10% carrot purée, and (3) a treatment group with buckwheat and all-purpose flour plus 20% carrot purée. The batter was mixed, scooped into muffin cups, and baked at 350°C for 10 minutes. The muffins were analyzed for texture, color, moisture content, and water activity, while sensory evaluations assessed consumer acceptance based on flavor, texture, and appearance. Data were analyzed using SAS Software and Tukey's mean separation test for statistical significance ($p < 0.05$). The results indicated significant differences in color, moisture content, and texture among the formulations ($p < 0.05$). The control group exhibited the highest hardness (1282.50 N), while the 20% carrot purée treatment had the lowest (495 N), indicating a softer texture. Sensory evaluations showed that muffins containing carrot purée were more widely accepted than the control, with the 10% carrot purée formulation receiving the highest ratings for moistness and overall flavor. Incorporating carrot purée into buckwheat-all-purpose flour muffins significantly improved their nutritional value, moisture content, and sensory appeal. The 10% carrot purée formulation yielded the most desirable texture and flavor, suggesting its potential for consumer preference. These findings highlight the feasibility of developing nutrient-dense baked goods that cater to health-conscious consumers.

Abstract # 192

Formulation and Quality Evaluation of Fiber-Enriched Breakfast Muffins Made with Composite Flours and Carrot Purée

Kristian Gooden

Mentor(s): Zoe Jackson, **Ogechukwu Tasie, and Martha Verghese**

Department of Food and Animal Sciences

The demand for nutritious bakery products has grown, prompting the exploration of alternative flours to enhance product quality. Building on information gathered from our previous experiment, this study focused on maximizing fiber intake while aligning with a more preferred taste preference. The objective was to evaluate the formulation and quality characteristics of breakfast muffins made with composite flours and carrot purée. Four treatment groups were developed: (1) a control using buckwheat and all-purpose flour, (2) buckwheat and all-purpose flour with 10% carrot purée, (3) buckwheat and whole wheat flour with 10% carrot purée, and (4) buckwheat, all-purpose, and whole wheat flour with 10% carrot purée. The batter was prepared, portioned into muffin trays, and baked at 350°C for 10 minutes. Tests for texture, color, and moisture content were conducted, along with sensory evaluations, to assess consumer acceptance based on flavor, texture, and appearance. Data were analyzed using SAS Software and Tukey's mean separation test for statistical significance ($p < 0.05$). Results indicated significant variations among treatments. The lightness (L *) value was highest in the fourth treatment (46.75) and lowest in the second treatment (38.51). Moisture content varied significantly ($p < 0.05$), with the control having the lowest moisture (14.25%) and the second treatment the highest (18.86%). Texture analysis showed that the control had the highest hardness (1351.67 N), while the second treatment exhibited the lowest (895 N), indicating a softer texture. Sensory evaluation revealed that panelists preferred formulations containing buckwheat and whole wheat flour with 10% carrot purée. The incorporation of carrot purée and composite flours significantly influenced the muffins' physicochemical properties and sensory acceptability. These findings show that adding carrot purée improves moisture retention and reduces hardness while maintaining desirable sensory qualities, providing insights for developing healthier, fiber-rich, whole-grain bakery products.

Abstract # 193

Determining the Ability of Food-Grade Sanitizers to Control Foodborne Pathogens Commonly Used in the Produce Industry

Haley Noland, Armitra Jackson-Davis and Philip Bwayla

Mentor(s): Drs. Armitra Jackson-Davis & Philip Bwayla

Department of Food and Animal Sciences

Escherichia coli (*E. coli*) and *Salmonella* are mesophilic, facultative anaerobic microorganisms commonly found in the intestines of warm-blooded mammals. While many strains of *E. coli* and Salmonella are harmless, certain pathogenic strains can contaminate produce during or after harvest, posing significant risks to food safety. Food-grade sanitizers are widely used to control microbial loads on produce that are covered by the Produce Safety Rule. Evaluating the efficacy of these sanitizers is critical to ensuring consumer safety and minimizing contamination by foodborne pathogens. This study evaluated the ability of select sanitizers to control *Salmonella* and *E. coli* using the Kirby Bauer Well Diffusion Method. For this study, four Tryptic Soy Agar (TSA) petri dishes were divided into four quadrants and numbered to correspond with the sanitizers and controls. Each petri dish was labeled with the date prepared, pathogen name, and the name of the researcher. A sterile pipette was aseptically used to create wells in each quadrant of the agar. A sterile swab was dipped twice in the *E. coli* and *Salmonella* cells and were spread evenly on the petri dishes. A pipette was used to dispense 0.1 mL of each sanitizer and controls in the corresponding quadrant. The plates were incubated at 37°C for 24 h and then observed for survival of the pathogens. The effectiveness of each sanitizer had various results based on the pathogens. One of the sanitizers exhibited a larger zone of inhibition but was more effective at controlling the *E.coli* than *Salmonella.* The other sanitizer was effective at controlling both pathogens but had a smaller zone of inhibition. The controls had a minimal effect on the pathogens. This study shows the importance of using sanitizers to prevent common food borne outbreaks related to produce that can lead to serious illness and/or death.

Key words: *Escherichia coli*, *Salmonella*, produce, sanitizers

Abstract # 194

Assessing the Effectiveness of Food Grade Sanitizers in Inhibiting *Escherichia coli* and *Salmonella*

Meagan Turner, Philip Bwalya, and Armitra Jackson-Davis

Mentor(s): Drs. Philip Bwalya, Armitra Jackson-Davis
Department of Food and Animal Sciences

Sanitizer usage on produce is critical to minimizing pathogens such as *Escherichia coli* (*E. coli*) and *Salmonella*. Evaluating sanitizer efficacy is crucial for ensuring the safety of fresh, unprocessed produce. The goal of this study was to investigate the effectiveness of sanitizers commonly used in the produce industry to control *E. coli* and *Salmonella*. Tryptic Soy Agar (TSA) plates were prepared and divided into four separate quadrants. Following this a sterile petri dish was labeled with identifying information (e.g. date the study was conducted, initials of the student researcher, and the

name of the target pathogen). A well was aseptically placed into each quadrant using the base of a pipette. A microbial suspension of *E. coli* and Salmonella were spread across individual plates using a sterile swab. In this study, 100 µL of two produce industry sanitizers were added to wells on agar plates and assessed for their ability to control *E. coli* and *Salmonella*. The same was done for the two controls. The plates were incubated at 37°C for 24 h, and sanitizer efficacy was evaluated using the Kirby-Bauer Well Diffusion method by evaluating the zones of inhibition. The study revealed significant microbial growth in quadrants treated with sanitizers A, C, and D. In contrast, Sanitizer B demonstrated the largest zones of inhibition, making it the most effective in reducing the growth of *E. coli*. The sanitizers did not have the same effect on *Salmonella*, thus allowing for more growth. These findings support the importance of using effective sanitizers to prevent pathogen growth on produce in the food industry.

Keywords*: E.coli, Salmonella*, Diffusion, Sanitizer

Abstract # 195

Evaluating the Efficiency of Sanitizers in Reducing Pathogens Contamination on Produce covered in the Produce Safety Rule

Victor Moore, Philip Bwalya, and Armitra Jackson-Davis

Mentor(s): Drs. Philip Bwalya and Armitra Jackson-Davis

Department of Food and Animal Sciences

Salmonella and *Escherichia coli* (*E. coli*) are foodborne pathogens that can cause illness. These pathogens are commonly found on produce and illness can occur through consumption when produce is not properly sanitized. Sanitation is extremely important in the safe production of produce. The purpose of this study was to determine which sanitizer was the most effective at controlling foodborne pathogens on agar plates determined by the Kirby-Bauer Well Diffusion

Method. Two Tryptic Soy agar plates were divided into four labeled quadrants. One plate was inoculated with *E.coli* and another plate was inoculated with *Salmonella*. A sterile pipette was used to create wells in the center of each quadrant aseptically. *E. coli* and *Salmonella* cells were spread on petri dishes using a sterile swab. Following this, 100 µL of each sanitizer and control was placed into each labeled well. Plates were incubated at 37°C for 24 h to observe bacterial growth and zones of inhibition. After a 24 h incubation period, the plates were reviewed for their zones of inhibition as well as differences between *E.coli* and *Salmonella* reactions to the sanitizers. Sanitizer A had the largest zone of inhibition for both *E.coli* and *Salmonella*, indicating strong antibacterial activity against both pathogens when compared to Sanitizer B . Controls C and D had very little to no zones of inhibition, possibly suggesting both controls on either Salmonella or *E.coli* were not effective at controlling microbial growth. These results of the study demonstrate the importance of sanitizers in the produce industry.

Keywords: *Salmonella, E.coli*, sanitation, produce

Abstract # 196

Development of High-protein Energy Bites to Support Pre-Workout Performance and Post–Workout Recovery: Utilizing Lavender

Caleel Holifield, Heaven Stewart, Amirah El-Amin, Katelyn Boyle, Martha Verghese

Mentor(s): Drs. Heaven Stewart, Amirah El-Amin, Katelyn Boyle, Martha Verghese

Department of Food and Animal Sciences

Lavender is an aromatic herb known for its functional properties, including relaxation promotion and inflammation reduction. Overall, the aim was to create a functional snack to support workout performance and serve as a potential meal replacement. Energy bites with and without lavender (control) were developed and tested for consumer acceptability. The control high-protein energy bites were formulated with dried fruits, alternative flours, and functional ingredients. A focus panel of 18 participants (44% athletes, 56% non-athletes) evaluated sensory attributes: taste, texture, and acceptability, using a 5-point hedonic scale (1 = Dislike very much, 5 = Like very much). Background data on physical activity, meal replacement use, and protein bar consumption habits were collected to assess consumer behavior and market needs. Competitor market research analyzed pricing, nutritional trends, and niches. Physiochemical analysis (pH, texture, Aw and color) of energy bites were conducted. Focus panel showed 100% of athletes rated energy bites highly (4-5) for appearance, aroma, tactility, texture, taste, and acceptability. Non-athletes had varied responses: 40% rated taste/texture lower (2–3), and 30% rated acceptability as "neutral." However, 62% expressed interest in meal replacements, showing potential for refinement. Among athletes, 75% used protein bars regularly pre-workout, compared to 20% of non-athletes. Non-athletes favored smoothies or homemade snacks as meal replacements, presenting opportunities to position energy bites as functional snacks and meal alternatives. Competitor comparison showed alignment with high-protein trends but opportunities for sensory improvement and market differentiation. Physiochemical analysis of energy bites showed an average of 5.15 for pH, 0.59 Aw for water activity, 4778g hardness and 397g adhesive force for texture, and L* 74.91, a* 9.02, b* 21.70 for color. High-protein energy bites are formulated to support workout performance and recovery. These functional ingredients offer a unique product in the market, catering to consumers seeking nutrition and wellness benefits.

Abstract # 197

Influence of Hydrocolloids on the Rheological Properties of 3D-Printable Plant-Based Chicken Breast Formulation

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Mentor(s): Drs. Vinay Madala, Mamadou Lamin Kassama, Armitra Jackson-Davis
Department of Food and Animal Sciences

Additive Manufacturing (AM), also known as 3D printing, builds complex solid structures by adding material layer by layer. To optimize the 3D printing of plant-based chicken breast, it's essential to understand the rheological properties of the formulation. This study examined the influence of hydrocolloids (Xanthan gum, and Methylcellulose) on the rheological characteristics of a plant-based chicken breast formulation made from soy protein isolate, water, coconut oil, and sunflower lecithin formulation. Three ratios of Xanthan gum and Methylcellulose were prepared, including Control formulations. The rheological properties, such as the relationship between shear stress and shear rate and viscosity, were measured using a Discovery Hybrid Rheometer (DHR-2) at shear rates from 0 to 100 s^{-1}. Data were analyzed using SPSS 27 software, with an analysis of variance (ANOVA) at a 5% significance level. The flow behavior of the samples was studied at 25°C over a shear rate range of 1 to 100 s^{-1}. Results showed a decrease in apparent viscosity as the shear rate increased. The xanthan gum formulation exhibited a distinct shear-thinning behavior compared to the control and methylcellulose formulations. The control sample, which did not contain hydrocolloids, exhibited minimal shear-thinning. All formulations displayed shear-thinning characteristics, which are advantageous for smooth extrusion during the 3D printing of plant-based meat analogs. These findings highlight the importance of shear-thinning behavior in achieving effective extrusion and precise layer deposition in 3D-printed chicken breasts.

Abstract # 198

Functional Analysis of ATP-Citrate Lyase Subunits in *Y. lipolytica* Through Targeted Gene Disruption

Oluwatimileyin Ogundele and Stylianos Fakas

Mentor(s): Dr. Stylianos Fakas

Department of Food and Animal Sciences

Precise gene deletions are essential for clarifying gene function and advancing metabolic engineering in the yeast *Yarrowia lipolytica*, an emerging industrial biotechnology platform known for its high lipid accumulation. ATP-dependent citrate lyase (ACL) plays a vital role in lipid biosynthesis by converting citrate into acetyl-CoA, the precursor for fatty acid synthesis. *Y. lipolytica* ACL is a heterodimeric enzyme comprising the catalytic subunit ACL1 and the regulatory subunit ACL2. Investigating combinatorial mutations, such as double deletions of ACL subunits, is crucial for dissecting the interplay between catalytic and regulatory functions. However, our research has been hindered by the absence of deletion cassettes with appropriate selectable markers. In this study, we developed a Gibson assembly-based cloning strategy to construct an ACL2 gene deletion cassette using URA3 as the selectable marker, overcoming inefficiencies associated with restriction enzyme-based methods. Our approach utilized Gibson assembly to efficiently integrate URA3 between homologous 5′ and 3′ flanking regions of ACL2, enabling efficient recombination in *Y. lipolytica*. PCR amplification of the deletion cassette was optimized for high-fidelity assembly, and PCR purification and DpnI digestion were used to eliminate background donor plasmid DNA. Following Gibson assembly, transformed E. coli cells were screened via colony PCR and sequencing to confirm successful recombination. This optimized workflow establishes a robust, marker-flexible genetic engineering tool for *Y. lipolytica*, expanding its utility for targeted genome modifications in synthetic biology and industrial biotechnology applications. Future studies will focus on validating ACL2's functional role by examining the effect of its deletion on ACL activity and expression.

Abstract # 199

Formulation, Textural, and Sensory Profiling of a Health-Conscious Gummy Candy

Jacob Reeves and Elvis Baido

Mentor(s): Dr. Martha Verghese

Department of Food and Animal Sciences

The development of healthier confectionery options has become increasingly important for food scientists, primarily due to rising health awareness among Americans. Concerns such as tooth decay, weight gain, and type 2 diabetes have prompted a search for substitutes in the candy market. This study focused on creating a healthier gummy product by experimenting with alternative ingredients. The new formulation was tested for its texture and sensory properties, and its performance was compared to commercial gummy product. The results showed that there were no significant

differences ($p \leq 0.05$) in the hardness, gumminess, and springiness of the developed gummies and were comparable to those of existing commercial product. The overall acceptability of the new gummy was rated at 74%, reflecting a significant level of consumer approval. This research highlights the potential for gummy confectionery to be reformulated in a way that prioritizes health without sacrificing taste or texture. By incorporating alternative healthy ingredients, the study demonstrates that it is possible to create a candy that aligns with health-conscious consumer preferences. The findings suggest that the confectionery industry can adapt to meet the demand for healthier options, thereby contributing to the overall well-being of the public. This innovative approach could pave the way for further advancements in the production of health-oriented gummies, making them not only enjoyable but also beneficial for consumers' health.

Abstract # 200

Anti-Oxidative Potential of Coffea arabica beans: Raw, Roasted, and Fermented with Saccharomyces cerevisiae and Lactobacillus paracasei, Signally and in Combination

Alexis Watson, Nedra Montgomery, and Martha Verghese

Mentor(s): Dr. Martha Verghese
Department of Food and Animal Sciences

With over 2 billion cups of coffee consumed in a day, coffee is considered the most popular beverage consumed globally next to tea and water. Many studies have linked coffee consumption to selected health benefits due to the polyphenolic content and ability to be a potent antioxidant. Arabica species is the most produced and consumed variety of coffee due to sweet, fruity, and nutty attributes which yields a better-quality cup of coffee. The objective of this study is to evaluate the variety of green, roasted, and fermented Arabica coffee bean's total phenolic content (TPC), total flavonoid content (TFC), and antioxidant potential: Trolox Equivalent Antioxidant (TEAC) Capacity, 2,2, diphenyl-1-picrylhydrazyl (DPPH), and Ferric Reducing Antioxidant Potential (FRAP). Green Brazilian Peaberry Arabica beans were obtained commercially. Green beans were roasted at 400 degrees for 12 minutes. Green beans were fermented for 72 hours with Saccharomyces cerevisiae (SC), Lactobacillus paracasei (LP), or Saccharomyces cerevisiae and Lactobacillus paracasei in combination (SCLP). All coffee bean groups were extracted using ethanol (ET) and aqueous (AQ) solvents. Results showed that fermentation with the combined strains was faster than single strains used. The initial pH and BRIX°, 5.3 and 20° reached 3.3 and 10° after 72hr. Roasted Arabica (AQ) consistently contained higher levels of flavonoids and phenolics, with TFC reaching an average of 279.60 mg C.E./100g DW and TPC averaging 20.77 mg G.A.E./100g DW. ET Raw, Roasted and Fermented, beans showed lower antioxidant values, indicating that solvents used, may impact the efficiency of bioactive compounds extracted. These findings suggest that roasted and fermented Arabica coffee (AQ) may possess substantial antioxidant properties capable of mitigating oxidative stress—an underlying factor in developing chronic diseases. The elevated levels of polyphenols and flavonoids observed support the potential of Arabica coffee as a functional food component with possible protective effects against oxidative stress.

Abstract # 201

Amaranth in Red Velvet Cupcakes: A Healthier Alternative to Traditional Ingredients

Louive Brandon Brogan and Arlington Carty, Jelisa Thomas, Ph.D.; Elvis Baidoo, Ph.D.; Martha Verghese, Ph.D.

Mentor(s): Dr. Jelisa Thomas

Department of Food and Animal Sciences

Pseudocereals are gaining popularity due to their health benefits. Amaranth, a nutrient-dense pseudocereal, has gained attention recently due to its exceptional nutritional profile and health benefits. While previous research highlights the dietary advantages of amaranth, it remains underutilized. Limited studies have examined the direct impact of amaranth on sensory properties in baked goods. This experiment aims to fill that gap by determining the optimal substitution level that enhances nutritional value without compromising taste and texture. Red velvet cupcakes are a widely enjoyed dessert, but traditional recipes rely on refined flour, which lacks essential nutrients and may not be suitable for individuals with gluten sensitivities. This experiment explores the use of amaranth, a nutrient-rich, gluten-free ancient grain, as a healthier alternative to conventional gluten-free flour in gluten-free red velvet cupcakes. The objective is to determine the maximum amount of amaranth that can be incorporated without compromising consumer acceptance in terms of taste, texture, appearance, and quality. The study investigates the incorporation of amaranth into red velvet cupcakes at 0% (control), 25% amaranth, 50% amaranth, and 75% amaranth, aiming to enhance the nutritional profile of this product while maintaining its sensory appeal. A series of formulation trials were conducted to determine the optimal inclusion levels of amaranth flour, taking into account factors such as texture, flavor, and consumer acceptability. Mini cupcake formulations (control, 25% Amaranth, 50% Amaranth, 75% Amaranth) were tested among consumer panelists using a 5-point hedonic scale. Based on taste, texture, color, aroma, appearance, and other factors, amaranth-containing cupcakes were deemed acceptable, and 84% of respondents indicated that they would pay between $2.00 and $5.00. This research offers valuable insights into the feasibility of utilizing amaranth in the development of healthier, sustainable food products, thereby contributing to its potential role in diversifying and enriching the modern food landscape.

Abstract # 202

Development of Plant-Based Fruit Snacks: Emphasizing Clean Ingredients and Sustainability

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Mentor(s): Dr. Josh Herring

Department of Food and Animal Sciences

As consumer preferences continue to evolve, there is a growing demand for snack options that align with healthier lifestyles, dietary restrictions, and sustainability concerns. This project aims to develop a plant-based fruit snack that meets these demands by providing a gelatin-free, clean-label, and functional alternative to conventional options. The formulation emphasizes the use of all-natural ingredients without added sugars or artificial food additives. To better understand consumer preferences, a comprehensive market survey was conducted to assess key factors such as taste preferences, texture expectations, and packaging convenience. Packaging considerations, such as resealable bags, were evaluated for convenience and shelf-life extension. The plant-based fruit

snacks are formulated using 100% fruit juice combined with agar agar powder, a plant-based gelling agent known for excellent setting properties. Spirulina, a nutrient-dense superfood, is incorporated to enhance the product's nutritional profile. Natural sweeteners, including agave and honey, are used to improve flavor while maintaining a clean-label profile. The physiochemical characteristics analyzed for the final product include color, texture, pH, and water activity. Proximate analysis provides the nutritional content of the product while sensory evaluation gauges consumer acceptability, ensuring the product meets market expectations for taste and quality. By integrating health-conscious ingredients with sustainable practices, this plant-based fruit snack has the potential to thrive as a functional and innovative confectionery product.

Abstract # 203
Effect of Temperature on Citrate Lyase Mutants of *Yarrowia lipolytica*

Emille White, S. Fakas, K. Jackson, and A. Odunsi
Mentor(s): Dr. Drs. Stylianos Fakas and Martha Verghese
Department of Food and Animal Sciences

Yarrowia lipolytica is an oleaginous yeast known for its ability to accumulate lipids, making it a promising candidate for biotechnological applications such as producing food lipids and biofuels. This yeast's ability to accumulate lipids makes it an excellent model organism for studying lipid biosynthesis. One of its key metabolic features is the activity of ATPcitrate lyase (ACL). The ACL enzyme, composed of subunits ACL1 and ACL2, catalyzes the conversion of citrate into acetyl-CoA, a critical precursor for lipid synthesis. Understanding ACL function is crucial because its key role in lipid synthesis makes it a critical target for biotechnological applications. The objective of this work was to identify the function of ACL1 and ACL2 in adaptation to temperature using a spotting assay to measure growth. Wild-type (WT), acl1Δ, acl2Δ, ACL1 overexpression, and ACL2 overexpression strains were grown in YPD broth to an optical density of 5 at 600 nm. To assess temperature-dependent growth, serially diluted cultures were spotted on YPD plates and incubated at 22°C, 34°C, and a control temperature of 30°C for 24 hours. All strains demonstrated the strongest growth during cultivation at 30°C, the optimal temperature for this yeast. Compared to the WT, deletion mutants showed improved growth at 34°C, indicating an enhanced ability to grow at elevated temperatures. The results show that the loss of ACL1 or ACL2 might alter cell metabolism in a way that provides a growth advantage under heat stress. Overexpression strains showed varied responses, with some showing growth comparable to or better than the WT, depending on the temperature. At 22°C, all the strains exhibited similar growth, although acl2Δ and ACL1 overexpression showed a slight advantage in early growth. These findings suggest that ACL1 and ACL2 play a complex role in temperature adaptation, and their loss might alleviate metabolic stress at high temperatures.

Graduate

Abstract # 204

ATP citrate lyase catalyzes the ATP-dependent conversion of citrate to acetyl-CoA, an indispensable intermediate in lipid biosynthesis

Ayodeji Odunsi and Stylianos Fakas

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The *Yarrowia lipolytica* ACL enzyme is a heterodimeric protein composed of the catalytic subunit Acl1 and the regulatory subunit Acl2. Mutants deficient in ACL exhibit diminished lipid levels and global transcriptional reprogramming. In this work, we investigated the phenotypic effects of the ablation of each ACL subunit on growth and carbon source utilization. Strains lacking ACL1 (i.e., acl1Δ) or ACL2 (i.e., acl2Δ) were cultivated in a microbioreactor. Three carbon sources were utilized: glucose, glycerol, and citrate. The loss of ACL1 resulted in a significant reduction in growth rate on all carbon sources tested. Similar growth phenotypes were observed with the acl2Δ mutant, although the decrease in growth rate was less severe compared to the acl1Δ mutant. Interestingly, growth experiments utilizing oleic acid as the sole carbon source revealed no growth defects in either mutant. These results suggested that β-oxidation could supply acetyl-CoA for fatty acid synthesis, thereby compensating for the loss of ACL activity. A comparison of the different carbon sources revealed that growth on citrate was minimal, suggesting that the ablation of ACL compromised the utilization of citrate as a carbon source. Citrate utilization experiments using radiolabeled 14C-citrate confirmed that the deletion of ACL1 or ACL2 impaired the ability of cells to utilize exogenous citrate for lipid biosynthesis. Interestingly, wild-type cells preferentially utilized exogenous citrate to synthesize phospholipids and ergosterol. Subsequently, we investigated the temperature sensitivity of ACL mutants. We used two restrictive temperatures: 22°C and 34°C. Results demonstrated that the growth of the acl1Δ mutant was compromised at 34°C, while no growth defects were observed for the acl2Δ mutant. Collectively, our findings provide the first insights into the function of the ACL subunits in *Y. lipolytica*.

Abstract # 205

ATP citrate lyase (ACL) is indispensable for lipid biosynthesis. It catalyzes the ATP-dependent conversion of citrate to acetyl-CoA, a key intermediate in both fatty acid and triacylglycerol (TAG) biosynthesis pathway

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The *Yarrowia lipolytica* ACL is a heterodimeric enzyme consisting of catalytic Acl1 and regulatory Acl2 subunits. Previous research has shown that mutants lacking ACL1 or ACL2 present reduced lipid accumulation and altered lipid profiles. Furthermore, the ablation of ACL1 or ACL2 leads to a global transcriptional reprogramming, impacting the expression of thousands of genes. To investigate the specific contributions of each subunit, we overexpressed ACL1 and ACL2 in their

respective mutant strains. Strains were cultured in glycerol-based lipogenic media, and their growth and lipid profiles were analyzed by thin-layer chromatography coupled with gas chromatography-mass spectrometry.

The expression of the catalytic subunit ACL1 in the acl1Δ mutant strain led to a substantial increase in lipid accumulation, particularly in the form of TAG. Notably, TAG levels in the complemented strain attained or even surpassed those observed in the wild-type strain expressing native ACL. In contrast, the loss of ACL1 (i.e., acl1Δ) resulted in a 50% decrease in fatty acid levels and a 75% reduction in TAG levels. Preliminary findings from the acl2Δ mutant overexpressing ACL2 exhibited a similar trend of elevated lipid and TAG levels, comparable to those observed in the wild-type strain. These results collectively highlighted the pivotal role of ACL1 in regulating lipid metabolism, particularly TAG synthesis, and suggested that ACL2 may play a supporting role in this process.

Abstract # 206

INFLUENCE OF SALTS ON SOAKING CHARACTERISTICS OF PINTO AND BLACK BEANS

Mariam Yakubu, Manideep Busarapu, Elvis Baidoo, Nathaniel Ogunkule and Judith Boateng

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Department of Food and Animal Sciences

Common beans (*Phaseolus vulgaris L.*) are known for their nutritional and functional attributes. The quality of beans is influenced by their chemical and physical characteristics, which processing seeks to enhance or preserve. Soaking is a conventional pre-treatment used to reduce hard-to-cook phenomenon and eliminate undesirable compounds in beans. Although soaking is a crucial step in bean processing, most research has concentrated on post-cooking changes, with limited attention given to its standalone effects on key attributes such as polyphenol content, antioxidant activity, color, and texture. The objective of this study was to investigate the influence of soaking with and without salts on the chemical and physical properties of pinto and black beans. Pinto and black beans were soaked in water, 1% NaHCO3, 1% NaHCO3+1%NaCl, 2%NaHCO3, and 2%NaHCO3+1%NaCl solutions. Key parameters, including polyphenol content (total polyphenol content-TPC, total flavonoid content-TFC), antioxidant capacities (ferric reducing antioxidant power, DPPH % radical scavenging activity, IC50, and trolox equivalent antioxidant capacity), hardness, and color, were analyzed at intervals of 6, 12, 18, and 24 hours. Unsoaked pinto beans exhibited higher polyphenol levels compared to black beans. However, black beans demonstrated 5.4% to 78.3% greater antioxidant capacity and were 36.7% harder than pinto beans. Soaking led to TPC reductions of 1.6–38.0% in pinto beans and 5.4–27.4% in black beans, along with TFC losses of 11.9–63.5% and 1.8–57.5%, respectively for pinto beans and black beans, with time. The inclusion of salts during soaking increased polyphenol and antioxidant losses, with higher NaHCO3 concentrations causing more pronounced reductions. While NaCl treatments had minimal impact on hardness and effectively preserved the color of the beans. These findings provide critical insights for refining pre-processing methods in bean production, enabling the enhancement of nutritional and functional qualities. This contributes to improved processing practices and product quality.

Abstract # 207

Effect of Industrial Hemp (*Cannabis sativa*) on Ruminal Short Chain Fatty Acid in Beef Cattle

Nathaniel Ogunkunle and Judith Boateng

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Department of Food and Animal Sciences

Diet is a major factor, which influences anaerobic fermentation in the rumen to produce short chain fatty acid (SCFA). The objective of this study was to determine the impact of industrial hemp (IH) supplementation on the production of short chain fatty acid in the rumen of beef cattle. Twenty black Angus heifers were randomly assigned into CON (0% hemp, received commercial diet; n=10) and IH (received 150mg/kg of hemp) groups. After a feeding trail that lasted for 35 days, rumen samples were collected on day 0, 7, 14, 21 and 35 for short chain fatty acid analysis using GC-FID. Data were analyzed with PROC MIXED for repeated measure in SAS 9.4, means were separated with tukey posthoc at 5% level. Animals in the IH group had significantly ($p<0.05$) higher acetate concentration on day 21 when compared to CON. Significant ($p<0.05$) differences were also observed in propionate and butyrate concentration on day 21 with the IH group having a higher concentration. In conclusion, utilizing IH in the diet of beef cattle improved the production of short chain fatty acids in the rumen, which can be utilized for energy and fat metabolism and also, it could improve the quality of animal products.

Abstract # 208

Effect of Hemp (*Cannabis sativa*) Supplementation on Vital Parameters and Plasma Antioxidant Enzymes of Sheep During Wool Shearing

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Mentor(s): Drs.Felix Samuel, Judith Boateng
Department of Food and Animal Sciences

Wool shearing is a stressful event in sheep production, plant phytochemicals are known to possess antioxidant potential that scavenge free radicals and prevent animals from stress. The objective of this study was to determine the effect of hemp supplementation on vital parameters and antioxidant status of sheep during wool shearing. Thirty (30) Merino sheep were randomly assigned to CON (fed commercial concentrates) and HEMP (fed 150mg of hemp per kg of commercial concentrates). Vital parameters were measured, and blood were collected 24hrs before, during and 24hrs after wool shearing. Data was analyzed with MIXED model in SAS 9.4, significant means were separated with tukey posthoc test. There was significant ($P<0.05$) difference in rectal temperature, respiratory and heart rate of the sheep. Hemp also improved the antioxidant status of the animals by increasing plasma total antioxidant capacity, superoxide dismutase and glutathione peroxidase. Conclusively, hemp improved sheep antioxidant status and maintained optimum vital parameters during wool shearing thereby improving the welfare of the animals.

Abstract # 209

Mechanistic evaluation of Curry leaves (*Murraya koneigii*) extracts in modulation of antioxidant, anti-inflammatory, and apoptotic pathways in 3T3-L1 adipocytes for potential in anti-obesity applications

Karthik Medabalimi. Harpreet Singh, Nedra Montgomery, Judith Boateng, Rajwinder Kaur, Martha Verghese

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Obesity is closely associated with chronic inflammation, oxidative stress, and hypertrophy of adipocytes, contributing to metabolic disorders. Natural plant extracts, derived from curry leaves (Murraya koenigii), are recognized for their potent antioxidant and anti-inflammatory properties, making them promising agents in obesity management. This study investigates the effects of curry leaf extract on 3T3-L1 adipocytes, examining its influence on cytotoxicity, oxidative stress, inflammation, and apoptotic pathways to understand its potential as an anti-obesity agent. 3T3-L1 preadipocytes were cultured and differentiated into adipocytes which includes the Induction phase (Day 0), intermediate differentiation (4-7days), and mature adipocyte differentiation (7-10 days), then treated with dried curry leaf extracts at various concentrations (125, 250, 500, 1000, 2000µg/ml). Cytotoxicity was assessed via lactate dehydrogenase (LDH) release. Antioxidant activity was evaluated by measuring superoxide dismutase (SOD), catalase, and glutathione peroxidase (GPx) activities. Interleukin-6 (IL-6) levels were measured using ELISA to assess inflammation. Apoptotic effects were analyzed using caspase activity assay, and morphological changes were observed under fluorescence microscopy (Standard kits from Invitrogen and Abcam). Curry leaves resulted in higher LDH release (%) with increasing concentration in both the differentiation (35-64%) and maintenance stages (28 - 52%). Cell viability (MTT %) decreased with increasing concentrations, suggesting cell death by apoptosis/necrosis (72-43%) in the differentiation stage vs. (51-23%) in the maintenance stages. Catalase activity (17-13µm) and glutathione levels (3.16-2.47µm) did not differ at different concentrations tested. This study provides insight into the potential of curry leaf extract as an anti-obesity agent and supports further investigation into its application in obesity-related health issues. This study focuses on understanding curry leaf extract as a valuable natural intervention in obesity treatment by mitigating adipocyte inflammation, increasing cellular antioxidant defenses, and promoting apoptosis in hypertrophic adipocytes.

Keywords: *Murraya koenigii*, Antioxidant, inflammation oxidative stress, obesity

Abstract # 210

Consumer Perception of Natural and Synthetic Colors, and Flavors: The Development of a Functional Mint-Based Beverage

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Natural colors and flavors have gained popularity due to perceived health benefits attributed to natural ingredients and product transparency. Objectives were to assess consumer perceptions of natural versus synthetic colors and flavors. To determine consumer preferences and perceptions for artificial flavor and color (AFAC), natural flavor, color (NFNC), and natural flavor, artificial color

(NAC) combinations were tested (consumer perception and preference survey). Forty panelists (diverse demographics), ages 18 to 44 (varied educational levels) participated in this study, (Total phenolic and flavonoid contents, Ferric Reducing Antioxidant Potential (FRAP) and 2,2-Diphenyl-1-picrylhydrazyl (DPPH) were determined. AFAC was preferred by younger panelists (18-44), peaking at 36.59% (35-44). NFAC preferred by 45-54 (44.68%). NFNC and NFAC share equal preferences among oldest (55-64). Females showed a slightly higher preference (33.55%)compared to males (31.69%) for NFNC. Males lead in preference for AFAC (34.58%) and NFAC (34%). Asians preferred AFAC (37.74%), with a lower preference for NFAC. African Americans preferred AFAC (33.55%), NFNC (33.33%). Whites had a strong preference for NFAC (40%) MS graduates showed equal preferences for NFNC and AFAC (35.69%). PhDs preferred NFAC (37.50%), but NFNC least (27.88%). High School graduates favored NFNC (34.63%) over AFAC (33.81%). Ethanol extracts showed significantly higher FRAP and DPPH values (309.78%, 83.81%) compared to aqueous extracts (195.56%, 62.63%) suggesting lipophilic phytochemicals present in mint. Food/beverage industry is leaning towards clean-label, functional, and sustainable products. Mint, a functional ingredient, is on the forefront of meeting these demands.

Abstract # 211

Utilization of Functional Foods in Reducing the Incidence and Severity of PCOS

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Mentor(s): Drs. Nedra Montgomery, Elvis Baidoo, Martha Verghese
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Polycystic Ovary Syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age, with an estimated global prevalence of 5–10%. It is characterized by hormonal imbalances, insulin resistance, chronic inflammation, and metabolic dysfunction, which can lead to infertility, obesity, and an increased risk of type 2 diabetes. Despite its widespread impact, there are limited functional food products available that specifically target PCOS-related symptoms through dietary intervention.

This study focuses on the development of a functional food product designed to address the key dietary concerns associated with PCOS: chronic inflammation, insulin resistance, and glycemic control. Sweet potatoes and turmeric manage PCOS by improving insulin sensitivity, reducing inflammation, and balancing hormones. Sweet potatoes have a low glycemic index, fiber, and beta-carotene, which support blood sugar control and ovarian function. Turmeric's curcumin reduces inflammation, enhances insulin sensitivity, and lowers testosterone, helping regulate menstrual cycles and reduce symptoms. A Sweet Potato Turmeric Cheese Stick was developed. Sweet potatoes serve as the base, providing a nutrient-dense, slow-releasing carbohydrate source. Turmeric, a potent anti-inflammatory ingredient, aids in mitigating chronic inflammation. Various flour and ingredient combinations were tested to optimize texture, color, and pH while maintaining low glycemic impact, including almond flour mixed with brown rice flour, almond flour with sorghum flour, and almond flour with wheat flour.

The physicochemical properties (texture, color, aW and pH) were evaluated. Preliminary results indicate that the formulation successfully maintained desirable textural properties while meeting the dietary needs of individuals with PCOS. The findings underscore the need for expanding PCOS-friendly food options in the market, providing a novel, nutrient-dense alternative for symptom management through dietary means.

Abstract #212

The development of a High Protein Muffin targeting Adolescents with Obesity: antioxidative potential of ancient grain flours in comparison to gluten free flour

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The increasing prevalence of obesity among adolescents aged 18-24 presents a growing public health concern. This study explores the development of a gluten-free, high-protein functional food product aimed at supporting weight management while catering to individuals with gluten sensitivity. Many commercially available gluten-free products are high in carbohydrates, which can contribute to weight gain and metabolic issues. To address this gap, this research investigates the use of protein- and fiber-rich ancient grains, including amaranth, buckwheat, quinoa, and chickpea flours, as alternatives to traditional gluten-free all-purpose flour. The study assesses the antioxidant potential of these flours through 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) assays. A gluten-free muffin formulation was developed using selected flours, and its nutritional profile was evaluated to ensure a balance of macronutrients conducive to weight management. Additionally, a nutrition label, Hazard Analysis and Critical Control Points (HACCP) plan, and packaging plans were developed to enhance the product's market readiness. Key findings indicate that the selected flours exhibit significant antioxidant potential and provide an improved nutritional profile compared to conventional gluten-free options. The study highlights the potential of high-protein, low-carbohydrate gluten-free products in addressing obesity concerns among adolescents, athletes, and individuals with gluten intolerance. Future research should explore long-term health impacts and the expansion of such formulations. This study contributes to the growing field of functional food development by demonstrating the feasibility of nutritionally enhanced gluten-free products that promote healthier lifestyles.

Abstract # 213

Development of a Functional Food Snack Product Utilizing Antioxidant Rich Spirulina Microalgae and Bilberry

Katelyn Boyle, Terica Curtis, Rajwinder Kaur, Joshua Herring, Nedra Montgomery II, Martha Verghese

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Department of Food and Animal Science

In this century where effective disaster management has become more urgent than ever, social media plays a critical role in sharing information during crises. Disaster management is key to saving lives and reducing the impact of crises. This research focuses on extracting, classifying, and analyzing tweets using Natural Language Processing techniques such as BERT-based text classification, Named Entity Recognition, and sentiment analysis. The system supports dynamic, real-time monitoring. The paper describes the methodology employed, including dataset preprocessing, model training, and the development of an interactive dashboard for disaster monitoring. The results demonstrate the system's ability to categorize disaster-related posts, assess their urgency, and pinpoint affected areas. A brief discussion is provided on how these findings can help local communities and the authorities respond more effectively during emergencies. Future work is

recommended to incorporate data from additional social media platforms, such as Facebook and TikTok, and to integrate multimedia analysis using Convolutional Neural Networks for satellite images and videos. This research lays the foundation for enhancing disaster response systems through insights drawn from social media and satellite images. Spirulina (S) is a protein-rich cyanobacterium. Bilberry (B) is a dark berry known for its medicinal purposes. Overall, the aim was to use two underutilized (S & B) ingredients to develop an adolescent-friendly functional snack addressing childhood obesity. Aqueous (AQ) and 80% ethanol (ET) extracts of S & B (100% S (100S), 100% B, (100B), 50% S + 50% B (50S+50B), 75% S + 25% B (75S+25B), and 25% S + 75% B, (25S+75B) were prepared. A functional snack muffin was developed (containing different concentrations of S & B) followed by physicochemical analysis, sensory evaluation, shelf life, and scanning electron microscopy (SEM). Muffin ET extracts (chocolate (control), 1% S + 4%B), 2% S + 8% B) were prepared. Chemical, Total Phenolic and Flavonoid Content (TPC & TFC), and antioxidant assays: Trolox Equivalent Antioxidant Capacity, 2,2, Dipheyl-1-picrylhdrazyl, and Ferric Reducing Antioxidant Potential (TEAC, DPPH, & FRAP) were conducted using standard protocols.TPC (1987.57) and TFC (41.41) were highest in 100B ET compared to 100S ET and combinations. DPPH % inhibition ranged from 67% - 95% (ET) and 20% - 60% (AQ). TEAC in 100S ET (148.68) was 1.23 to 7.66 times higher than other ET extracts. Highest NORS (mM NO/ 100g DW) in 100B ET (28.41), 75S+25B AQ (26.52). Highest FRAP (mM F.E. (II)/100g DW) seen in 100B ET (229.48) and AQ (113.51). Sensory panelists determined 1%S+4%B muffin was most acceptable for all attributes. 2%S+8%B muffin (170.00) had the highest texture (post peak (N)) and better volume from SEM micrographs compared to counterparts. Physicochemical properties remained constant for 9 days. The 2%S+8%B muffin showed the highest DPPH % inhibition and FRAP values. DPPH % inhibition and FRAP values ranged from 2.47% -33% and 49.00-117.63, respectively.

Abstract # 214

The Development of Functional Pastry Products Targeting Celiac Disease

Kaylah Bias, Nedra Montgomery II, Elvis Baidoo, Martha Verghese

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Department of Food and Animal Science

Celiac disease is an autoimmune disorder where gluten ingestion triggers an immune response that damages the villi leading to nutrient malabsorption. Gluten is a protein found in wheat, rye, and barley. It is made up of gliadin and glutenin. Gliadin is a prolamin protein which has a high content of proline and glutamine, making it resistant to digestion. It is responsible for the elasticity of dough. Glutenin creates a network that traps gas bubbles during fermentation, given rise to dough. Although the demand for gluten-free products is growing, many commercially available options lack nutrients and functionality. To address this gap, functional pastry products were developed utilizing alternative flours. Physiochemical properties (pH, Color, aW, Volume, Texture) were determined in comparison to wheat flour counterparts. The antioxidant potential of these flours were determined using standard protocols of Total Phenolic Content (TPC), Total Flavonoid Content (TFC), 2,2-diphenyl-1-picrylhydrazyl (DPPH), and ferric reducing antioxidant power (FRAP) assays. Preliminary formulations of the products developed include Chocolate Chia Cake, Avocado Matcha Cake, Almond Oat Mini Cake, Sweet Potato Chocolate Lava Cake, and Carrot Coconut Cake. As consumer demand for gluten-free products continues to rise, this research will contribute to enhancing their accessibility and market viability.

Abstract # 215

Evaluating the Efficiency of Sanitizers Against Salmonella and E. coli Using a Kirby-Bauer Diffusion Method

Philip Bwaly, Armitra Jackson-Davis

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Department of Food and Animal Science

Foodborne pathogens such as Salmonella Enteritidis and E. coli O157:H7 are significant risks to food safety. Both are Gram-negative, facultative anaerobes, capable of surviving with or without oxygen, and possess an outer membrane that enhances resistance to antimicrobial agents. Salmonella causes gastroenteritis, while E. coli produces Shiga toxin, leading to severe illnesses such as hemorrhagic colitis. Natural and commercial wash solutions are being explored as safer alternatives to chemical sanitizers for reducing microbial contamination. The objective of this study was to compare the antimicrobial efficacy of various sanitizers against Salmonella Enteritidis and E. coli O157:H7. A total of six Tryptic Soy Agar plates were divided into six quadrants, and a circular well was cut into each quadrant using a sterile pipette. Salmonella Enteritidis was spread onto three plates, and E. coli O157:H7 onto the other three using sterile swabs, avoiding contact with the wells. A pipettor was used to add 100 µL of each sanitizer to its designated well, with distilled water as a control. Plates were incubated at 37°C for 24 h, and zones of inhibition were observed. Sanitizer D showed large, defined zones of inhibition against both pathogens, indicating strong antimicrobial activity. Sanitizer E exhibited medium inhibition against both microorganisms. Sanitizer A produced very small zones against both, while lemon oil and rosemary extract showed no inhibition. These results suggested that Sanitizer D was highly effective, Sanitizers A and E were minimally effective, and sanitizers B and C had no effect at all. This study identifies effective, natural, and commercial sanitizers to reduce foodborne pathogens, enhancing food safety and public health.

Abstract # 216

Evaluating the effect of hemp by-products on proliferation and glucose utilization of Immortalized chicken macrophages.

Lizette Garcia and Miriam Garcia

Mentor(s): Dr. Miriam Garcia
Department of Food and Animal Sciences

Hemp byproducts have been approved for use in laying hens, yet research on their immunomodulatory effects remains scarce. Ethanol-based extracts require determining ethanol tolerance to separate solvent toxicity from bioactive effects. This study aimed to determine the effects of hempseed extracts (HS) and ethanol on proliferation and glucose utilization of immortalized chicken macrophages, providing baseline data for future immunometabolic studies. Dehulled HS was extracted with 70% ethanol. Cells were cultured in 20% FBS, 1% glutamine, and 1% antibiotics at 41℃ with 5% CO2. At 80% confluence, cells were treated with 13 treatments: six HS doses (4,000 to 125 µg/mL in twofold dilutions, each with ethanol from 0.7% to 0.022%), six ethanol-only doses at matching ethanol levels, and one untreated control. After 24 h, media was collected for glucose analysis, and AlamarBlue (10 µL) was added; proliferation was measured 48 h after treatment (absorbance at 520 nm). Data were analyzed using the PROC MIXED procedure in SAS, with significance set at $P \leq 0.05$ and tendencies at $0.05 < P \leq 0.10$. Compared to the untreated control, the highest four ethanol doses and the highest three HS doses tended ($P < 0.10$) to reduce

proliferation, while lower doses did not differ from control. HS at doses 1 (P=0.08) and 2 (P=0.07) tended to increase proliferation compared to their ethanol counterparts, and at dose 4, the difference was significant (P<0.01), suggesting a potential cytoprotective effect of HS against ethanol-induced cytotoxicity. No treatment effects on glucose levels were observed at 24 h, indicating longer incubation may be needed to detect metabolic changes. In conclusion, HS doses and ethanol levels that maintained acceptable cell viability showed dose-dependent improvements in proliferation relative to ethanol controls, suggesting potential cytoprotective and immunomodulatory effects. Future studies will use selected HS doses in this cell model to assess immunometabolic responses to pathogen challenge.

Abstract # 217

Health Benefits of Selected Processing Methods on Oregano (*Origanum vulgare*)

Amir Akinloye, Nedra Montgomery II, Harpreet Singh, and Martha Verghese
Mentor(s): Dr. Martha Verghese
Department of Food and Animal Sciences

A popular herb for cooking and medicine, oregano (*Origanum vulgare*) is known for various bioactive compounds. Oregano is a viable option for treating metabolic diseases, including diabetes and obesity due to its anti-inflammatory, antidiabetic, and antioxidant properties. However, the concentration and therapeutic potential of these compounds are greatly influenced by parameters including particle size and processing methods. Optimizing particle size and drying may increase the functionality of oregano. This study investigates commercially processed and fresh oregano antioxidant potential in reference to particle size (from whole to crushed) and comparing drying (microwave, air, and oven) methods. Oregano extracts were prepared with two solvents, 80% ethanol (EtOH) and Aqueous (AQ). Chemical analysis was performed using standard protocols for total phenolic content (TPC) and total flavonoid content (TFC). Antioxidant potential was measured using standard protocols of ferric reducing antioxidant potential (FRAP), 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging, nitric oxide radical scavenging (NORS), and Trolox equivalent antioxidant capacity (TEAC) assays. Oregano extracts will be used to determine antidiabetic properties by performing in-vitro assays for inhibition of lipase, alpha-glucosidase, and alpha-amylase activity. Commercial oregano TPC, (EtOH and AQ) were higher than farm fresh at 1439.36 and 1479.66mg GAE/g DW respectively. However, whole dried (leaf) was higher than all processing methods at 10239.36. The values for TFC followed the same trend as TPC for all processing methods. When extracted with EtOH, FRAP values were higher than counterparts extracted with AQ solvent no matter the processing method. This study suggests that processing conditions may maximize health benefits of oregano by having smaller particle size and multiple drying methods based on the source and origin of oregano.

Abstract # 218

Evaluation of Dynamic Rheological Characteristics of 3D-Printable Ink Formulations for Plant-Based Meat Analogues

Vinay Madala and Mamadou Lamin Kassama
Mentor(s): Dr. Mamadou Lamin Kassama
Department of Food and Animal Sciences

Plant-based meat analogs are primarily made from soy protein isolate (SPI) and texturized vegetable

protein (TVP), designed to replicate meat. Additive Manufacturing (AM), or 3D printing, is one production method that builds complex structures layer by layer. To ensure effective 3D printing, understanding the viscoelastic properties of the meat analog formulation is essential. This study evaluates the rheological properties related to the printability of a 3D-printable ink formulation for plant-based meat analogs. The ingredients include soy protein isolate, texturized soy protein, water, salt, methylcellulose, potato starch, coconut oil, beet juice extract, mushroom powder, wheat gluten, and sunflower lecithin. Three formulations with different ratios of SPI to TVP, 100:0, 50:50, and 0:100, were developed. A Discovery hybrid rheometer (DHR-2) was used to measure the viscoelastic properties (G', G", and tan δ) of these formulations. Data analysis was performed using SPSS 27 Software, with an analysis of variance (ANOVA) conducted at a 5% significance level. The flow behavior of the samples was assessed at 25°C over a shear rate range of 1 to 100 s^{-1}. All samples exhibited shear-thinning behavior, which aids in smooth extrusion during 3D printing. The formulations displayed primarily elastic behavior, suggesting their suitability for 3D printing. Additionally, tan δ values were below 1 for all samples, indicating stronger elasticity than viscosity, ideal for 3D printing. This additive formulation ensures high-quality 3D-printed meat analogs. The viscoelastic properties of a 3D-printable ink, particularly its shear-thinning behavior, are critical for smooth extrusion and precise layer deposition. Achieving the right balance between viscosity (G") and elasticity (G') ensures the ink flows easily under shear stress while maintaining structural integrity, resulting in accurate and stable 3D-printed meat analogs.

Abstract # 219

Antioxidant Activity and Cytotoxic Effects of Date Seed Extracts on Colon Cancer Cells (HT-29)

Harpreet Singh, Judith Boateng, Rajwinder Kaur, and Martha Verghese

Mentor(s): Dr. Martha Verghese

Department of Food and Animal Sciences

Date seeds (Phoenix dactylifera) are a promising source of bioactive compounds, particularly phenolics and flavonoids, known for their antioxidant properties (Maqsood., 2020). This study investigates antioxidant and cytotoxic effects of date seed extracts on HT-29 colon cancer cells. Date seeds were assessed for total phenolic (TPC) and flavonoid content (TFC). Antioxidant activities were determined using 2,2-diphenyl-1-picrylhydrazyl (DPPH), Ferric reducing antioxidant power (FRAP), Trolox equivalent antioxidant capacity (TEAC), and Nitric oxide radical scavenging (NORS). HT-29 colon cancer cells were treated with varying concentrations (125, 250, 500, and 1000 µg/ml) of extract for 24 hours. Lactate dehydrogenase (LDH) release was measured as an indicator of cytotoxicity. Cell viability was evaluated via MTT assay, while superoxide dismutase (SOD), catalase (CAT) activities and glutathione (GSH) levels were measured to assess cellular antioxidant response using standard kits. TPC of date seed extracts was 7660 ± 80 mg G.A.E/100g DW and TFC was 4360 ± 22 mg C.E/100g DW. Antioxidant activities of date seed extracts were 82.6 % for DPPH% inhibition, whereas TEAC & NORS were 31.74 ± 0.24 µg T.E./100g D.W., and 28433 ± 238 mM NO/100g D.W. MTT assay indicated a decrease in cell viability with increasing extract concentrations: 82% at 125 µg/ml, and 62% at 1000 µg/ml. LDH release increased with higher extract concentrations, showing 11.11% at 125 µg to 30.06% at 1000 µg/ml, indicating increased cytotoxicity. SOD activity increased significantly ($p \leq 0.05$) to 38.9 U/mg protein at higher concentration (1000 µg/ml). GSH increased from 5.62 µM to 41.14 µM, and CAT activity increased with increasing concentrations. Results demonstrated that date seed extracts possess significant antioxidant activity and exhibited dose-dependent cytotoxic effects on HT-29 colon cancer cells. Increased cytotoxicity suggests a protective mechanism against cancer, highlighting potential of date seeds as a functional food in cancer prevention and management.

Abstract # 220

Non-thermal (NT) Plasma -Activated Water (PAW): Enhanced Food Safety and Quality

Miguel Sanmartin and Lamin Kassama

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Department of Food and Animal Sciences

Plasma Activated Water (PAW) is an innovative non-thermal disinfection method that involves exposing water to cold plasma, generating reactive oxygen and nitrogen species (ROS and RNS) such as hydroxyl radicals, ozone, hydrogen peroxide, nitric oxide, and nitrate compounds. These reactive species possess potent antimicrobial properties, making PAW a promising alternative to traditional thermal and chemical disinfection methods. PAW's potential in food safety is particularly noteworthy due to its sustainable, chemical-free, and energy-efficient nature. Hence, this study aims to evaluate the efficacy of PAW in inactivating common foodborne pathogens, including Escherichia coli, Listeria monocytogenes, and Salmonella spp., while preserving the sensory and nutritional qualities of fresh produce, meat, and seafood. The antimicrobial activity of PAW will be evaluated by examining physicochemical parameters such as Oxidation Reduction Potential (ORP), conductivity, and pH. These parameters reflect the concentration of reactive species, and the antimicrobial capacity will be tested against various microorganisms. The expected outcomes include microbial reductions of 3 to 5 log CFU/mL across various food matrices and an extension in shelf life by 2 to 7 days, depending on the food type and storage conditions. The study will also address challenges related to the consistency of PAW's antimicrobial performance, variability in treatment systems, and the lack of standardized protocols, which currently hinder large-scale implementation. Additionally, toxicological evaluations will be conducted to ensure the safety of plasma-treated foods. By addressing these issues, PAW has the potential to prove a scalable solution for enhancing food safety and extending the shelf life of various food products.

Abstract # 221

Evaluation of Dynamic Rheological Characteristics of 3D-Printable Ink Formulations for Plant-Based Meat Analogues

Vinay Madala and Lamin Kassama

Mentor(s): Dr. Lamin Kassama
Department of Food and Animal Sciences

Plant-based meat analogs are primarily made from soy protein isolate (SPI) and texturized vegetable protein (TVP), designed to replicate meat. Additive Manufacturing (AM), or 3D printing, is one production method that builds complex structures layer by layer. To ensure effective 3D printing, understanding the viscoelastic properties of the meat analog formulation is essential. This study evaluates the rheological properties related to the printability of a 3D-printable ink formulation for plant-based meat analogs. The ingredients include soy protein isolate, texturized soy protein, water, salt, methylcellulose, potato starch, coconut oil, beet juice extract, mushroom powder, wheat gluten, and sunflower lecithin. Three formulations with different ratios of SPI to TVP, 100:0, 50:50, and

0:100, were developed. A Discovery hybrid rheometer (DHR-2) was used to measure the viscoelastic properties (G', G", and tan δ) of these formulations. Data analysis was performed using SPSS 27 Software, with an analysis of variance (ANOVA) conducted at a 5% significance level. The flow behavior of the samples was assessed at 25°C over a shear rate range of 1 to 100 s^{-1}. All samples exhibited shear-thinning behavior, which aids in smooth extrusion during 3D printing. The formulations displayed primarily elastic behavior, suggesting their suitability for 3D printing. Additionally, tan δ values were below 1 for all samples, indicating stronger elasticity than viscosity, ideal for 3D printing. This additive formulation ensures high-quality 3D-printed meat analogs. The viscoelastic properties of a 3D-printable ink, particularly its shear-thinning behavior, are critical for smooth extrusion and precise layer deposition. Achieving the right balance between viscosity (G") and elasticity (G') ensures the ink flows easily under shear stress while maintaining structural integrity, resulting in accurate and stable 3D-printed meat analogs.

Abstract # 222

Harnessing Polyphenols in Muscadine Grape Pomace Seed Oil

MANIDEEP BUSARAPU

Mentor(s): Dr. JUDITH BOATENG
Department of Food and Animal Sciences

Muscadine grape (Vitis rotundifolia), is gaining attention due to its high concentration of bioactive compounds. The polyphenol content in muscadine grape seed oil (MGSO) is of significant interest due to its potential health benefits and functional applications in food and nutraceuticals. The choice of extraction method of polyphenols from MGSO involves various methods that influence the yield, composition, and bioactivity of the polyphenolic compounds. In this study, the solvent extract method (hexane) was used to extract oil from muscadine grape pomace seeds. Methanol was used for isolating polyphenols from MGSO. Varying solvent concentration, temperature, and extraction time to determine the most effective conditions for polyphenol yield was studied. The extracted polyphenols were analyzed using spectrophotometric assays to quantify total polyphenols, flavonoids, anthocyanins and antioxidant activities. The results demonstrated that methanol extraction provides a high yield of polyphenols with significant antioxidant activity, making it a promising method for enhancing the value of muscadine grape seed oil as a functional food ingredient or in nutraceutical and cosmetic formulations.

Abstract # 223

Comparative Analysis of SCOBY Formation and Physicochemical Properties in Kombucha Produced from Two Commercial Kombucha Brands

Maria Martinez, Karyn Rose, and Joshua Herring

Mentor(s): Dr. Joshua Herring
Department of Food and Animal Sciences

Kombucha, a fermented tea beverage, relies on a symbiotic culture of bacteria and yeast (SCOBY), with its microbial composition and environmental conditions greatly influencing fermentation outcomes. This preliminary study evaluated two different commercial kombucha starter cultures under identical controlled conditions to assess their effects on SCOBY formation, microbial activity, and key fermentation parameters. Both starter cultures were fermented using a standardized tea blend consisting of 60% black tea and 40% green tea. During this initial trial phase, fermentation efficiency and product quality were monitored through pH and °Brix (sugar content) measurements. Results revealed notable differences between the two starter cultures: one produced a lower average pH of 1.92, indicating higher acidity, while the other retained a significantly higher °Brix (40.1% versus 8.9%), suggesting slower sugar metabolism. A t-test confirmed that both observed differences were statistically significant ($p < 0.05$). These findings underscore variability in fermentation dynamics among commercial starter cultures and confirm that pH and °Brix can serve as effective early indicators. This study provides a methodological foundation for subsequent full-scale experiments, including replication, microbial profiling, and sensory analysis, to further explore kombucha fermentation efficiency and its implications for product quality and consumer acceptance.

Keywords: Kombucha, fermentation, pH, Brix, SCOBY

Abstract # 224

Venison Sausage and its benefits

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Department of Food and Animal Sciences

The growing demand for healthier meat products has prompted the exploration of alternative ingredients that enhance nutritional profiles without compromising sensory quality. This study investigates the incorporation of quinoa as a fat substitute in deer sausage formulations. Deer meat, known for its low fat and high protein content, offers a lean base for sausage production; however, traditional sausage formulations rely heavily on animal fat for texture, flavor, and juiciness. Quinoa, a nutrient-dense pseudo- cereal rich in essential amino acids, dietary fiber, and unsaturated fats, was evaluated as a functional ingredient to replace pork fat at varying levels (0.0, .25, .500, .75, an 1.00 lb.) Physicochemical properties, including moisture content, pH, moisture, water activity, and color, were measured alongside sensory attributes such as flavor, texture, juiciness, maintained acceptable texture and flavor profiles while significantly reducing total fat and overall acceptability. Results showed that replacing up to 20% of fat with quinoa content and increasing dietary fiber. Sausages with quinoa demonstrated improved nutritional value, including a better lipid profile and higher antioxidant capacity, without compromising microbial stability during storage. Texture profile analysis indicated that quinoa contributed to increased firmness and reduced cohesiveness compared to the control. The study concludes that quinoa is a promising fat alternative for formulating healthier deer sausage, particularly at 15%-20% substitution levels, balancing improved health benefits with sensory quality. Further research may explore quinoa’s interaction with binding agents or emulsifiers to optimize texture at higher substitution levels.

Abstract # 225

Selected Synergistic Health Benefits of Spices (Ginger and Turmeric)

Tejasri Thatipamula, N. Montgomery, R. Kaur, H. Singh, K. Medabalimi, J. Boateng, M. Verghese

Mentor(s): Dr. Martha Verghese
Department of Food and Animal Sciences

Spices (ginger and turmeric) contain bioactive compounds that may inhibit carbohydrate and lipid-metabolizing enzymes, contributing to their anti-diabetic and anti-obesity properties. Ginger (G) and Turmeric (T) contain phenolic substances with strong anti-inflammatory and antioxidant effects. In

combination, G&T may synergistically enhance functional bioactivity, bioavailability, and their utilization in the food industry for additional health benefits. The objectives were to determine the selected health benefits of G&T (pure and in combinations). Total phenolic content (TPC), total flavonoid content (TFC), 1,1-diphenyl-2picrylhydrazyll radical scavenging activity (DPPH), Ferric reducing antioxidant power (FRAP), Trolox equivalent antioxidant capacity (TEAC), Nitric oxide radical scavenging ability (NORS) and inhibition of α-glucosidase, α-amylase, and lipase enzymes by G&T extracts were evaluated using standard protocols. Aqueous extracts (AQE) and 80% Ethanol extracts (ETE) were prepared from samples, 100%Ginger (100G), 75%Ginger + 25%Turmeric (25G+75T), 50%Ginger + 50%Turmeric (50G+50T), 25%Ginger + 75%Turmeric (25G + 75T), and 100%Turmeric (100T). Spice ETE yielded over 5-fold higher phenolics compared to AQE. Among ETE, samples with higher turmeric concentration showed higher TPC (mg G.A.E./100g DW) [100T (3098.22), 25G+75T (2733.66)] and TFC (mg C.E./100g DW) [100T (995.36), 25G+75T (967.06)]. The highest DPPH inhibition (90%) was seen by 50G+50T ETE combination, followed by 25G+75T (87%) and 100G (86%). AQE significantly ($p \leq 0.05$) lowered DPPH inhibition, from 9- 61%. However, TEAC in AQE was significantly ($p \leq 0.05$) higher than ETE. Spices with a higher Ginger concentration had higher inhibition (%) of metabolizing enzymes. The highest enzyme inhibition (%) was seen by 75G-25T ETE (50.23% of α-amylase and 60% of lipase), indicating a synergistic interaction between G&T. Synergistic effects of G&T enhance antioxidant activity and inhibit metabolizing enzyme activities. Future studies should explore alternative extraction methods, cell culture studies, and development of functional foods or beverages using G&T for chronic disease prevention.

Abstract # 226

Antioxidant potential of pigmented rice: black and red rice using different processing methods

Vanessa Njoku, N. Montgomery, J. Boateng, E. Baidoo and M. Verghese

Mentor(s): Dr. Martha Verghese

Department of Food and Animal Sciences

Introduction Black and red rice, known for their high anthocyanin content have gained attention because of their potential health benefits. These pigmented rice varieties have traditionally been utilized in Asian medicine to treat a variety of disease conditions. Recent research has also linked their consumption to a lower risk of heart disease and certain cancers (Murdifin et al, 2015). Purpose This study aims to evaluate the antioxidant potential of black and rice utilized in different extraction solvents (80% ethanol and aqueous). Methodology: Each rice sample was subjected to various preparation methods, including raw, roasted, boiled, and naturally fermented treatments. Preparation treatment methods were conducted in triplicates. All samples were analyzed on a dry matter basis. Fermented rice samples and boiled rice samples were freeze-dried to dry matter prior to analysis. All rice samples were extracted with 80% ethanol and aqueous following standard procedures. A 5-fold serial dilution was performed on all extracted samples following standard protocols. Total flavonoid content (TFC) was assessed on all extracted samples following a standard protocol. Preliminary results: The Total Flavonoid Content (TFC) for rice samples extracted with 80% ethanol for raw red rice was 638.03± 1.90 (mg/100g C.E D.W), raw black rice was 476.84± 1.90(mg/100g C.E D.W), roasted red rice was 458.64±1.06 (mg/100g C.E D.W), roasted black rice was 389.42± 2.87 (mg/100g C.E D.W), boiled red rice was 496.06± 1.40 (mg/100g C.E D.W), boiled black rice was 385.07± 1.03(mg/100g C.E D.W), fermented red rice was 458.64± 1.06 (mg/100g C.E D.W), and fermented black rice was 431.92± 1.22 (mg/100g C.E. D.W) Significance: Red and black rice are nutrient-dense grains high in antioxidants, fiber, and key vitamins, which help to improve heart

health and overall well-being. Exploring several preparation methods can provide a better understanding of which technique provides the highest antioxidant potential

MECHANICAL AND CIVIL ENGINEERING

AND

CONSTRUCTION MANAGEMENT

Undergraduate

Abstract # 227

INL Remote Core Clamping Actuator

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Mentor(s): Dr. Mebougna Drabo
Department of Mechanical and Civil Engineering

The Idaho National Laboratory (INL) is advancing nuclear testing technologies at the Transient Reactor Test Facility (TREAT) by improving the remote-controlled core clamping system. This system ensures proper alignment of fuel assemblies using four horizontally mounted clamping bars actuated by push rods that penetrate the concrete shield. The North and East clamping bars are bolted into position, while the South and West bars are spring-loaded to maintain even pressure. Currently, the system operates manually via an 81-inch-long tool with a welded 1⁄2-inch hex socket.

This project aims to enhance the clamping process's safety, efficiency, and reliability by developing a hybrid manual and remote-controlled mechanism. The new system will enable operators to apply the required 20 ft-lbs of torque while integrating a visual verification feature for monitoring clamp position, both remotely and locally. Additionally, the design will minimize modifications to existing clamps and incorporate a backup system to ensure continued operation in case of remote system failure. These improvements will enhance usability, and reduce operational risks, and strengthen reactor testing capabilities at TREAT.

Abstract # 228

Hypersonic Thermal Protection System Analysis

Kaila Cox, Demetrius Freeman, Jaylon Dixon

Mentor(s): Dr. Mebougna Drabo
Department of Mechanical and Civil Engineering

This study presents a comparative analysis of a hypersonic vehicle with and without defects in its Thermal Protection System (TPS), highlighting the associated risks and performance implications. Hypersonic vehicles, operating at speeds of Mach 5 and above, experience extreme aerodynamic

heating, necessitating a robust TPS to ensure structural integrity and mission success. A defect in the TPS—such as a crater-like material removal—can disrupt airflow, alter heat distribution, and compromise structural stability, potentially leading to mission failure.This research examines the aerodynamic and thermal consequences of such defects by comparing a Mach 10 hypersonic vehicle with an intact TPS to one with a specified defect. Key parameters, including speed, temperature, atmospheric pressure, and material selection, are analyzed to assess the impact on vehicle performance and safety. By evaluating airflow disturbances, heat concentration effects, and structural integrity variations, this study provides critical insights into the challenges posed by TPS defects and their implications for future hypersonic vehicle design and reliability.

Abstract # 229

Raytheon Autonomous Vehicle Competition

Wesley Cotton, Jarett Davis, Dillion Ripper, Kevin Wells, Chade Curtis, Ernest Battles, Tionne White, Antonio Miller, Jakobe Lett

Mentor(s): Dr. Mebougna Drabo
Department of Mechanical and Civil Engineering

The Raytheon Autonomous Vehicle Challenge is an annual competition designed to foster innovation and critical thinking by allowing students to apply the knowledge acquired throughout their academic careers. This competition provides an immersive, real-world experience where students collaborate under the mentorship of seasoned professionals to develop advanced autonomous systems.

The challenge involves two distinct teams working in tandem to achieve a common objective: one team is responsible for constructing a reconnaissance drone, while the other develops a delivery drone. Although each team operates independently, precise synchronization between the two autonomous vehicles is essential for success.

The competition is divided into two phases. In the first phase, the autonomous reconnaissance vehicle must scout a designated area, identify a specific marker, and transmit the coordinates to the delivery vehicle. This transmission initiates the second phase, where the autonomous delivery vehicle must navigate to the identified location and deliver its payload without any human intervention. Throughout both phases, all communication and data logging between the vehicles must be conducted entirely autonomously, demonstrating seamless integration of hardware and software systems. This challenge not only tests the students' technical skills in robotics, communication systems, and software development but also emphasizes teamwork, problem-solving, and system integration. By participating in this competition, students gain valuable hands-on experience, preparing them to tackle complex engineering challenges in their future careers.

Abstract # 230

Conceptual Design of a Wastewater Treatment Plant for Compliance with Future Effluent Standards in Clearford, Alabama

Aglaia Dextra, Ashanti Harper, and Pooja Preetha

Mentor(s): Dr. Pooja Preetha

Department of Mechanical and Civil Engineering

Clearford, Alabama, faces increasingly stringent wastewater discharge regulations under its upcoming Alabama Department of Environmental Management (ADEM) permit. To ensure compliance for the next 20 years, this research proposes a new wastewater treatment plant (WWTP)

to treat an average daily flow of 18 million gallons per day (MGD) of domestic and commercial wastewater. The multi-stage treatment system includes preliminary sedimentation, activated sludge treatment, and secondary settling, with provisions for tertiary processes as needed. The main design features include a 250,000-gallon pH adjustment tank with real-time monitoring, targeted reductions in Biochemical Oxygen Demand (BOD_5) from 230 mg/L to 10 mg/L, Total Suspended Solids (TSS) from 200 mg/L to 30 mg/L, and Ammonia (NH_3) from 23 mg/L to 2 mg/L. The design scenarios yielded removal efficiencies of 95%, 85%, and 91%, respectively. The study results found that an aeration tank volume of 6.45 MG with a detention time of 6 hours and a secondary clarifier diameter of 169.6 feet favors an effective design compliance for future water use. By implementing this optimized process, the new WWTP will not only meet regulatory standards but also improve water quality and operational efficiency for the growing population.

Abstract # 231

Attitude Thruster Control System: Rocket Thruster Anomaly

Ryan Griffin, Christopher Vaughn, Aaron House, Chandler Gulley

Mentor(s): Dr. Mebougna Drabo

Department of Mechanical and Civil Engineering

Precise attitude control is critical for space operations, ensuring satellite stability and mission success. This project investigates an anomaly in the Attitude Control System (ACS) thrusters, which stabilize a spacecraft along three axes: roll, pitch, and yaw. Malfunctions in certain thrusters have led to unintended positional deviations, compromising fuel efficiency and navigation.

Our team aims to identify the root cause of this anomaly and develop innovative solutions to mitigate future risks. We employ MATLAB simulations to analyze thruster performance under real-world conditions and use fault tree analysis to systematically diagnose potential failure points. These simulations allow us to evaluate the impact of thruster misfires on spacecraft stability and test corrective strategies before implementation.

Key contributions of this project include:

- Root Cause Analysis: Identifying failure points within the ACS to determine the cause of thruster irregularities.
- Simulation and Testing: Developing MATLAB models to replicate and troubleshoot anomalies in a controlled environment.
- Safety and Reliability Enhancements: Implementing design modifications to ensure precise attitude control and prevent future malfunctions.
- Standards Compliance: Aligning proposed solutions with established spacecraft safety standards (ISO 9001, ISO 14620-1, IEC 61508) to enhance mission security and efficiency.

By improving ACS reliability, our research helps prevent mission-critical failures, reduces fuel consumption, and enhances spacecraft maneuverability. Through refined control algorithms and rigorous verification, we contribute to safer and more efficient space operations.

Abstract # 232

ASCE Construction Institute Presentation on Metlife Stadium Renovation

Bryce Howard, and. Pooja Preetha

Mentor(s): Dr. Pooja Preetha

Department of Mechanical and Civil Engineering

The presentation, made for the 2025 ASCE Construction Institute Competition for the Gulf Coast Symposium at Mississippi State University, aimed to analyze and optimize the construction project logistics of a hypothetical stadium renovation project for the 2026 World Cup Stadium locations in New York, Atlanta, and Nashville. Precisely, it addressed the transportation of materials, storage space optimization, and cost reduction measures. It further examined contingency planning to counter schedule disruptions caused by external factors, such as sporting activities and spurious delays. To construct the analysis, broad data were collected from industry cost databases (USGS, RSMeans), contractor bids, and real stadium renovation case studies like Bryant-Denny's Stadium Renovation in 2019. The presentation involved a formal review of modular field installation techniques and evaluated their impact on labor efficiency, material loss, and overall project duration.

Abstract # 233

Horizontal Axis Wind Turbines (HAWT)

Corion J Holloman, Destiny Brand, Isaiah Thompson, Tyra Ravenell, and Showkat Chowdhury

Mentor(s): Dr. Showkat Chowdhury

Department of Mechanical and Civil Engineering

Wind energy is a clean, renewable power source that harnesses the kinetic energy of moving air (incoming wind) to generate electricity. Among the various wind turbine designs, the horizontal-axis wind turbine (HAWT) is the most widely used due to its efficiency and adaptability. HAWTs feature blades that rotate around a horizontal shaft, capturing wind energy and converting it into mechanical power, which is then transformed into electricity. This technology plays a crucial role in reducing dependence on fossil fuels, which contribute to environmental degradation, greenhouse gas emissions, and resource depletion. Compared to fossil fuels, wind energy is sustainable, produces no direct emissions, and relies on an abundant natural resource. However, while fossil fuels provide a consistent and high-density energy supply, they come at the cost of pollution and long-term environmental harm. HAWTs, on the other hand, depend on wind availability, making energy output variable but significantly cleaner, and cheaper.

This project examines the significance of HAWTs, particularly small-scale turbines capable of generating 100W to 150W of power, highlighting their efficiency, environmental benefits, and potential applications in decentralized energy systems. The growing shift toward renewable energy underscores the importance of improving wind technology, making HAWTs an essential component in the transition to sustainable energy solutions.

Abstract # 234

Dual Axis Solar Tracking

Isaiah Thompson, Destiny Brand, Corion Holloman, Tyra Ravenell, and Showkat Chowdhury
Mentor(s): Dr. Showkat Chowdhury
Department of Mechanical and Civil Engineering

The Industrial Revolution sparked a massive surge in advancements in technology and quality of life, but it also introduced an unprecedented amount of CO_2 emissions from coal-fired power plants, chemical facilities, and steel foundries. This legacy continues to shape today's environmental challenges known as climate change.

CO_2 is a greenhouse gas that creates a negative feedback loop, trapping infrared radiation and warming the entire planet. This, in turn, heats water—another greenhouse gas—melting ice caps therefore increasing ocean levels and adversely affecting biodiversity. Additionally, fossil fuel reserves are finite, whereas the sun provides a virtually limitless source of energy, generating both sunlight and air currents that can be harnessed by photovoltaic (PV) cells and wind turbines.

This project focuses on PV cells stacked together, commonly known as solar panels. Our generation now faces the daunting challenge of mitigating the worst impacts of industrialization while grappling with dwindling fossil fuel supplies. Anthropogenic climate change remains one of the most pressing challenges of our time.

Solar energy provides a clean, abundant, and renewable alternative to fossil fuels, yet fixed solar panels suffer efficiency losses due to inconsistent sun exposure. This project addresses that limitation by designing and developing a dual-axis solar tracking system that dynamically adjusts a solar panel's orientation to maximize energy absorption throughout the day. The system integrates a 195W monocrystalline solar panel, charge controller, battery, inverter, and motorized tracking system. Utilizing light sensors and actuators, the panel adjusts its tilt along both the east-west and north-south axes, optimizing its position based on sunlight intensity.

Key performance metrics focus on solar power generation efficiency, tracking accuracy, and system effectiveness with and without battery storage. The dual-axis tracking system is designed to increase energy yield by 35-45% compared to fixed panels, aligning with findings from solar tracking research.

Abstract # 235

Utilizing Civil 3D for Topographical mapping: Case study of Fairborn, Ohio

Aliya Khanthavong, Nehemiah Ibi-eletta, Dannielle Palmore, and Niya Pettway
Mentor(s): Dr. Pooja P. Preetha
Department of Mechanical and Civil Engineering

This study explores the use of Civil 3D in generating a detailed topographical map for a part of the city of Fairborn, Ohio located in sections 13 and 19, Town 3, Range 8 between the Miami Rivers Survey. Civil 3D, a powerful civil engineering design and documentation software, was utilized to process survey data, create digital terrain models (DTMs), and visualize elevation changes across the city. The workflow included importing point data, surface modeling, and contour generation to produce an accurate representation of Fairborn's terrain. The resulting topographical map provides valuable insights for urban planning, infrastructure development, and environmental analysis. This project demonstrates the efficiency of Civil 3D in topographic mapping and its significance in civil engineering applications.

Abstract # 236

Infrastructure Disasters: Prevent, Respond, Advocate

Charleston Walker

Mentor(s): Dr. Pooja P. Preetha

Department of Mechanical and Civil Engineering

When faced with infrastructure disaster, Civil Engineers are morally obligated to strive to prevent collapse and casualties. The work that's done by Civil Engineers often goes unnoticed to the public audience. In the event of infrastructure collapse, the importance of prevention, response, and advocating for safer engineering practices across the globe is heightened tremendously. The research done compiled multiple infrastructure collapses. Each event forces us to understand three Engineering practices that will ensure the safety of our structures and communities. The 1st practice is "Safety from the Start". This practice ensures that we understand the necessary safety precautions needed to be taken before any structure begins construction. The 2nd practice is "Maintaining Our Creations". This practice places emphasis on Infrastructure Maintenance and ensuring that the structure stands for years to come. The 3rd practice is becoming the Structure's Advocate. In this research and presentation, we can compare our structures to our children in an Engineering sense. Like a baby, a structure cannot effectively communicate vocally the issues it may be having. Our job as Civil Engineers is to understand the signs the structure gives us when it is in need. There are many cries from structures across the globe that require engineers to advocate for its safety or lack thereof. While using examples of infrastructure disaster across the globe, this research concluded that each could've been prevented with Safety From the Start, Infrastructure Maintenance, and advocating for the structure.

Abstract # 237

The Flash Radiography Shield

Mikaylah Pratt, Tayla Oliver, Damari Bender

Mentor(s): Dr. Mebougna Drabo

Department of Mechanical and Civil Engineering

Neutron radiography is a powerful imaging technique that uses neutrons instead of X-rays or

0gamma rays to capture radiographic images, offering unique insights into the internal structures of various materials. At the Transient Reactor Test Facility (TREAT), neutron radiography is currently conducted in steady-state reactor operations at 80 kilowatts, requiring a two-week scheduling process due to the reactor's primary function in transient testing. This constraint limits the availability of neutron radiography for critical applications. To address this limitation, we propose performing neutron radiography during transient reactor operations rather than relying solely on steady-state mode. By harnessing TREAT's high-speed, high-energy pulses, neutron imaging could be achieved within fractions of a second using a digital imaging system composed of a high-speed camera and a scintillator screen. This approach eliminates the need for traditional neutron

radiography foils, which require prolonged exposure times, thereby increasing efficiency and reducing scheduling conflicts. However, implementing this method presents radiation safety challenges. While new shielding has been installed, a remaining gap allows radiation to escape into the surrounding area, posing potential exposure risks. Additional shielding is necessary to fully contain radiation and ensure the safe execution of neutron radiography during transient operations.

This study explores the feasibility of utilizing transient reactor pulses for neutron radiography, highlights the advantages of digital imaging techniques, and underscores the need for enhanced shielding to mitigate radiation risks. Integrating neutron radiography into transient operations has the potential to significantly improve imaging efficiency, minimize scheduling constraints, and expand the utility of neutron imaging for both research and industrial applications.

Graduate

Abstract # 238

AI-Driven Predictive Analysis for Hydrological Forecasting and Water Resource Management

Sai Kumar Dasari, Sai Kumar Dasari, Dr. Pooja P. Preetha

Mentor(s): Dr. Pooja P. Preetha

Department of Mechanical and Civil Engineering

This study presents a comprehensive predictive analysis of key hydrological variables using historical data from 2005 to 2022 in Cahaba watershed in Alabama, USA, aiming to enhance hydrological forecasting accuracy and improve water resource management. The analysis focuses on critical variables such as rainfall, snowmelt, evapotranspiration, surface runoff, groundwater levels, sediment yield, and total water output, which are essential for understanding hydrological dynamics and their impact on environmental systems. This study employs advanced computational methodologies, including the Prophet time-series forecasting model, which effectively captures seasonal trends, manages missing data, detects outliers, ensuring robust forecasts. Additionally, machine learning techniques, such as multi-output regression and polynomial feature transformations, are utilized to model complex nonlinear interactions between environmental factors, further enhancing the accuracy of predictions.

The research methodology involves rigorous data preprocessing, cleaning, and transformation to align with the forecasting models. Each hydrological variable is individually trained using the Prophet model, allowing for monthly predictions that offer valuable insights into long-term hydrological patterns. Comparative analyses between predicted and observed values validate the models' reliability, pinpointing areas where prediction accuracy is high and where further refinements are needed. The Prophet model successfully captured seasonal trends for evapotranspiration (ET) and potential evapotranspiration (PET) with a high degree of accuracy. However, it struggled to accurately predict precipitation (PRECIP) and snowmelt (SNOWMELT), especially during extreme weather events, leading to noticeable deviations in forecasted values. The findings have significant implications for environmental planning, disaster mitigation, and

sustainable water resource management. Furthermore, the integration of machine learning and time-series forecasting highlights the potential of AI-driven approaches in hydrological modeling. The future studies could incorporate additional climatic variables and high-resolution datasets, further strengthening predictive capabilities and supporting climate adaptation strategies for resilient water balance management using the Prophet time-series forecasting model.

Abstract # 239

Evaluation of the Stability of Edge-Passivated CZTS Radiation Detectors

Keith Rivers Jr., Utpal N. Roy, Joshua W. Kleppinger, Jan Franc, Václav Dědič, Keith Rivers, and Ralph B. James

Mentor(s): Dr. Mebougna Drabo

Department of Mechanical and Civil Engineering

CdZnTeSe (CZTS) is a next gen replacement room temperature radiation detector that solves common issues with modern CZT detectors. The surface states can trap radiation induced carriers and can act as leakage current pathways requiring detectors to be passivated for optimal performance. In this work we seek to identify the best passivation technique for CZTS detectors.

PHYSICS, CHEMISTRY AND MATHEMATICS

Undergraduate

Abstract # 254

Statistical Analysis of Alabama Electricity Demand and Consumption

Prithak Shresth and Salam Khan

Mentor(s): Dr. Salam Khan
Department of Physics, Chemistry and Math

In this study, electricity consumption, demand, net electricity generation and price in the State of Alabama are collected and analyzed by using statistical methods. Regression analysis is used to analyze the trend and predict the future average demand, consumption and price. This research performs exhaustive electricity consumption in Alabama on the basis of demand trends, nuclear capacity provisions, electricity productions, mean electricity tariff, and electricity sales. Using time series analysis, modeling and machine learning, we examine key variables for defined patterns, seasonal variations, and interrelations.

Abstract # 255

Independent Domination of k-Trees

Adeyori Adekunle and Steven Rodriguez

Mentor(s): Dr. Andrew Pham
Department of Physics, Chemistry and Math

Given a simple finite graph G = (V (G), E(G)), a vertex subset D ⊆ V (G) is a distance k-dominating set if every vertex v ∈ V (G) − D lies within distance k of some vertex in D. The distance k-domination number γk(G) is the cardinality of a minimum distance k-dominating set. The distance k-bondage number bk(G) is the size of a minimum edge set B such that γk(G − B) > γk(G). In this paper, we establish upper bounds on bk(G) in respect to degree sums and some structural properties of the graph. Our results generalize previous bounds by incorporating distance-based domination constraints. We also introduce a refined bound in respect to the number of internally disjoint paths. These findings contribute to the broader study of domination and bondage parameters in restricted graph classes and provide insights into combinatorial optimization.

Abstract # 256

Network Resilience of Fixed Dominating Sets Under Edge Failure

Uchenna Justin, Ehi Oko, Itiza Subedi, and Andrew Pham (Faculty)

Mentor(s): Dr. Andrew Pham
Department of Physics, Chemistry and Math

Given a simple, finite graph or network G=(V(G),E(G)), a vertex subset D⊆V(G) is a dominating set of G if every vertex v∈V(G)-D is adjacent to at least one vertex in D. Under edge deletions, D may possibly be a non-dominating set of the resulting network. While it is sometimes possible to rearrange D to maintain domination with the same cardinality, such adjustments may not always be practical in real-world applications. Therefore, it is of interest to consider a fixed dominating set of the network. In this paper, we introduce and investigate the properties of two measures, the weak resilience r_G (D,t) and the strong resilience R_G (D,t), to quantify the stability of a network's fixed dominating set against edge failure. This focus on the resilience of fixed dominating sets may be used in a variety of applications and provides insight into the viability of currently existing systems or infrastructure like transportation networks, social networks, biological relationships, and other networks.

Abstract # 257
Statistical Modeling of Stock Prices: Analyzing Volatility and Trends in Finance and Tech
Iyanuoluwa Adekoya, Dr. Kenneth Sartor
Mentor(s): Dr. Kenneth Sartor
Department of Community and Regional Planning
This study explores the application of statistical and machine learning models in stock price analysis, focusing on financial and technology companies. The research employs the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to analyze stock price volatility and the Autoregressive Integrated Moving Average (ARIMA) model to predict price movements. Historical stock data from Macrotrends will be used to examine the effectiveness of these models on select financial firms, including JPMorgan Chase and Goldman Sachs, as well as technology companies like Nvidia and Tesla. Additionally, the study will discuss the benefits of Hidden Markov Models (HMM) and Monte Carlo Simulation in financial forecasting, although they will not be implemented. By comparing the performance of GARCH and ARIMA across different sectors, this research aims to evaluate their predictive accuracy and suitability for modeling stock price behavior in varying market conditions. The implementation of these models will be carried out using Python

programming, providing a computational framework for assessing stock market dynamics.

Abstract # 258

Exploring Oceanic Garbage Patches: Utilizing Dynamic Mode Decomposition for Insight

Moyinoluwa Adelowo

Mentor(s): Dr. K.G.D. Sulalitha Priyankara
Department of Physics, Chemistry and Math

The garbage patch consists of suspended debris, predominantly plastics, which has the potential to cause significant environmental consequences and impact marine life. Five well-known garbage patches exist worldwide, with one of the most notable examples being the Great Pacific Garbage Patch, located in the North Pacific Ocean. Understanding the formation of these garbage patches is critical for addressing marine pollution and developing mitigation strategies. In this project, we aim to analyze drifter data using the well-known Dynamic Mode Decomposition (DMD) technique. Our goal is to determine whether the reconstructed data, using a few dominant DMD modes, can accurately identify the location of the drifters (longitudes and latitudes) as well as their northward and eastward velocities. The research utilizes satellite-tracked drifter datasets sourced from NOAA's Global Drifter Program. Key parameters such as eastward and northward velocities, and positional coordinates (longitude and latitude) were processed. Singular Value Decomposition (SVD) was utilized to extract dominant modes. Findings revealed the presence of dominant dynamical patterns within the garbage patches. The analysis provided insights into the various drifter patterns. We evaluated the accuracy of the reconstructed data against the original dataset. Reconstruction errors indicated limitations in DMD's accuracy for modeling the drifter's patterns. While DMD highlights critical dynamics within garbage patches, further optimization or alternative modeling methods are necessary for enhanced accuracy. Future research will explore the Randomized DMD approach to improve the representation of the drifter movement.

Abstract # 259

Mathematical Model of Fake News Diffusion

Nya Hardy

Mentor(s): Dr. Congxiao Liu, Dr. Segun Okei

Department of Physics, Chemistry and Math

This study develops a mathematical model of fake news diffusion surrounding the 2020 United States presidential election that analyzes the dynamics of fake news propagation and assesses the impact of intervention strategies. By formulating a system of differential equations, we extend traditional epidemic models (e.g. SEIR) to categorize online social network (OSN) users based on their interaction with misinformation: susceptible (S), exposed (E), infected/spreaders (I), and recovered (R). The model introduces ways to correct misinformation, including fact-checking mechanisms, credibility weighting, and user-based reporting, to examine their effectiveness in mitigating misinformation spread. The basic reproduction number R_0 is derived to determine the conditions under which misinformation dies out or persists. Using real-world OSN data and numerical simulations, we tested the accuracy of the model and examined how the spread of fake news is affected by content virality, user interactions, and intervention strategies. Our findings support efforts to combat political misinformation by offering a mathematical framework to analyze

and manage the spread of false political content online.

Keywords: online social networks (OSNs), basic reproduction number, fake news, election

Abstract # 260

Mapping Chaotic Manifolds in KSE: From PDE to ODE with Finite-Time Lyapunov Exponents

Pablo Ruiz Crespo, Dr. Kanaththa Priyankara, Segun Oke

Mentor(s): Dr. Kanaththa Priyankara

Department of Physics, Chemistry and Math

The Kuramoto-Sivashinsky Equation (KSE) is a nonlinear partial differential equation (PDE) known to exhibit spatio-temporal chaos. This project aims to investigate the chaotic dynamics of the KSE by transforming it into a system of ordinary differential equations (ODEs) through the Fourier series expansion of the term u(x,t). Additionally, this study investigates fluid flow barriers and approximates the stable and unstable manifolds by computing the Finite-Time Lyapunov Exponent (FTLE) field associated with the ODE system. These findings will effectively inform improved thin-film fluid dynamics, reaction-diffusion systems, turbulence modeling, and microfluidic flow control where spatio-temporal instability must be managed.

Keywords: KSE, Spatio-temporal Chaos, Nonlinear PDE, ODE, FTLE, stable/unstable manifolds, chaotic dynamics

Abstract # 261

Mathematical Model for Tornado Predictions in the Southeastern Region of the US

Tamyra Duke, Segun Oke, Dr. Kanaththa Priyankara

Mentor(s): Dr. Kanaththa Priyankara

Department of Physics, Chemistry and Math

In this paper, we propose a mathematical model of tornado predictions using a spatiotemporal point process model to analyze and predict tornado patterns in the southeastern United States. According to this model, the distribution and clustering of tornadoes can be characterized using second-order statistical properties rather than relying solely on first-order intensity measures. We employ the spatio-temporal K-function to quantify these interactions, which captures dependencies between tornado occurrences over space and time. The characteristics of tornado clustering are examined by estimating the first- and second-order intensity functions, allowing for improved identification of high-risk areas. We validate our model using historical tornado data and apply it to forecast future tornado patterns in the southeastern region, demonstrating its potential to improve risk assessment and early warning systems.

Keywords: Tornado Prediction, spatiotemporal point process model, US Southern region

Abstract # 262

Predicting the Percentage of Wins per team in an NFL Season Using Regression Analysis

Phillip Constant, Dr. Salam Khan

Mentor(s): Dr. Salam Khan

Department of Family and Consumer Sciences

This study uses NFL performance metrics to evaluate the power of multiple regression analysis in predicting the win percentage of each NFL team. To accomplish this goal, the following are used as predictors: The number of Pro Bowl players on each club, the number of winning seasons, the coaching expertise of each team's staff, and the home field advantage. These predictors and others will be used in regression analysis to determine a given team's win percentage.

Abstract # 263

The mathematical model of heart rate baroreceptor control and sympathetic and vagal activity

Tiarra Smith

Mentor(s): Tiarra Smith, Andrew Pham, Segun Oke

Department of Physics, Chemistry and Math

In this paper, we integrate two models to improve the predictive power of HRV analysis for physiological and clinical applications. Heart rate variability (HRV) is a non-invasive marker of autonomic nervous system (ANS) function. The arterial baroreflex mechanism model used bifurcation theory to explain the emergence of self-sustained oscillations at 1.0 Hz (LF) and 0.26 Hz (HF) and the heart variation model demonstrated how HRV emerges from beat-to-beat interactions of sympathetic and vagal control. Our mathematical model of heart rate baroreceptor control and sympathetic and vagal activity created a better understanding of HRV studies. We construct a simplified mathematical model of arterial baroreflex and heart variation by combining animal and human studies.

Keywords: modeling of autonomic regulation, neurotransmitters, physiological modeling, heart rate

Abstract # 264

Optimizing Solar Test Days: Weather Data and Predictive Models

Ezekiel Salama

Mentor(s): H. Evan Bush, Dr. Segun Oke

Department of Physics, Chemistry and Math

This study aims to optimize concentrating solar test days by leveraging historical and forecasted weather data, employee insights, and predictive modeling to identify the most favorable conditions for testing for the National Solar Thermal Testing Facility (NSTTF) in Albuquerque, NM. We gathered historical weather trends from selected months to identify optimal testing days (information gathering). The data was extracted and parsed from the National Weather Service (NOAA) and the Iowa Environmental Mesonet. We employed mathematical models of weather trends, including linear regression and correlation analysis, to evaluate historical weather data, to find any correlations between sky cover, precipitation, and/or wind speed, and to predict optimal testing conditions for

solar thermal experiments. We proposed a predictive model that integrates historical averages, current weather conditions, and machine learning techniques to forecast favorable testing days. The model utilizes key metrics such as wind speed, cloud cover, and precipitation to assess the likelihood of successful testing outcomes. From the data gathered, we found the average count of favorable test days throughout the year and the different seasons that were more favorable for testing, calculated high and low disagreement correlations between NSTTF faculty's perception of the weather and the actual weather conditions, and were able to give estimates of the most effective testing times within the year.

Keywords: Concentrating Solar Testing, National Solar Thermal Testing Facility (NSTTF), Historical and Forecasted Weather Data, Predictive Modeling, Linear Regression, Correlation Analysis, Weather Trends, Machine Learning, Optimal Testing Days, Wind Speed, Sky Cover, Precipitation, Seasonal Testing Analysis, Albuquerque, NM.

Abstract # 265

Synthesis, Nanosecond Transient Absorption, and Structural Characterization of Fe- and Zn-Doped Hydroxyapatite

Ieshia Dumas

Mentor(s): Dr. Clyde Varner, Dr. Jules Guei, Dr. Gernerique Stewart
Department of Physics, Chemistry and Math

Iron- and zinc-doped hydroxyapatite (HAp) was synthesized via a controlled wet-chemical route and characterized using nanosecond transient absorption spectroscopy (ns-TAS) and X-ray diffraction (XRD). XRD confirmed the phase purity and crystallinity of the doped hydroxyapatite, with lattice parameter shifts indicative of Fe^{3+} and Zn^{2+} substitution within the apatite lattice. ns-TAS, performed using a 355 nm pump source, revealed distinct transient absorption features, suggesting efficient photoinduced charge carrier dynamics. The observed excited-state lifetimes and decay kinetics provide insight into electron transfer processes and defect-state interactions, relevant for potential photocatalytic or bioactive applications. The presence of Fe^{3+} ions introduced enhanced optical absorption, potentially improving the material's photocatalytic efficiency, while Zn^{2+} incorporation contributed to antimicrobial properties. These findings suggest that Fe/Zn-doped hydroxyapatite could serve as a multifunctional material for biomedical implants, drug delivery, or photocatalytic degradation of organic pollutants. Further studies on electronic structure modifications and biocompatibility will be necessary to optimize its functional applications.

Abstract # 266

Development of Latent Fingermarks on Non-Porous Synthetic Papers and Medical Gauze Pads Using Ninhydrin and 1,8-Diazafluoren-9-one and their Comparison

TiYanna Watson

Mentor(s): Jules Guei

Department of Physics, Chemistry and Math

Although ninhydrin and DFO have become two widely used chemical reagents for the development of latent fingermarks on porous surfaces, little effort was devoted to the development of new substrates (i.e., semi-porous and non-porous) to expand their applications. This work presents the

development of fingermarks on synthetic paper (non-porous), and medical gauze pads (non-woven sponges) (semi-porous and non-porous), using ninhydrin and DFO.

REVLAR synthetic papers and gauze pads were evaluated as new substrates for ninhydrin and DFO. Preliminary results showed that synthetic papers and medical gauze pads could act as substrates for ninhydrin and DFO. The developed fingermarks with ninhydrin on synthetic papers showed visible friction ridges. The friction ridges were also visible on gauze pads, although less revealing. Similarly, DFO reacted with fingermarks on gauze pads and REVLAR synthetic papers, but the friction ridge patterns showed less visibility.

In all, both ninhydrin and DFO reacted with fingermarks on synthetic papers (non-porous) and medical gauze pads (semi-porous and non-porous), but ninhydrin produced visible fingermarks than DFO.

Keywords: ninhydrin, DFO, semi-porous, non-porous, synthetic papers, non-woven sponges

Abstract # 267

Quantum Unruh Effect on Performances of Superconducting Qubits

De'Angelo Bailey, Tianxi Zhang, Dr. Padmaja Guggilla

Mentor(s): Dr. Padmaja Guggilla
Department of Physics, Chemistry and Math

Quantum field theory remarkably predicts that an accelerating observer detects a thermal radiation, called Unruh radiation, with temperature proportional to acceleration. This implies that a particle in a force field, as it is accelerating, detects Unruh radiation. Therefore, a particle with mass in a gravitational field detects Unruh radiation with temperature proportional to the gravitational field. A particle with electric charge in an electric field detects Unruh radiation with temperature proportional to the strength of electric field and the charge-mass ratio of particle. Recently, we have investigated the quantum Unruh effect on singularity and radiation of black holes, spectra of atoms, and beta emissions of nuclei. In this study, we investigate how the quantum Unruh radiation influence on performances of superconducting qubits that are constructed by Josephson junctions, which are formed with two superconductors, separated by a thin insulating barrier. Experimentally, it has been discovered that an electric current could flow through Josephson Junction due to quantum tunneling effect. The electric potential difference developed across the barrier is proportional to the rate of phase change or the frequency of oscillations. For a typical Josephson junction with oscillating frequency of tera-hertz and barrier thickness of micro-meters, the electric field generated in the barrier could be one-tenth of milli-volts per meter, which can be pulsated and enhanced maximally up to some hundred times when the two superconductors have different properties and variations. Super-electrons in the barrier will be accelerated by the electric field and thus detect Unruh radiation with temperature up to tens of milli-Kelvins, which would significantly affect performances of superconducting qubits. This poster presents results newly obtained from our recent studies, supported by the NSF-HBCU Research Initiation award (2400021) and the IBM-HBCU Quantum Center award.

Abstract # 268

Characterization of Radiation-Induced Defects in InAs for Space-Based Infrared Detectors

Shanice Gray, Claudiu Muntele, Jonathan Lassiter, Satilmis Budak, Evan M. Anderson

Mentor(s): Satilmis Budak & Jonathan Lassiter

Department of Physics, Chemistry and Math

Ion irradiation in infrared detectors degrades performance by generating atomic-scale defects that impact electrical and structural properties. This work aims to characterize irradiation-induced defects in InAs and related materials through a combination of experimental techniques and modeling to establish damage equivalence among various ion species found in radiation environments, such as space. We will investigate the effects of bombardment with protons, C, and Si. We used SRIM, a Monte Carlo modeling package, to simulate the accumulation of damage in these materials for the purposes of guiding ion bombardment experiments and interpreting characterization results. Targeting fluences in the range of 109–10^{12} ions/cm^2—typical for III-V devices—we emphasize materials characterization before and after irradiation. Fourier Transform Infrared (FTIR) Spectroscopy and Raman Spectroscopy are used to analyze the energetics of induced defects, with Raman being particularly sensitive to pre-existing and irradiation-induced defects. Additional techniques, including X-ray Photoelectron Spectroscopy (XPS) for elemental and chemical state analysis and ion channeling, will further clarify structural changes. By examining defect formation, charge trapping, and localized strain effects, this study provides insights into how irradiation impacts carrier mobility and conductivity in InAs, contributing to the broader understanding of semiconductor radiation effects. SNL is managed and operated by NTESS under DOE NNSA contract DE-NA0003525.

Abstract # 269

Development of dyes-ceramic composite materials for photo-induced biological processes

Oghenetega Miracle

Mentor(s): Dr. Clyde Varner

Department of Physics, Chemistry and Math

The study of electron lifetimes in catalytic processes is pivotal to advancing enzymatic catalysis, particularly in redox reactions and bioinspired catalytic systems. This work explores the integration of organic dyes and perovskite ceramic nanomaterials as complementary systems for nanosecond (ns) transient absorption spectroscopy (TAS) to elucidate electron transfer dynamics. Organic dyes, known for their strong absorption coefficients and tunable electronic properties, serve as efficient photosensitizers, enabling the generation of photoexcited states under visible light irradiation. Concurrently, perovskite ceramics, characterized by their exceptional charge transport properties and stability, act as electron acceptors or catalytic surfaces, facilitating extended charge separation and promoting electron transfer to enzymatic active sites.

The ns-TAS technique offers a robust approach to capturing ultrafast electron dynamics by monitoring transient species and decay kinetics in real time. Through strategic dye-perovskite pairing, we achieve controlled photoinduced electron transfer processes, leveraging the broad absorption range and customizable bandgaps of perovskite materials. Experimental results demonstrate prolonged electron lifetimes, enhancing the efficiency of electron donation to redox-active enzymes and boosting catalytic turnover. By correlating the transient absorption data with enzymatic activity assays, we provide insights into the mechanistic pathways of electron transfer, including the role of intermediate species and the impact of surface states on electron mobility.

This study proposes a novel framework for optimizing hybrid catalytic systems by tuning the dye-perovskite interface to maximize electron lifetime and catalytic efficiency. The findings have significant implications for designing advanced photoenzymatic systems, contributing to the development of sustainable catalytic processes in energy conversion, environmental remediation, and biocatalysis. The integration of ns-TAS with hybrid dye-perovskite systems establishes a versatile platform for advancing the understanding of electron dynamics in complex catalytic environments.

Abstract # 270

Synthesis and Characterization of Dialkyl Dithiophosphate Ruthenium Complexes and Screening for Bioactivity

Delainey Harris, Dr. Adnan El-Khaldy, Jayden Boatwright

Mentor(s): Dr. Kamala Bhat

Department of Physics, Chemistry and Math

This research investigates the synthesis and characterization of dialkyl dithiophosphate ruthenium complexes and evaluates their potential bioactivity. Dialkyldithiophosphoric acid, an organophosphorus compound widely used in industrial and agricultural applications, serves as the primary ligand. The synthesis involves reacting phosphorus pentasulfide with various alcohols, producing dialkyldithiophosphates under strictly anhydrous conditions. Comprehensive spectroscopic analyses, including IR and NMR, are employed to confirm structural and chemical properties.

The study aims to explore the coordination behavior of dithiophosphoric ligands with ruthenium, assess bioactivity, and establish industrial relevance in fields such as agriculture, pharmaceuticals, and lubrication. The findings emphasize the multifaceted applications of these complexes, particularly their biological activity, chemical stability, and mechanical performance in demanding environments. This work lays the foundation for advancing the use of organometallic complexes in specialized and industrial applications.

Abstract # 271

Characteriztiion of Cesium Hafnium Chloride Using Absorption Analysis

Nehemiah Ibi-Eletta, Bello Ibrahim, Elijah Adedeji, Dr. Oluseyi Babalola, Dr. Claudiu Muntele

Mentor(s): Dr. Oluseyi Babalola
Department of Physics, Chemistry and Math

This study focuses on the characterization of Cs_2HfCl_6 using absorption analysis performed with a spectrophotometer. Cesium hafnium chloride (Cs_2HfCl_6) is an emerging material with potential applications in scintillation and optical technologies. The material's optical properties were

evaluated by measuring its absorbance across a range of wavelengths, providing insight into its bandgap and electronic transitions. Key parameters, including peak absorption wavelengths and absorption coefficients, were determined to assess the material's suitability for optoelectronic applications. The findings contribute to a deeper understanding of Cs_2HfCl_6's spectral behavior, aiding in its potential integration into advanced photonic devices.

Abstract # 272

Statistical Analysis of Alabama Electricity Demand and Consumption

Prithak Shrestha, Dr. Salam Khan

Mentor(s): Dr. Salam Khan

Department of Physics, Chemistry and Math

In this study, the electricity consumption, demand, net electricity generation and price in the State of Alabama are collected and analyzed by using statistical methods. Regression analysis is used to analyze the trend and predict the future average demand, consumption and price.

This research performs exhaustive electricity consumption in Alabama on the basis of demand trends, nuclear capacity provisions, electricity productions, mean electricity tariff, and electricity sales. Using time series analysis, modeling and machine learning, we examine key variables for defined patterns, seasonal variations, and interrelations.

Abstract # 273

Independent Domination of k-Trees

Adeyori Adekunle and Steven Rodriguez

Mentor(s): Dr. Andrew Pham

Department of Physics, Chemistry and Math

Given a simple finite graph $G = (V(G), E(G))$, a vertex subset $D \subseteq V(G)$ is a distance k-dominating set if every vertex $v \in V(G) - D$ lies within distance k of some vertex in D. The distance k-domination number $\gamma k(G)$ is the cardinality of a minimum distance k-dominating set. The distance k-bondage number $bk(G)$ is the size of a minimum edge set B such that $\gamma k(G - B) > \gamma k(G)$. In this paper, we establish upper bounds on $bk(G)$ in respect to degree sums and some structural properties of the graph. Our results generalize previous bounds by incorporating distance-based domination constraints. We also introduce a refined bound in respect to the number of internally disjoint paths. These findings contribute to the broader study of domination and bondage parameters in restricted graph classes and provide insights into combinatorial optimization.

Abstract # 274

Network Resilience of Fixed Dominating Sets Under Edge Failure

Uchenna Justin, Ehi Oko, Itiza Subedi, and Dr. Andrew Pham (Faculty)

Mentor(s): Dr. Andrew Pham

Department of Physics, Chemistry and Math

Given a simple, finite graph or network G=(V(G),E(G)), a vertex subset D⊆V(G) is a dominating set of G if every vertex v∈V(G)-D is adjacent to at least one vertex in D. Under edge deletions, D may possibly be a non-dominating set of the resulting network. While it is sometimes possible to rearrange D to maintain domination with the same cardinality, such adjustments may not always be practical in real-world applications. Therefore, it is of interest to consider a fixed dominating set of the network. In this paper, we introduce and investigate the properties of two measures, the weak resilience r_G (D,t) and the strong resilience R_G (D,t), to quantify the stability of a network's fixed dominating set against edge failure. This focus on the resilience of fixed dominating sets may be used in a variety of applications and provides insight into the viability of currently existing systems or infrastructure like transportation networks, social networks, biological relationships, and other networks.

Graduate

Abstract # 275

Process Parameter Optimization of Recycled SS316L Powder-Based Additive Manufacturing For Enhancing Mechanical Strength Using Machine Learning

Ajibike Joan Farounbi, Ajibike Joan Farounbi, Padmaja (Paddy) Guggilla , and Judith Schneider

Mentor(s): Dr. Padmaja Guggilla
Department of Physics, Chemistry and Math

This study explores the use of machine learning in optimizing process parameters in a recycled SS316L laser bed powder fusion process to improve mechanical strength. The research uses a Random Forest regression machine learning model to identify optimal parameter combinations and performance trends. The findings show that integrating machine learning improves mechanical strength while maintaining high material utilization rates, setting a precedent for future research in sustainable and high-performance additive manufacturing technologies.

Abstract # 276

Response Surface Methodology for Optimization of Poly Acrylonitrile (Pan) Nanoparticles

Karishma Gupta, Dr.Stephen Babalola, Dr. Padmaja Guggilla

Mentor(s): Dr. Padmaja Guggilla
Department of Physics, Chemistry and Math

Nowadays, the toxicity of polyacrylonitrile is attracting extensive attention in the field of ecological environment. Polyacrylonitrile nanoparticles were prepared by emulsion polymerization of acrylonitrile in a continuous aqueous phase in the presence of potassium persulfate as initiator and sodium hexadecyl sulfate as emulsifier. In this study, the Central Composite Design (CCD) effective tool was used for the optimization of the polymerization process, and Response Surface Methodology (RSM) was employed to evaluate the effects and attainment of optimum conditions for narrower particle size through the interaction of operating variables. ANOVA analyzed the response. The surface morphology and characterization of the nanoparticles were performed using methods such as transmission electron microscopy and scanning electron microscopy, and the

chemical characterization was identified by Fourier transform infrared spectroscopy.

Abstract # 277

Quantum Unruh Effect and Radiation of Black Holes

Hannah Sukarloo, Tianxi Zhang

Mentor(s): Tianxi Zhang

Department of Physics, Chemistry and Math

Quantum Unruh effect is a remarkable prediction of quantum field theory. It refers to an accelerating observer that detects thermal radiation with temperature proportional to the acceleration. Since acceleration is indistinguishable from the gravitational field in accordance with the Mach principle of equivalence, an observer at rest in a gravitational field detects an Unruh radiation with temperature proportional to the gravitational field. Hawking first studied radiation of black holes with this quantum effect and showed that a black hole radiates or evaporates with power inversely proportional to the square of black hole mass. Recently, Zhang indicated that Unruh radiation is gravitational, not due to motion of thermal particles, so that we cannot apply the Stephan-Boltzmann law to calculate the power of black hole Hawking radiation based on the Unruh temperature at the surface of black hole. Zhang further showed that the emission power of Unruh radiation from a gravitational object should be calculated in terms of the rate of increase of the total Unruh radiation energy outside the object. For a black hole, the emission of Unruh radiation does not occur unless it can lose its mass. The emission power of Unruh radiation is only an extremely tiny part of the rate of mass-energy loss if the black hole is not extremely micro-sized. In addition, mass falling into a black hole does not form a sizeless singularity at the center, instead it forms a finite mass-dependent singularity sphere. In this study, we will investigate the quantum Unruh effect on radiation of black holes in more detail, especially for various sized black holes including their mergers and radiation spectra. In this poster presentation, we will present new results obtained from our recent studies, supported by NSF Research Initiation and IBM-HBCU Quantum Center Awards.

Abstract # 278

Investigating Optimal Polyvinylidene Fluoride (PVDF) Concentrations for Its Applications as Efficient Smart Material

Angela Davis, Clyde Varner, Padmaja Guggilla, Sijan Mainali

Mentor(s): Dr. Clyde Varner & Padmaja Guggilla
Department of Physics, Chemistry and Math

Demand for thin films of various functional materials is increasing due to the miniaturization of electronic devices to nanometer scales. Nano sized thin films can be defined as a thin layer of material, where the thickness is less than 109 nm in at least one dimension. As the material gets to the size of a nanometer, the characteristics (color, electrical and optical properties) will behave completely different from bulk size materials. The objective of this project is to develop nano sized Polyvinylidene Fluoride (PVDF) thin films and investigate the impact of Cold Jet Plasma on the electrical characteristics of the films. Partially fluorinated polymers like PVDF become pliable (moldable) at certain elevated temperatures and solidify upon cooling. An additional objective was to characterize the surface current mechanism(s) of such films under the influence of temperature

and low electrical voltages (corresponding low electric fields). The preliminary results indicate that both microscopic structure and environmental conditions contributed to observed properties. Specifically, electric surface current densities were measured on the surface of pure PVDF thin films, and were found to be produced mainly through ohmic conduction or space- charge conduction, as the two are indistinguishable behaviors at low voltages, yielding surface- limited conduction phenomena, and dielectric loss resulted from electromagnetic energy loss as manifested through phase differences between low-frequency input signal to the films and time varying polarization. The study conducted will help shine light on the concentration of PVDF required to exhibit higher polarity and consequently improved mechanical properties. Under the current investigation both pure PVDF thin films are fabricated with various concentrations of pure PVDF films and doped PVDF films fabricated with different concentrations of CaTiO3, LiNbO3, Li2ZrO3 and Li2ZrO3/ Si3N4. The films are then characterized for their electrical and optical properties for their use as smart materials.

Abstract # 279

Optimization of the Energy Resolution of Cesium Hafnium Chloride

Karishma Gupta, Amari Williams ,Stephen Babalola, and Claudiu Muntele
Mentor(s): Dr. Stephen Babalola
Department of Physics, Chemistry and Math

Cesium Hafnium Chloride (Cs_2HfCl_6, CHC) has emerged as a highly promising scintillator due to its exceptional light yield, energy resolution, and non-hygroscopic nature. CHC crystals exhibit a cubic K_2PtCl_6-type structure and can be efficiently grown using the Bridgman method with minimal precursor purification. Recent research has demonstrated several key advantages of CHC. It achieves a light yield of up to 54,000 photons/MeV, the highest reported for an undoped scintillator, and energy resolution of 2.8–3.3 percent at 662 keV, outperforming conventional materials such as NaI:Tl and $LaBr_3$:Ce. Unlike traditional halide scintillators, CHC is non-hygroscopic, eliminating the need for costly encapsulation and extending detector longevity. Large, high-purity, crack-free CHC crystals have been successfully synthesized, with studies revealing that controlled stoichiometry reduces defect-related recombination centers and enhances performance. CHC exhibits principal decay components of 4.37 µs and improved non-proportionality behavior. Investigations into charge trapping and recombination centers provide insights into optimizing its luminescence. Substituting alkali (Cs → Tl), metal (Hf → Zr), and halide (Cl → Br, I) elements, along with doping (e.g., Ce^{3+}, Eu^{3+}), has resulted in novel scintillators with enhanced properties. Due to its high purity and low internal radioactivity (U/Th chain contamination below detection limits), CHC is a strong candidate for rare event physics experiments. Additionally, CHC exhibits excellent thermal stability, with negative thermal quenching effects improving light yield in the 125–150 K range. These findings highlight CHC as a superior alternative to existing scintillators, with potential applications in medical imaging, security screening, and fundamental nuclear research. Additionally, CHC crystals demonstrate thermal stability with congruent melting at approximately 821–822 °C under nitrogen and vacuum conditions, making them suitable for stable performance in radiation detectors. The negative thermal quenching effect observed at cryogenic temperatures further enhances the light yield, making CHC an attractive candidate for high-sensitivity detection applications in fundamental physics and low-background experiments.

Abstract # 280

Growth and Characterization of Cesium Hafnium Chloride (CHC) Scintillator Crystal from Melt

Elijah Adedeji, Amari Williams, Karishma Gupta, Angel Reeder, Stephen Babalola (PhD)
Mentor(s): Dr. Stephen Babalola
Department of Physics, Chemistry and Math

We report an effort to grow Cesium Hafnium Chloride (CHC) scintillator crystals from the melt using the Bridgman and modified Czochralski (CZ) methods. CHC, initially discovered as a luminescent material, has been re-invented as a promising scintillator for gamma-ray detection. The material exhibits a cubic crystal structure, is nearly non-hygroscopic, and offers highly proportional scintillation with performance superior to thallium-activated sodium iodide (NaI:Tl) and comparable to lanthanum bromide. Unlike many other scintillator crystals, CHC achieves a high light yield and exceptional energy resolution without requiring doping. The modified CZ method employed in this study features an ampoule equipped with a rotatable borosilicate stir rod to facilitate the controlled descent and precise introduction of the seed crystal into the melt. The ampoule's O-ring ensures a controlled atmosphere, safeguarding the hygroscopic starting materials and stabilizing the melt. Additionally, the setup generates hafnium vapor within the ampoule, contributing to crystal quality. Grown crystals and a seed crystal were subjected to comprehensive characterization for a comparative study of their structural and scintillation properties. These findings demonstrate the significant potential of CHC as a next-generation scintillator material.

Abstract # 281

Spectroscopic Investigations of Samarium doped Barium Borate Glasses

Aaron Johnson and Rupesh Telawar
Mentor(s): Dr. Rami Bommareddi
Department of Physics, Chemistry and Math

"Barium borate glasses doped with silver and/or samarium are fabricated using the melt quenching technique. These glasses are heated to 1200 degrees centigrade for one hour, then left to cool to room temperature in ambient air. The resultant glasses are then polished with different grades of sandpaper until smooth for characterization. Samarium and Silver were chosen as dopants because Sm^{3+} and Ag nanoparticles exhibit absorption in the vicinity of 405 nm. Hence it is possible to investigate interaction mechanisms between the metallic nanoparticles and Sm^{3+} ions. The samples were heat treated above the glass transition temperature to induce nanoparticles. Optical microscope images revealed the formation of micron size Ag particles. Optical absorption spectrum revealed enhancement Sm^{3+} transitions in the vicinity of plasmon absorption wavelength region. Initial investigation revealed a drastic reduction in the Sm^{3+} emission intensity. Both Sm^{3+} and Ag nanoparticles exhibit absorption in the vicinity of 405 nm. It appears that some of the excitation energy is transferred from Sm^{3+} to Ag particles. However, when the co-doped sample was heat treated at 530°C for 18 hours the emission intensity of co-doped sample enhanced again. Further work is in progress to understand this effect.

*This research was supported by a DoD grant No. W911NF2310157 and NSF grant No. 2331969."

Abstract # 282

COMPARATIVE STUDY OF EUROPIUM DOPED MATERIALS FOR WHITE LIGHT GENERATION

Yannik Palmer-Tesema and Dr. Rami Bomarreddi
Mentor(s): Dr. Rami Bomarreddi
Department of Physics, Chemistry and Math

Now-a-days there is a great demand for LED bulbs which are replacing incandescent light bulbs. LED bulbs are compact, rugged, and free from pollution. Diodes emit a single wavelength. However, phosphor coated diodes generate white light on exposure to blue or violet light. Global research is ongoing to design phosphor coatings which emit high intensity in a broad spectral wavelength region. We are also investigating different phosphor materials to address this issue. We are investigating the suitability of europium doped crystals and glasses for this purpose. Crystals used for this study were procured from commercial sources and the glasses were made in our laboratory by the melt quenching technique. The glass samples were then polished with sandpapers of different grades. Detailed spectroscopy measurements were performed to characterize the materials. Absorption spectral measurements of the materials were performed using a Cary 3E spectrophotometer. Emission was stimulated from the samples by exposing them to blue diode lasers. A compact spectrometer was used for fluorescence spectral measurements. Emission spectral data and lifetime measurements are used for unambiguous spectroscopic assignments. From the emission spectral measurements, color coordinates and color temperature were derived.

Behavioral Sciences

Abstract # 283

A STEM Perspective: Mindset, Wellness & Perception of Counseling

Tamiya Bowden, Marcus Brown, Ekua Young- Arthur, Ashley Hernandez Martinez, Obinna Okoyo, Cenaya Nolen, Talyn Davis, Xavier Rucker, Darianne Ewing, Callie Pitsinos, Dr. Tonya Davis
Mentor(s): Dr. Tonya Davis
Department of Behavioral Sciences

Student mental health is an urgent and critical issue and mental health challenges among STEM undergraduates are a growing concern, as these students often face intense academic pressure and unique stressors. The demanding nature of STEM programs fosters a culture where high stress levels are normalized, leading students to question whether their struggles are an expected part of the learning process or indicators of deeper mental health issues. This internal conflict can discourage help-seeking behaviors, as students may perceive stress and sacrifice as necessary components of success. Despite the prevalence of mental health concerns, many STEM students remain hesitant to seek professional counseling. The lack of research on STEM-specific mental health challenges, combined with deeply ingrained beliefs about perseverance and self-reliance, creates barriers to accessing support. Understanding why STEM students are reluctant to seek help is essential for developing effective interventions. This study aims to examine the specific stressors affecting STEM

undergraduates and explore how their academic identity influences perceptions of counseling and mental health support. By analyzing the factors that contribute to help-seeking reluctance, this research will provide insight into strategies that encourage students to prioritize their well-being. Addressing these barriers can help reshape STEM culture to foster a healthier balance between academic rigor and mental wellness. The findings from this study will inform institutional efforts to create more supportive environments that normalize mental health conversations and provide accessible resources.

Other (Category Not Judged)

Abstract # 267

Cold Atmospheric Plasma Application for the Inactivation of the Seed-borne Pathogen *Xanthomonas campestris pv. vesicatoria* on Bell Pepper Seeds

Manjula Bomma, Drs. Florence Okafor, S.R. Mentreddy, Leopold Nyochembeng

Mentor(s): Dr. S.R. Mentreddy

Department of Natural Resources and Environmental Sciences

Bacterial leaf spot caused by *Xanthomonas campestris pv. vesicatoria* is a common seed-borne disease affecting solanaceous crops, particularly tomatoes and peppers. Although traditional methods of control, such as the use of resistant varieties and cultural and seed treatment with bacteriocidal chemicals, are used, a need exists for innovative chemical-free technology to combat this destructive disease. Cold atmospheric plasma (CAP), applied in microelectronics, medicine, food processing, and material modification, is an environmentally friendly technology that enhances food safety and security and promotes sustainable agriculture. CAP has demonstrated antimicrobial capabilities, effectively suppressing bacterial and fungal pathogens responsible for plant diseases. This preliminary study evaluated the efficacy of CAP in reducing the seed-borne bacterial *pathogen X. campestris pv. vesicatoria* on bell pepper (*Capsicum annuum*) seeds. A bacterial colony was introduced into 5 mL of nutrient broth, incubated for 24h, and then multiplied in 20 mL of nutrient broth, reaching a final concentration of 10^8 colony-forming units per mL. Bell pepper seeds were inoculated with the pathogen by mixing 0.6 g of seeds with the bacterial culture and incubating for 48h. Post-incubation, bacteria were exposed to CAP treatments at energy levels of 6 kV and 8 kV for 6 and 8 minutes each. Bacterial growth inhibition was assessed using a microplate reader with optical density (OD) measurements between 420–580 nm to determine treatment effects. CAP at 8 kV and 6 kV for 6 minutes reduced bacterial populations by 0.26 OD (30%) and 0.30 OD (17.5%), respectively, compared to 16.33% (0.31 OD) and 8.8% (0.34 OD) reductions at 8 kV and 6 kV for 8 minutes. The control treatment showed 0.37 OD with no inhibition. These findings highlight cold atmospheric plasma's potential to reduce seed-borne bacteria. Future research will explore expanded CAP treatments on foodborne and human pathogens to improve seed and food safety.

Abstract # 268

The Effects of the BioPolymer Xanthan Gum Amendment on Soil DNA Quality

Prestige Aliche
Mentor: Dr. Venkateswara Sripathi
Department of Natural Resources and Environmental Sciences

In biotechnology or molecular biology labs, the capacity to quantify microliters, or ul, of liquid chemicals or reagents is an essential skill. Micropipettes are used by researchers to accurately quantify very minuscule quantities. Using micropipettes, one can precisely move tiny amounts of liquid (microliters) from one container to another. Biopolymers are eco-friendly materials that have been widely employed in agricultural and medical applications. For soil conditioning purposes, xanthan gum is one of the most promising materials due to its biodegradability, soil-strengthening efficiency, film-forming ability, and high water-absorbing capability. Thus, xanthan gum, when added to untreated soil, enables more vigorous growth and an increased survival rate under drought conditions.

Abstract 269

Analysis of TNNT2 Gene Variant and the Development and Severity of Familial Hypertrophic Cardiomyopathy

Lisa Eben
Mentor: Dr. Ebony I. Weems-Oluremi
Department of Biological Sciences

Familial hypertrophic cardiomyopathy (HCM) is a genetic disorder characterized by the thickening of the heart muscle, primarily affecting the left ventricle. This form of cardiovascular disease is the most common inherited cardiovascular disease. Cardiovascular disease is one of the leading causes of death in the United States. Mutations in various genes have been associated with its development. TNNT2 is one of the genes known to harbor mutations associated with familial HCM. Clinical manifestations of familial HCM can vary widely, ranging from asymptomatic individuals to those experiencing symptoms such as chest pain, shortness of breath, palpitations, or sudden cardiac death. The purpose of this study was to identify and characterize TNNT2 mutations (variants) associated with familial HCM. A variant analysis was performed to characterize genetic variations within the TNNT2 gene. The analysis examined single nucleotide polymorphisms (SNPs) to predict the potential impact of variants on protein structure, function, and stability. Three variants were chosen, V148I, R206W, and R148Q out of over 500 variants. The three variants were used in five different prediction tools: PolyPhen-2, CADD, PANTHER, PhD-SNP, and SNPs-GO. Results show that the single amino acid substitution R206W has the potential to be pathogenic and disease-causing. Further analysis will be done to advance our understanding of the genetic and molecular aspects of familial HCM, provide insights into its clinical manifestations, and pave the way for the development of more targeted therapies and improved patient care.

Abstract # 270

Introduction to Food Safety and Processing.

Yamari Collins
Mentor: Dr. Lamin Kassama

Food Safety offers practical measures and scientific measures taken to ensure that food products are safe for human consumption, free from contamination, and pose no risk to public health. Food safety practices are essential to safeguard public health. It reduces the burden on healthcare systems and prevents suffering. There are concerns about the use of synthetic phenolic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) as food additives because of the reported negative effected human health. The changes in the lifestyle of people around the world have led to changes in their food needs. There is a rise in demand for clean and safe food without compromising the nutritional qualities of food. Use of 3-D printing, also known as Additive

Manufacturing (AM), or Rapid Prototyping and non-thermal processing methods (PUV) have been on the increase. Food safety in processing and preservation is a shared responsibility which spans from the farm to the table and fork and demands everyone’s unwavering commitment to excellence and maintenance of food integrity.

~~~ STEM 2025~~~~

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Dr. Matthew E. Edwards, Professor of Physics

Fall Semester 2006

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Dr. Florence Okafor	Dr. Showkat Chowdhury	2009
Dr. Florence Okafor	Dr. Mezemir Wagaw	2010
Dr. Mezemir Wagaw	Dr. Vernessa Edwards	2011
Dr. Vernessa Edwards	Dr. Elica Moss	2012
Dr. Elica Moss	Dr. Malinda Gilmore	2013
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Dr. Josh Herring	Dr. Kamala Bhat & Dr. Aschalew Kassu	2015
Dr. Kamala Bhat	Dr. Dedrick Davis Dr. Mebougna Drabo	2016
Dr. Dedrick Davis	Dr. Padmaja Guggilla Dr. Armitra Jackson-Davis	2017
Dr. Padmaja Guggilla	Dr. Armitra Jackson-Davis Ms. Terry Miller	2018
Dr. Armitra Jackson-Davis	Dr. Salam Khan Dr. Laricca London-Thomas	2019
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- **American Society of Military Engineers**
- **Animal Science Club**
- **Environmental Science Club**
- **Association for Computing Machinery Student Chapter**
- **Black Chemists and Chemical Engineers**
- **Biology Club**
- **Chemistry Club**
- **Future Physicians Club**
- **Computer Science Club**
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- **Forestry Club Alpha Zeta**
- **Institute of Electrical and Electronics Engineers (IEEE) Students Branch**
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- **Minorities in Agriculture, Natural Resources and Related Sciences**
- **National Institute of Science Club**
- **Food Science Club**
- **National Society of Black Engineers**
- **Society of Physics Students**
- **Phi Tau Sigma (Food Science Honor Society)**
- **Graduate Students Association**
- **Society of Photographic Instrumentation Engineers (SPIE)**
- **Society of Women Engineers**
- **Computer Science Club**
- **The National Organization for the Professional Advancement of**
- **The Pre-Professional Club**
- **Beta Kappa Chi Honor Society**

ACKNOWLEDGEMENTS

On behalf of STEM Day 2025 Planning Committee, the Chair and Co-Chairs would like to extend a big, heartfelt 'thank you' to all the sponsors, chairs, STEM Day 2025 Committee Members, and coordinators of the various units, for their dedication, support and encouragement to the faculty in the respective units without whom this event would be hard to visualize.

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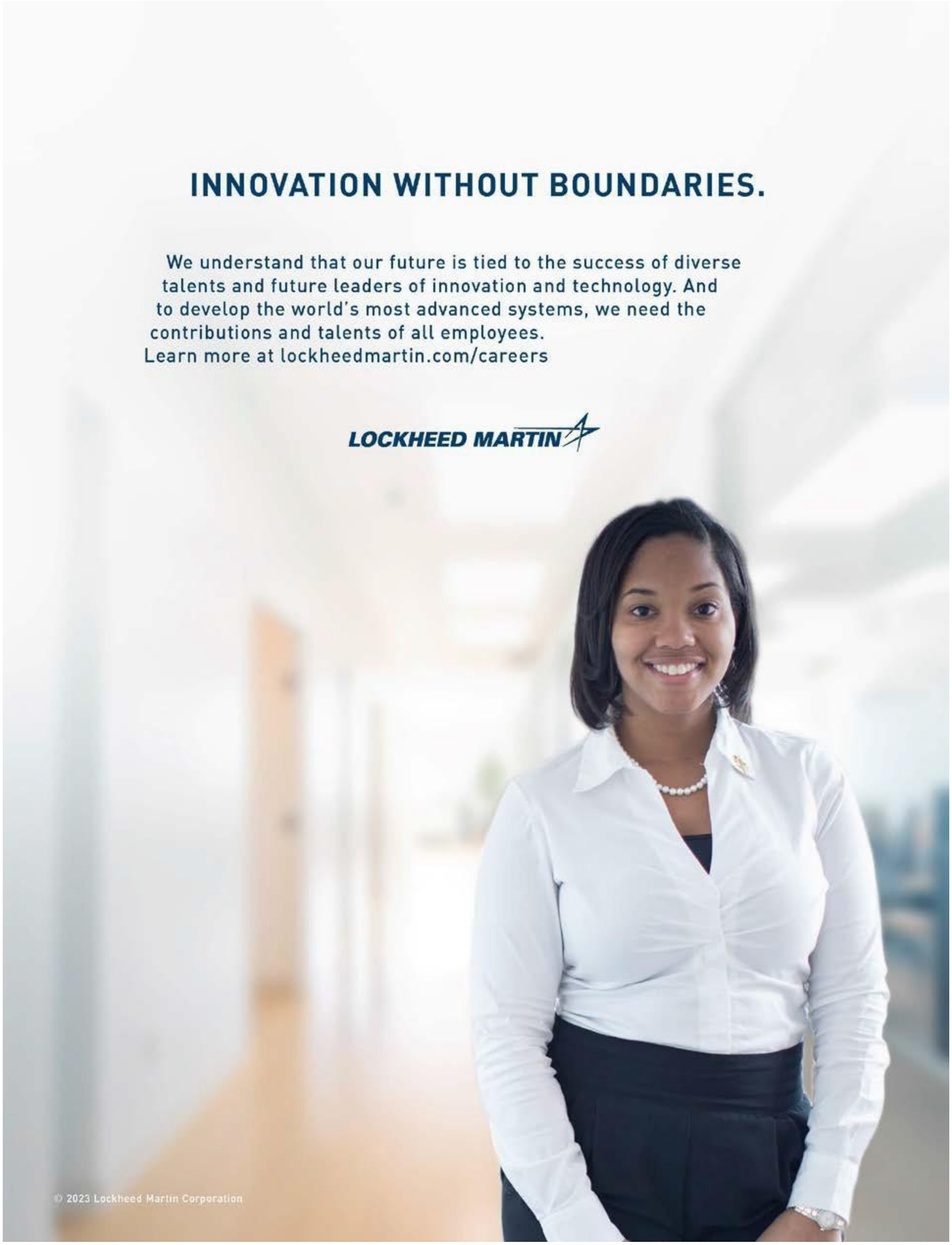
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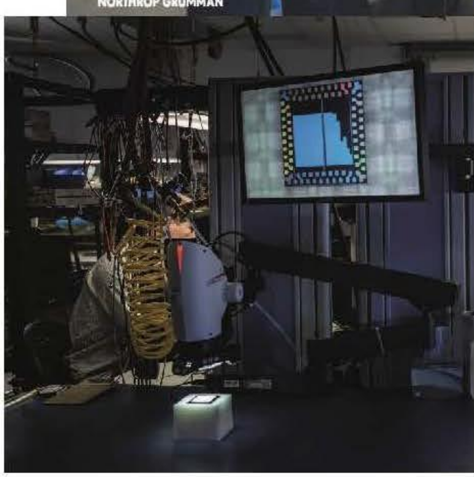


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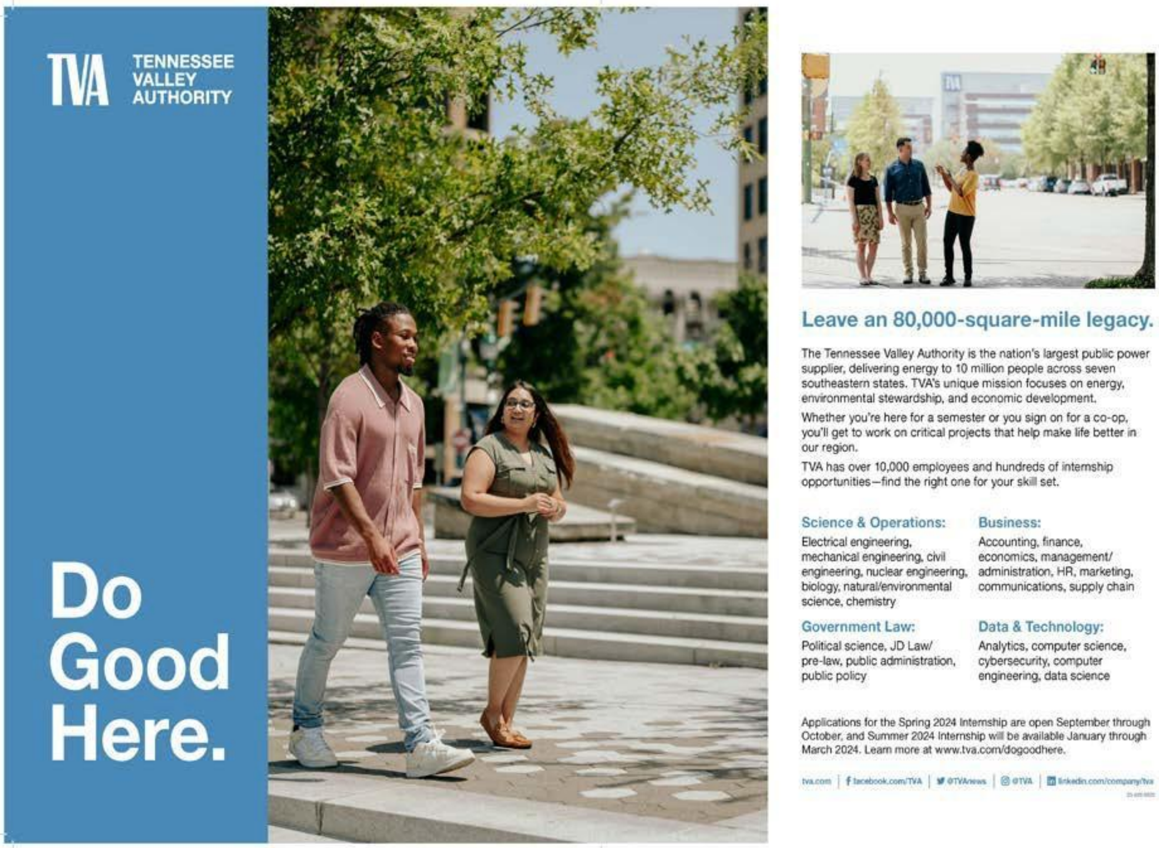
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