ARKANSAS STEM POSTERS @ the Capitol

"It is essential, if we want to continue to reap the benefits of science, to commit as a nation to preparing more young people for extraordinary careers in science."

—Carol W. Greider, 2009 Nobel laureate in physiology & medicine

February 14, 2024

Highlights

- **72 students**
- **From 11 Arkansas colleges and universities**
- **Presenting 45 different presentations of original work**
- **Encompassing all aspects of science and technology**


STATE
ARKANSAS STATE
UNIVERSITY


1871
UNIVERSITY OF
ARKANSAS


1890
HENDERSON
STATE UNIVERSITY


OUACHITA
BAPTIST UNIVERSITY


1876
HENDRIX


ARKANSAS
TECH
UNIVERSITY


UNIVERSITY OF
CENTRAL
ARKANSAS


UALR
UNIVERSITY OF ARKANSAS
AT LITTLE ROCK


UNIVERSITY
of ARKANSAS
AT PINE BLUFF
1873


UAM
THE UNIVERSITY OF ARKANSAS AT MONTICELLO
MONTICELLO • CROSSETT • MCGEHEE


LYON
COLLEGE


JOHN BROWN
UNIVERSITY


CENTRAL
BAPTIST COLLEGE


PHILANDER
SMITH COLLEGE
EST 1877


UAFS
UNIVERSITY OF ARKANSAS
FORT SMITH


UAMS
UNIVERSITY OF ARKANSAS
FOR MEDICAL SCIENCES


HARDING
UNIVERSITY

ARKANSAS STEM POSTERS@ the Capitol

Student presenter (school) ….. page with abstract

Quantification of Gordonia terrae Bacteriophages using Lysate qPCR

Mikayla Long *[Mentor: R. Plymale]*

Ouachita Baptist University - Biology

Bacteriophages are viruses that infect and replicate only in bacterial cells. Quantitative PCR was used in this experiment to count the number of DNA copies in the phage lysate sample. In this project, the more rapid lysate qPCR method was compared to standard plate count titer assays using the double layer agar method, to match the number of genomic copies with the plaque forming units in the lysate. Initially, multiple primer sets were designed to amplify the best primers and reaction conditions to use for phage detection. Because qPCR is sensitive to contamination, there were multiple controls to ensure no contamination. Subsequently, a standard curve was generated by comparing the phage concentration determined from titer assays with that measured using SYBR Green qPCR. The optimized lysate qPCR method will be a faster method to determine the number of bacteriophage DNA copies in phage lysate, allowing the rapid determination of phage concentration for optical density-based infection growth curve experiments.

Nutrition Assessment of Preschool and School-Aged Children

Madison Lovell and Brooklin Pitard *[Mentor: D. Brech]*

Ouachita Baptist University - Nutrition and Dietetics

One in three US children has a body mass index (BMI) categorized as overweight or obese. Working alongside Dr. Detri Brech, Madison Lovell and Brooklin Pitard provided education focused on nutrition and physical activity to preschool and school-aged children in Arkadelphia. After six weeks of lessons, there was a reduction in BMI among the treatment group.

Proliferation and Oxygen Production of Arthrospira platensis in Varying Light Intensities

Trace Morrow, Lawrence Davis IV *[Mentor: J. Taylor]*

Ouachita Baptist University - Biology

As space travel becomes more advanced, adequate nourishment and oxygen resources are crucial issues for scientists concerning long-term travel. Arthrospira platensis, also known as spirulina, is a protein rich cyanobacteria that could potentially provide a solution to these issues with minimal energy consumption. Spirulina is known to be used for protein supplementation with various health benefits and pharmacological applications. In addition, spirulina cultures produce high amounts of oxygen through photosynthesis using carbon dioxide. Proliferation and oxygen production are primarily dependent on the spirulina cell structure (straight or coiled). A mixed culture (containing straight and spiral Spirulina cells) and a spiral Spirulina culture were studied under 40 µM, 60 µM, and 80 µM light intensities in order to determine the behavior of cell reproduction and its effects on oxygen production. Six 2.5 L containers with Spirulina were placed under a light and elevated to reach the desired light intensities. Cell reproduction and oxygen production were monitored in 24-hour intervals for a total of 168 hours.

Enhancing the Resilience and Security of Phasor Measurement Unit (PMU) Networks in Energy Systems Using P4 Programmable Networks

Jack Norris *[Mentor: K. Jin]*

University of Arkansas—Fayetteville - Computer Science

With the inevitability of power-grid cyber attacks growing in number, the need for reliable energy system monitoring is clearer than ever. Phasor measurement units (PMUs) are key devices in meeting this need. PMUs accurately measure electrical phasor quantities such as voltage and current at specific points in a power grid, then relay this information through a computer network to a central control center for analysis. PMU network often experience unavoidable missing or erroneous measurements, undermining power system observability. The purpose of my research is to increase the resilience of PMU networks in energy systems. In particular, I take a decentralized, in-network approach to the detection and restoration of missing PMU data by leveraging P4 programmable networks. In practice, this approach will allow for faster, more accurate readings of the state of a power grid, meaning that system faults and security threats can more quickly be detected and mitigated. Currently existing methods adopt a slower, centralized approach to missing PMU data detection and restoration. Preliminary results with a container-based network emulator indicate an end-to-end delivery and recovery time for missing packets of approximately 3.96ms for this approach, sufficiently supporting most real-time applications reliant on PMU data. With a 5% packet loss rate, the mean absolute percentage error for voltage magnitude is a mere 0.04%, and the phase angle error typically hovers only around 0.06°.

Advanced Acoustic Sensing for Thermal Fault Detection in Electronics Cooling

Jackson Marsh, Stephen Pierson *[Mentor: H. Hu]*

University of Arkansas—Fayetteville - Engineering

Demand for high-performance computing and the compact integration of power electronics in electric vehicles (EVs) have pushed thermal management challenges to new heights. Conventional air-cooling methods are reaching limits due to high power densities. On the other hand, liquid cooling emerges as a superior alternative due to its higher density and thermal conductivity. Two-phase liquid cooling utilizes the latent heat of fluids for efficient heat transfer, maintaining safe operating temperatures for devices. This poster introduces an innovative multimodal acoustic sensing system designed for real-time thermal characterization of liquid cooling systems in single and two-phase modes. It integrates synchronized acoustic emission (AE) sensors, hydrophones, and microphones, offering a non-intrusive method to monitor and detect thermal faults, and quantify heat flux and temperature. System development allows for usage in DC power applications and running on smaller computer boards. Its efficacy lies in its ability to perform spectrum analysis of acoustic signals, identifying unique signatures associated with thermal expansion, bubble formation, and turbulent flows. The research characterizes four distinct liquid cooling mechanisms: single and two-phase immersion cooling, single-phase microchannel cooling, and two-phase microchannel flows. This work represents a significant step forward in thermal management technologies and multimodal AE sensing.

Hyperspectral Imaging of Plasmonic Nanoparticles with Ultrahigh-Throughput

James Batey *[Mentor: B. Dong]*

University of Arkansas—Fayetteville - Chemistry

Plasmonic nanoparticles (NP) have gained attention for their role in nanomedicine, cellular biology, photocatalysis, and more. At the single particle level, NPs exhibit heterogeneous physical and chemical properties. These qualities affect the behaviors of the materials and must be quantified to understand the systems they are employed in. Because NP characteristics are directly related to their scattering profiles, property characterization is traditionally done in bulk using spectrophotometric methods. The metrics obtained are gross averages of thousands of particles and not representative of the single NPs that will be studied in application. NPs can be characterized at single particle level using optical microscopy. However, the effectiveness of characterizing single NPs using dispersive techniques in high density is inefficient and low throughput. This is due to tradeoffs between localization precision and spectral resolution because intensity must be split between 0th and 1st-order spectra. At high concentration, 1st -order spectra of individual NPs significantly overlap in space, causing them to become spectrally unresolvable. I developed an ultrahigh throughput spectromicroscopy imaging system for the characterization of noble metal nanoparticles at the single particle level with high particle concentrations using spectral phasor analysis based on the physical Fourier transform.

Advancing Energy Efficiency: Miniature Conveyor Development for Testing Innovative Low-Friction Coatings

Shae Threlfall *[Mentor: M. Zou]*

University of Arkansas—Fayetteville - Engineering

Flat belt conveyors, indispensable in a range of global industries, are the fastest-growing conveyor type, already encompassing 26.6% of the global conveyor market which is projected to be worth $9.85B in 2026. In flat belt conveyors, the main efficiency constraint is the substantial sliding friction between the belt and slider bed surface, which is responsible for up to 60% of energy losses. This problem leads to significant energy waste, especially in U.S. industries that extensively use these conveyors. With the conveyor market experiencing rapid growth, partly fueled by a recent surge in e-commerce, enhancing energy efficiency has become a necessary concern. This project outlines the development of a miniature conveyor system that efficiently tests and verifies the effectiveness of innovative low-friction coatings that are specially developed to mitigate the effects of sliding friction. These coatings are expected to cut this friction in half, achieving a minimum of 30% reduction in energy consumption. The project encompasses the design, construction, and outfitting of the miniature conveyor with essential instrumentation. Crucially, this work stands as a pivotal contribution to a broader NSF project committed to overcoming the challenges in graphite coating commercialization. The research carried out signifies a pivotal step toward improving the efficiency and sustainability of supply chain operations through innovative friction-reducing technologies.

Photon Number and Waiting-time Distributions for Superposed States of Light

Eric Seglem *[Mentor: R. Vyas]*

University of Arkansas—Fayetteville - Physics

With the rise of quantum optics as a means of implementing quantum computers, the importance of research in quantum light is growing. Nonclassical states of light are characterized by properties which can be explained by the quantum model of light but not the classical model. Such nonclassical properties may be revealed through photon counting statistics. The photon statistics for the coherent state of light (a laser operating much above its threshold) and the squeezed state of light have been previously investigated, but the statistics for superposed coherent states remains largely unexplored. In our research, we have examined the photon statistical properties for the superposed state of light with evenly distributed phases. The photon statistics are quantified by measuring the photon number distribution and waiting-time distributions in photon counting experiments. By deriving an expression for the generalized superposed state, we calculated the photon statistics and compared the results to the coherent and squeezed states. An analysis of the statistics reveals a tendency to display significant photon antibunching, which indicates non-classicality. Building from these results, we will continue to explore further superpositions of the coherent state. This research contributes to an understanding of what distinguishes quantum light sources from classical light sources, which is essential to the future of quantum information.

Biochemical and Gene Expression Analyses Reveal the Importance of UDP-Glucose Pyrophosphorylase in the Utilization of Storage Starch for Seedling Growth in Rice

Colten Nichols *[Mentor: V. Srivastava]*

University of Arkansas—Fayetteville - Environmental Science

During germination, a rice seedling's growth is energized by starch stored in the endosperm. This starch must be converted to sucrose, through a series of degradation steps, to become metabolically available. The starch utilization process is known to be inhibited by inorganic pyrophosphate (PPi) as one of the steps involves UDP-Glucose Pyrophosphorylase (UGPase) that is sensitive to Ppi concentrations. Vacuolar H+ pyrophosphatase (V-PPase) regulates the cellular concentration of Ppi by hydrolyzing it to inorganic phosphate (Pi). Earlier, the rice V-PPase gene (VPP5) was mutated to slow down the process of PPi hydrolysis in rice endosperm. We examined the effect of VPP5 mutation on starch degradation and sucrose content in germinating seeds. VPP5 mutants showed lower starch reduction and lower sucrose content compared to the wild-type. A strong positive correlation was found between sucrose concentration and the expression of two starch degradation enzyme genes, UGPase and Sucrose Synthase (SuS). The α-amylase (Amy) genes, on the other hand, correlated with starch reduction endosperm but not with the sucrose content. Therefore, Amy is involved in reducing starch to maltose but subsequent steps involving UGPase and SuS are possibly inhibited in vpp5 mutants, impacting the production of sucrose during germination/ seedling growth. Overall, V-PPase activity in rice endosperm directly influences starch utilization, possibly by modulating the activity of PPi-sensitive UGPase.

Fabrication of Mechanically Reinforced and Physicochemically Tuned Polycaprolactone/ Cellulose Nanocrystal Scaffolds for Cardiovascular Disease

Jared Noel, Taylor Norris *[Mentor: J. Kim]*

University of Arkansas—Fayetteville - Engineering

Modern medical treatments for myocardial infarctions primarily consist of stents or blood thinners and are aimed at restoring oxygen flow to the heart. These treatments do not address the scar tissue that forms as a result of cardiac events, thus leaving patients at a greater risk for repeat events. Cell scaffolding is a prominent technology that utilizes biomimetic materials to facilitate native tissue regrowth. Polycaprolactone (PCL) is a synthetic biopolymer that has successfully been used in bone and musculoskeletal tissue engineering. However, PCL is limited for cardiovascular cell scaffolds because of its low mechanical strength and poor cell affinity. Cellulose nanocrystals (CNCs), naturally occurring subunits of cellulose, have a high tensile strength and tunable surface chemistry rich in hydroxyl groups. These unique properties make CNCs ideal as additive materials for PCL-based cell scaffolds. In this research, the preparation of uniformly mixed PCL and CNC composite materials at different ratios were utilized to make membranes. Mechanical properties, including tensile strength, Young's modulus, and elongation strain, were characterized. It was found that an increasing concentration of CNCs in the composites led to increasing mechanical strength values of the membranes, demonstrating the practicality of PCL/CNC composite materials for tissue engineering applications in stress-intensive environments like the cardiovascular system.

In vitro establishment and micropropagation of Ipomoea batatas an Arkansas relevant crop to establish a genomic library for the detection of pathogens

Alexandra Barnett, Pricila Tinajero *[Mentor: A. Ferrer]*

University of Arkansas—Monticello - Biology

An unknown cultivar of Sweet potato (Ipomea batata) was established in vitro and added to the UAM germplasm collection. Through this project, students have learned about concepts such as media preparation, aseptic techniques, pathogen identification and tissue culture techniques in a lab environment. After gaining an understanding of these techniques, our group created a goal: to establish a genomic library preparation of nucleic acids for next generation sequencing. These techniques include whole genome nucleic acid extraction and serological detection of pathogens. Both techniques will use the micropropagated material from our germplasm collection of sweet potatoes. The extraction protocols presented are based on a nucleic acid extraction kit E.Z.N.A. and nucleic acid CTAB extraction technique. The serological techniques presented in this work will test for the presence of the following sweet potato viruses: Sweet Potato Feathery Mottle Virus (SPFMV), Sweet Potato Virus G (SPVG), C (SPVGC) and 2 (SPVG2). All these viruses belong to the Potyvirus genus. Our team will use the Agdia Potyvirus specific immunostrips to test the material for the presence of pathogens. The presence of pathogens will also be determined through observation of sequencing data gathered by the Oxford Nanopore sequencing device. This project allows students to gain an understanding of molecular techniques while striving to learn about and improve the quality of the sweet potato plant in a safe laboratory environment.

Computational Study of CDC42 Inhibitors for Therapeutic Interventions in Triple Negative Breast Cancer

Emily Esquivel, Ross Hunter *[Mentors: D. Muhoza]*

University of Arkansas—Monticello - Biology, Chemistry

CDC42, a Rho GTPase, has been involved in various cellular processes, including cell morphology, migration, and division. Its dysregulation has been associated with various cancers, including triple negative breast cancer (TNBC), where it contributes to aggressive tumor behavior and metastasis. The present study used computational techniques to discover potential inhibitors that can modulate CDC42 activity in TNBC. Leveraging molecular docking and dynamic simulations, we analyzed a compound library of 10,000 small molecules for interactions with the CDC42 wild type and mutant. The most promising compounds, identified based on binding affinities, were further subjected to in silico pharmacokinetic and toxicity evaluations. Three standout compounds were identified that exhibited not only high binding affinities to CDC42 but also favorable drug-like properties with minimal predicted adverse effects. These compounds represent potential therapeutic agents for targeting CDC42-driven pathways in TNBC. Such interventions could attenuate the aggressive phenotypes associated with TNBC and enhance patient prognosis. Rigorous in vitro and in vivo validations are essential for these identified compounds. If substantiated in further studies, our findings could pave the way for novel therapeutic strategies targeting CDC42 in TNBC.

Ascorbate Content Dynamics in Rice Under High Night Temperature (HNT) Stress

Brilee Petty *[Mentor: A. Lorence]*

Arkansas State University - Biology, Chemistry

Rice is an important staple crop around the world. It produces vitamin C, or L-ascorbic acid, an essential antioxidant important in all plant functions. Vitamin C is also important in the daily functions of humans. However, humans cannot produce the antioxidant and must receive it through their diet. Oxidative stressors such as high night temperature stress can cause a plant to decline in ascorbate content. Global warming is a pressing issue on Earth, so it is important to find a tolerant accession of rice that can overcome these challenges. Therefore, my experiment aims to analyze the ascorbate content in a variety of rice accessions that have been found to demonstrate tolerance in high or cold temperature stress: Baldo, Bulgare, Dom Sufid, Lemont, N22, and WAB. I will sample these accessions during the flowering stage; this stage is known to be a high ascorbate level stage within development. I will sample the flag leaves, stems, and panicles from each rice plant. Each accession will be split between two greenhouses. One greenhouse will maintain optimal conditions for rice growth, while the other greenhouse will have a four-degree increase in high night temperature. The samples will be used in an ascorbate assay using a spectrophotometer to compute the total, reduced, and oxidized ascorbate within each sample. Statistical analysis will be used to determine the amount and location of ascorbate within rice as well as the most tolerant rice accession to HNT stress.

Anticancer Potential of Pigeon Pea Isoflavones in Triple-Negative Breast Cancer

Salma Abdel-Karim, Guarav Gajurel *[Mentor: F. Medina-Bolivar]*

Arkansas State University - Biology

Breast cancer is the most common type of cancer diagnosed among women in Arkansas, with an estimated 2,510 new breast cancer cases in Arkansas in 2023. One aggressive form of breast cancer, namely triple-negative breast cancer (TNBC), is characterized by the absence of the three classical breast cancer receptors. This presents a serious challenge because most current breast cancer treatments target these receptors, severely limiting therapy options for TNBC. Thus, it is crucial to explore alternative treatments, and one promising avenue involves utilizing naturally occurring compounds from plants, such as isoflavones. The objective of this study was to assess the cytotoxic effects of an isoflavone-rich extract and various isoflavones extracted from pigeon pea hairy root cultures on the MDA-MB-231 TNBC cell line. The TNBC cells were exposed to equal concentrations of the isoflavones genistein and isowighteone for up to 72 hours; isowighteone exhibited greater toxicity than genistein at all time points. The cells were then exposed to the isoflavone-rich extract and equivalent concentrations of genistein and isowighteone for up to 72 hours; the extract exhibited much greater toxicity than the individual isoflavones. These studies underscore the need for further research into the isoflavones from pigeon pea hairy root cultures as potential natural anticancer compounds and highlight the promising potential of isoflavones to treat one of the most widespread cancers in Arkansas.

Studying Bypass of Essential Genes in the Dental Caries Pathogen Streptococcus Mutans

Sangam Chudal *[Mentor: R. Shields]*

Arkansas State University - Biology

Studies have revealed the existence of many unknown and essential genes in Streptococcus mutans, a bacteria causing dental caries. To understand these genes' function, we conducted mutagenesis screens to determine if their essentiality could be bypassed. Firstly, we created oligonucleotide primers to target these hypothetical genes SMU_415, SMU_419, SMU_368, SMU_369, SMU_393, SMU_471, SMU_734, SMU_775, SMU_958, SMU_1801, and SMU_1802. We used molecular biology techniques, PCR, gel electrophoresis, and restriction enzyme digest to amplify, digest, and purify the PCR fragments. Next, we extracted an antibiotic marker aphA3 from the E. coli plasmid pALH123 and combined it with the PCR fragments in ligation . The ligation products were then transformed into S. mutans cells and selected on rich media agar with kanamycin. We observed putative mutant colonies for SMU_415, SMU_471, and SMU_369. We also introduced the transformed products into transposon library. This yielded putative mutant colonies for SMU_369, SMU_734, and SMU_775. Next, we sequenced the genomes of the mutant strains to compare them to the reference genome of S. mutans UA159. These revealed the mutations that rendered the essential components non-essential, which might help to identify critical genes and/or pathways that the essential genes interact with. Next, we will explore the linkage between essential and suppressor genes to make discoveries that determine the function of the unknown essential genes.

Existential Risk Judgments: A Cross-Cultural Comparison

Mei Ishimura *[Mentor: V. Medina]*

University of Central Arkansas - Psychology

Previous research using Western samples has found that people do not tend to judge an extinction catastrophe compared to a near-extinction catastrophe as uniquely bad as opposed to a near-extinction catastrophe compared to no catastrophe. The current project will investigate to what extent this judgment is distinguished by Eastern versus Western moral values. Based on Eastern collectivism and Western individualism, the primary hypothesis is that a Japanese sample should be more likely than an American sample to judge human extinction as uniquely bad because collectivism emphasizes the welfare of one's whole group (in this case, humanity and its ability to persist in the absence of extinction). A secondary hypothesis is that the Japanese sample should score higher on reflection ability as measured by the Cognitive Reflection Test 2. This hypothesis is based on prior existential risk research demonstrating that higher reflection ability is correlated with increased judgments of extinction as uniquely bad. The current study is the first to evaluate the Cognitive Reflection Test 2 as a function of culture, and more importantly, is the first attempt at understanding existential risk judgments as a function of culture.

Individual Difference Predictors of Existential Risk Judgments

Mackenzie Criner *[Mentors: V. Medina]*

University of Central Arkansas - Psychology

Prior research on existential risk judgments has found that people do not believe that an extinction catastrophe compared to a near-extinction catastrophe is uniquely bad as opposed to a near-extinction catastrophe compared to no catastrophe. Three constructs of interest that might drive this behavior are rationality, attention control, and fluid intelligence. We investigate these factors as underlying cognitive mechanisms of existential risk judgments by using a version of the Cognitive Reflection Test 2, the Adaptive Stroop Task, and Raven's Advanced Progressive Matrices respectively. Our first prediction is that better performance on the shortened version of the Cognitive Reflection Test 2 will significantly predict the belief that extinction is uniquely bad. This will replicate research demonstrating this effect of rationality on existential risk judgments. Our second prediction is that better performance on the Adaptive Stroop Task will significantly predict the belief that extinction is uniquely bad. This is supported by research establishing a correlation between rationality and attention control. Our third prediction is that better performance on Raven's Advanced Progressive Matrices will significantly predict the belief that extinction is uniquely bad. This is based on prior research establishing a correlation between rationality and fluid intelligence. The study is the first attempt at understanding existential risk judgments through individual differences in cognition. This extends research on the relationships between rationality, attention control, and fluid intelligence by evaluating these constructs using different measures than previous research.

10:30-11:45

Poster Number 18

Occluded Traffic Sign Detection with YOLOV3

Rahanuma Tarannum *[Mentor: T. Ensari]*

Arkansas Tech University - Computer Science

Traffic sign detection is an essential component for intelligent transportation systems and self-driving vehicles nowadays. Nevertheless, occlusion of signs due to features like other vehicles often negatively affects detection accuracy. In this project, we advance an occluded traffic sign detection system using You Only Look Once version 3 (YOLOv3), a state-of-the-art deep learning algorithm for real-time object detection. The approach is tailored and assessed to measure performance explicitly on occluded test cases from traffic sign datasets. Moreover, when it comes to automatically identifying and detecting road signage from cameras mounted on vehicles, computer vision is essential. Sign occlusion is still a major problem, though. Partial or complete blockage on the road is frequently caused by distance, people, trees, and other things. When signs are obscured, mainstream sign-detecting systems perform noticeably worse. For this, we used occlusion-robust techniques to overcome the problem. In this project, we present a detailed methodology, development, and analysis of building an occlusion-focused traffic sign detection system using deep learning that has engaging real-world applications to measure the detection of traffic signs accurately.

Classification and Segmentation of Material Microstructures Images Using Machine Learning

Mizanur Rahman *[Mentors: M.H. Kelestemur, S. Saedi, T. Ensari]*

Arkansas Tech University - Chemistry, Computer Science, Engineering

Manufactured metallic materials are used in aerospace rocket components, automotive parts, biomedical equipment, and infrastructural components. Manufactured materials contain microstructures with their material and properties. These metallic materials have diverse structure types and complex microstructures, which govern their mechanical properties, which are intrinsically linked to the manufacturing process. The relationship between composition, structure, processing, and properties of manufactured metallic materials exhibits the development of improved materials for known applications and new applications. Therefore, it is very important to identify material microstructure and the accurate feature parameters extraction for the research and materials' application. In our study, we use machine learning (ML) and deep learning (DL) methods to characterize pores, particles, grains, and grain boundaries (GBs) from a given microstructure image. A neural network-based material microstructure recognition and semantic segmentation model will be designed to automatically identify and classify material structure and their defects such as pores, particles, and grain boundaries, and then adaptively process images and extract features to overcome the challenges of efficient recognition and extraction of material structures.

Neuromorphic Computing for Data Compression

Margaret Corbett-Strain *[Mentors: T. Ensari, B. Ustundag]*

Arkansas Tech University - Computer Science

Neuromorphic computing is an approach to designing software, algorithms, electronic circuits, and hardware systems that mimic the structure and function of the human brain and nervous system. For both software and hardware cases, we aim for low power consumption and highly energy-efficient microprocessors (computers). Neuromorphic computing has many potential application domains such as machine learning, artificial intelligence, image recognition, computer vision, text mining, bioinformatics, healthcare, finance, robotics, dimensionality reduction, data compression, and others. Spiking neural networks (SNN) are a good model for biological neurons. It's a type of parallel information processing based on artificial neural networks (ANN) and the next generation of ANN as a deep learning (DL). SNN, ANN, and DL are adaptive and capable of learning from experience like biological neural networks. In this study, we offer and study neuromorphic computing algorithms for neural data compression. Because the data growth rate is quite high in our digital world today, especially in the last decade. We generate a large size of data each second on the internet, smartphones, and social media. Additionally, internet of Things (IoT) devices also generate large amounts of data to use, store, and analyze it. Therefore, the volume, velocity, and variety of information are important, and sending/receiving data is one of the main tasks for the researchers.

Optimizing Campus Chat-bot Experience: Integrating Large Language Model (LLM) into University AI Assistants

Sijan Panday, Clayton Jensen, Zurab Sabakhtarishvili

[Mentor: R. Ghosh]

Arkansas Tech University - Computer Science

The advent of large language models (LLMs) such as ChatGPT and Bard marks a significant milestone in knowledge acquisition, offering a streamlined alternative to the traditionally labor-intensive process of navigating through multiple checkpoints on the web. This emerging trend in LLMs renders the prevalent rule-based chatbots, commonly utilized by universities, increasingly outdated and subpar. This research project proposes integrating LLM technology into university websites, specifically targeting the needs of students seeking information about their institutions by introducing PUAA (Personal University AI Assistant). Our approach involves using the Retrieval-Augmented Generation (RAG) framework, leveraging the capabilities of the LlamaIndex in conjunction with state-of-the-art LLMs such as Llama-2 provided by the Hugging Face. To quantify the effectiveness of this integration, we have employed a comprehensive set of metrics, which includes user satisfaction rates and accuracy in information retrieval. PUAA enhances the student's experience by providing instant, accurate information and reducing administrative staff's workload, allowing them to focus on more complex inquiries and tasks. This endeavor aims to pioneer AI adoption in educational institutions, demonstrating the viability and benefits of advanced AI tools in enhancing the academic experience and information accessibility for students and staff.

Wildfire Fighting Drone Project

Timothy Cary Johnson, Derek Thompson, Parker Padgett

[Mentor: B. Ghosh]

Arkansas Tech University - Computer Science, Computer Vision

The wildfire fighting drone is a drone which will be used to monitor wildfires by firefighting professionals. Using the computer vision programming library OpenCV and a drone -mounted camera, the drone operator will be able to capture an overhead live feed of the fire as it is happening. This software also generates meaningful data about the fire such as its current trajectory and the rate at which it is spreading.

ATU Scheduling Page

Spencer Anderson, Nathan Doyle, Wilson Escobar, Devin Sandlin *[Mentor: B. Ghosh]*

Arkansas Tech University - Computer Science

The primary purpose of our application is to create a tool for both students and advisors that will help simplify and optimize the ATU's advising process. The application will provide students with a personalized degree map that they may use as a basis for choosing which classes to take for each semester left in their degree plan.

Tunable nanoparticles for improved photothermal treatment

Nistha Neptune, Sara Mateen *[Mentor: N. Siraj]*

University of Arkansas—Little Rock - Chemistry

Ionic materials containing a chemotherapeutic cation and a photosensitizer anion that can serve as a PDT/PTT agent was used to developed tunable nanomedicine. Herein, tunable combination nanomedicines are developed of varying size and surface charge. The effect of sonication time on the size of nanoparticles that can directly impact the photophysical characteristics and consequently in vitro cytotoxicity of the nanodrug are investigated in detail. The photothermal and photodynamic effect of ionic nanomaterials (INMs) are also investigated in solution using probe usdering laser irradiation (808 nm). It was examined that by simply altering the sonication time during nanoparticles synthesis, significant changes in the light to heat conversion efficiency and reactive oxygen species quantum yields were observed. To further elucidate, both dark and light cytotoxicity were performed using MCF-7 breast cancerous cell lines. In vitro light studies concluded that dark as well as light cytotoxicity can easily be controlled simply by using different sizes of the same nanomedicine. Furthermore, mild hyperthermic effect combined with reactive oxygen species production provide optimum cytotoxicity under laser irradiation. Additionally, these phototherapeutic mechanisms can be closely linked to the INMs' fluorescence quantum yield and non-radiative rate constants. This study provides a simplistic method to optimize the chemo, photodynamic and photothermal effect of nanomedicines.

Securing Utilities through AI

Nathan Thomason *[Mentor: P. Huff]*

University of Arkansas—Little Rock - Computer Science

The Emerging Threat Information Sharing and Analysis Center (ET-ISAC) uses cutting-edge AI to analyze open-source threat reports, enhancing the security of the national power grid and energy sector. In collaboration with the Forge Institute and the University of Arkansas at Fayetteville, this project automates the assessment of ransomware and other threats, providing utilities with real-time risk evaluations. Our platform empowers analysts to accurately gauge utility risks, offering a dynamic tool for utilities to identify and prioritize imminent threats.

Design and Construction of a High Temperature Induction Furnace for Synthesis of Large Area Tungsten Oxide Nanostructures for Future Photocatalytic Device Applications

Taylor Lackey *[Mentor: J. Nichols]*

University of Arkansas—Little Rock - Physics

The Nichols' Lab has pioneered a highly efficient and environmentally friendly hot filament technique for synthesizing a diverse set of tungsten oxide nanostructures of various stoichiometries. To close the gap between fundamental science and functional application, an induction furnace has been designed and constructed to enable the synthesis of such materials on two-dimensional substrates, including foils and meshes, rather than only thin wire. The advantage of this technique is the removal of the necessity of high-power electrical contacts to the substrates. This greatly reduces the thermal conductivity between the sample and the surrounding environment, enabling the fabrication of samples with significantly enhanced areas and volumes.

Investigating Antibiotic Evolution and Bacterial Resistance in Gram-Negative Bacteria

Kyrilos Sadaka *[Mentor: M. Goodarzi]*

University of Arkansas—Little Rock - Chemistry

Although the K12 strain isn't the most aggressive strain, it provides a foundation of understanding for how gram-negative bacteria adapt to antibiotics. Several established antibiotics have been tested to optimize effectiveness at disseminating the bacteria and factors that potentially inhibit or facilitate bacterial resistance. The factors evaluated include temperature, contamination, humidity, and dietary factors. With the newfound comprehensive understanding of antibiotic resistance of gram-negative bacteria, this project is paramount in developing countermeasures against bacterial resistance. Genetic mutations and adaptive mechanisms have been observed in relation to bacterial evolution. As a result of this research, other researchers will be able to identify new drug targets and synthesize novel antibiotics or mixtures of drugs that can stay ahead of bacterial resistance. For this project, we cultured K12 strain of E. coli under a controlled environment. We exposed E. coli to augmented levels of antibiotics with the factors previously mentioned. A minimum inhibitory concentration test (MIC) was utilized to determine the lowest concentration of an antimicrobial agent hindering growth of bacteria in the medium. A MIC test was performed using Broth dilutions. A fractional inhibitory concentration index was also utilized to test whether antibiotics have synergistic effects. To differentiate the bacteria, a 4’,6-diamidino-2-phenylindole and propidium iodide stain was used.

Synthesis and evaluation of C-ring modifications to prodigiosenes as anti-cancer drugs

Joshua Pack *[Mentor: B. Walker]*

University of Arkansas—Little Rock - Chemistry

The naturally occurring prodigiosins (PGs) compounds are a major metabolite of the gram-negative bacteria, Serratia marcescens and are known to produce brilliant red colors. Many of these natural products have shown anti-cancer, immunosuppressive, and antimicrobial actions, amongst other biological activities. However, early studies indicated that natural PGs are too cytotoxic for normal cells and, therefore, their potential as anti-cancer drug candidates has been limited.

Comparative Study of Simultaneous Carbonization and KOH Activation of Lignosol-Based Precursor for Hybrid Capacitor Application

Rayaan Muhammad, Taahaa Noor *[Mentor: N. Siraj]*

University of Arkansas—Little Rock - Chemistry

Herein, a hybrid capacitor material is introduced which is synthesized from biomass utilizing facile microwave irradiation. Moreover, the biomass carbon materials are doped with hetero elements as well as chemical activated using KOH in one step, rather than a traditional multi-step protocol. The supercapacitor performance of doped carbon materials is compared with chemically activated doped carbon materials. Lignosol is used as a carbon precursor for the synthesis of two nitrogen and phosphorus co-doped carbon materials. The similar KOH-activated co-doped carbon materials are also developed. All these four materials are characterized in details compare electrochemical and physical properties. The comparative materials, as shown by scanning electron microscopy, has a maximum resulting Brunauer-Emmet-Teller surface area of 1291 m2/g. These materials were further characterized by x-ray photoelectron spectroscopy, x-ray diffraction and Raman spectroscopy. The optimum conductive moiety exhibited a specific capacitance value of 347 F/g with excellent stability as compared to other similarly synthesized materials.

Study of Solvent-Free, Microwave-Assisted Ring-Opening Reactions of Phenyl Glycidyl Ether with Azoles

Marygrace Mcafee *[Mentor: B. Walker]*

University of Arkansas—Little Rock - Chemistry

Numerous literature reports validate the capacity of microwave-assisted organic reactions as a clean and efficient approach to synthesis. Using microwave-assisted organic reactions also aligns well with the principles of green chemistry and can often rival or surpass traditional methods. The goal of our project is to utilize microwave synthesis techniques to create imidazole derivatives through epoxide ring openings of glycidyl ether with an emphasis on minimizing energy and solvent usage. These imidazole-containing compounds that have shown to be effective as LOX-1 inhibitors and have also shown to have anti-fungal properties. The reactions we investigate generates both an alcohol product and an imidazole derivative concurrently. The synthesis is optimized to maintain neat (solvent-free) conditions in a microwave reactor, embracing a streamlined approach to curtail energy consumption and minimize solvent waste. After the synthesis of the derivatives, purification is accomplished through preparative TLC and column chromatography. Subsequently, the compounds will undergo characterization via hydrogen and carbon NMR spectroscopy.

Prognostic role of tumor associated macrophage markers CD204, CD68 and CD163

Carvis Campbell *[Mentor: V. Raj]*

University of Arkansas—Pine Bluff - Biology

Macrophages are an important part of the immune system affecting the development and prognosis of chronic and fatal diseases. The M1 and M2 macrophage polarization and role in the cellular microenvironment contributes to metabolic processes and the progression or suppression of the disease. Tumor associated macrophages (TAM) such as CD204, CD68 and CD163 have been studied for their expression as markers especially for associations with poor prognosis in many forms of cancer. The differential expression is also a characteristic feature in other inflammatory diseases affecting the liver, lung etc. The expression of macrophage markers is thus becoming more significant in understanding the role of the macrophages in the different diseases. In this research, we characterized the CD204, CD68 and CD163 macrophage markers. We then studied the literature for the expression of these macrophage markers in different diseases to gain insights into their role and relationships in macrophage polarization to elucidate the role of these macrophage markers as prognostic indicators. Our findings suggest that a differential expression of the CD204, CD68 and CD163 markers has a significant impact on the outcome of patients' survival especially in solid cancers. The potential for these macrophage markers to be used as individual prognostic indicators has to be evaluated further extensively.

Ordering-Disordering of GeSn films using RAMAN Spectroscopy

Kennedy Abanihe *[Mentor: M. Shah]*

University of Arkansas—Pine Bluff - Physics

We studied the atomistic configuration of Gen films through an investigation on the order-disorder analysis via Raman spectroscopy. The Raman measurement from Ge0.95S0.5 to Ge0.831Sn0.169 films grown on the silicon substrate was performed over the temperature range of 90 to 450 K using 785 nm and 532 mm lasers. The measured spectra were fitted for the Ge-Ge order, Ge-Ge disorder, Ge-Sn, a-Sn, and B-Sn modes. The main Ge-Ge peak shifts left from 300 cm-1 showing incorporation of Sn in the Ge lattice. The shift induced by temperature is larger than the S incorporation, which is mainly attributed by phonon-phonon coupling and thermal expansion.

3db measurement of GeSn Photodetectors

Wisdom Ariagbofo, Kennedy Abanihe, Joel B.M. Ruzindana

[Mentor: M. Shah]

University of Arkansas—Pine Bluff - Physics

Integrated Microwave Photonics (IMWP) incorporates the functions of MWP components in monolithic or hybrid photonic circuits with the aim of meeting future needs. IMWP offers the promise of reduction of size-weight-and-power and low production cost. Recently, the intriguing properties of band gap and lattice constant tunability, true direct-band gap, wavelength coverage up to 12 µm and CMOS compatible process of Germanium-tin (GeSn) has drawn much attention in the photonic society. Over a decade, many GeSn based photodetectors have been reported with dramatic improvement in their performance. Here, we have demonstrated high-speed Si-based GeSn photodetector design with Sn % of 8% for the IMWP applications. The measured 3 dB bandwidth of the devices achieve nearly 2.5 MHz, however, showed discrepancy with the simulations, resulting due to the leakage. This result indicates GeSn high speed photodetectors have promising perspectives in next-generation mid infra-red optic communications.

Modeling of III-V-on-Sapphire Waveguides for Sapphire-based Photonic Integrated Circuits Platform

Joel B.M. Ruzindana, Wisdom Ariagbofo, Kennedy Abanihe

[Mentor: M. Shah]

University of Arkansas—Pine Bluff - Physics

Photonic Integrated Circuits (PICs) have the potential to deliver a chip with reduced size-weight-power-and-cost. PICs have been demonstrated in various material systems such as III-V, Si, Si3N4 LiNbO3 with varying levels of functionality. The thermal expansion mismatch between the epitaxial film and substrate is a factor responsible for large numbers of defects and device failure. Matching the linear coefficient of thermal expansion of sapphire to that of GaAs and GaSb shows sapphire is a favorable substrate for the growth of III-V materials, creating a sapphire-based platform with the potential for use in large-scale integration platforms just like silicon's. We studied a GaSb/AlSb-on-Sapphire waveguide for a Sapphire-based PIC platform by Finite-Element Method (FEM) using Ansys software. The materials GaSb, AlSb, and Sapphire were used for core, buffer, and substrate layers respectively to design rib and strip waveguides. Using FEM, we investigated multi-mode, single-mode, and cut-off conditions and single-mode propagation loss in GaSb/AlSb-on-sapphire waveguides over a broad optical range, presenting the investigated conditions of rib and strip waveguides. The higher index contrast between the core and substrate layer allowed us to design compact, low-loss waveguides in mid-infrared regimes. The presented low-loss, GaSb/AlSb-on-sapphire PIC platform would enable applications in defense systems, ML, fiber optics, RF photonics, and space exploration.

Effect Of Ganoderma lucidum (Medicinal Mushroom) Extracts on Adult Female Spanish Goat Health Parameters

Henrietta Owusu *[Mentor: E.K. Asiamah]*

University of Arkansas—Pine Bluff - Agriculture-Animal Science

Overuse of drugs such as antibiotics and anthelmintics in animal production has raised food safety and public health concerns. Ganoderma lucidum, a known medicinal mushroom, is a safe alternative to antibiotics and has been shown to boost the host immune system.The present study investigated the effect of daily supplementation with Ganoderma lucidum (GL) extract on adult female Spanish goat health parameters. Seven adult female Spanish goats were administered a daily dose of 10g of GL extracts over a 60-day period, while a control group of seven goats received no GL supplementation. Blood samples (10 mL) and fecal samples (2g) were collected at three time points: Day 0, Day 30, and Day 60 of the study. Key health parameters, including body weight (BW), body condition score (BCS), FAMACHA scores, packed cell volume (PCV), and fetal egg count (FEC), were meticulously recorded and analyzed. While preliminary findings did not reveal statistically significant effects of Ganoderma supplementation on BW, PCV, FEC, and FAMACHA scores ($p \leq 0.05$), Ganoderma tended to improve body condition scores by 0.24 ($P = 0.11$). Further research is warranted to comprehensively assess the systemic impact of Ganoderma lucidum on goat health and to determine optimal strategies for its incorporation into feed regimens, with the aim of promoting and improving the health of goats.

Noteworthy Records of Colocasia esculenta (Araceae) in Arkansas, with Notes on its Biology and Ecology

J. Michael Brotherton, Tiffany Taylor *[Mentor: B. Serviss]*

Henderson State University - Biology

Previous naturalized records of Colocasia esculenta (L.) Schott (elephant-ear, taro) in Arkansas were restricted to Clark and Garland counties. Additional occurrences from Arkansas, Hot Spring, Johnson, Miller, Ouachita, Pope, Pulaski, and Union counties are documented for the species. In Hot Spring, Ouachita, Pulaski, and Union counties, plants were well-established in extensive populations, with evidence of aggressive spread and colonization via stoloniferous offsets. The Arkansas, Johnson, Miller, and Pope county occurrences are represented by iNaturalist observations, which also appear to be escaped populations. Identification of large-leaved Araceae in Arkansas, as well as notes on the ecology and invasiveness of C. esculenta in the state, also are presented.

Synthesis of Poly(acrylamide)s through Multiple Chain Transfer Agents

Matthew Will *[Mentor: A. Teator]*

John Brown University - Chemistry

Polymer functionalization reactions typically rely on the use of monomers that have been specially-designed to undergo further reactivity. One alternative strategy that is often employed by the Teator Lab instead utilizes the native functionality of commodity polymers to add new functionality. However the influence of the end groups on a given polymer on these reactions remains underexplored. RAFT (Reversible addition-fragmentation transfer) polymerization of diethylacrylamide using a chain transfer agent (CTA) was employed in order to create a library of polymers to determine the effect of end groups on future functionalizations. RAFT was chosen as a polymerization mechanism as it is a practical and straightforward method known to produce well-defined polymers. The four CTAs used were 2-propanyl dodecyl trithiocarbonate (CPDTC), 2-(((Dodecylthio)-carbonothioyl)thio)propanoic Acid (DSCPA), dibenzyl carbonotrithioate, and Cyanomethyl 3,5 -dimethyl-1H pyrazole-1-carbodithioate (CDPC). After the polymerizations were performed, the resulting polymers were analyzed using 1H NMR and GPC. Polymerization with CPDTC, DSCPA, and CDPC performed well resulting in a low dispersity ($Đ < 1.3$). Polymerization with dibenzyl carbonotrithioate exhibited an acceptable dispersity ($Đ = 1.2–1.5$); however, the higher dispersity range could be due to identical end groups on this CTA. Future work will explore functionalizing these polymers with new monomers and other modifications post-polymerization.

Trail: A Route Optimizing Tool for JBHunt

Carlos Borjes, Ethan Sluyter *[Mentor: J. Selwyn]*

John Brown University - Computer Science

This project aims to address the challenges faced by J.B. Hunt's drivers in route planning by developing a Route Optimization Tool. Leveraging machine learning algorithms and optimization tools, the tool considers multiple factors such as fuel type, weather, road conditions, traffic, and truck stops to generate efficient routes. The project involves creating a machine learning model that utilizes APIs to analyze real-time data, predicting the impact of various factors on transit time and cost. Implementation of optimization algorithms ensures compliance with Department of Transportation Hours of Service regulations and other constraints. The deliverable would be a device friendly web application which would suggest the optimized route, logging, grading, and history of trips which would be used to build machine learning models into the future.

Proposing a Knowledge Summarization and Visualization Tool

Jacinth Boggess, Pamela Carta *[Mentor: J. Selwyn]*

John Brown University - Computer Science

This research addresses the time students spend gathering materials rather than understand and retain them by developing a tool to produce visual study aids from lecture audio recordings. Time is a limited resource for all participants in the learning curve, and the goal we aim at is to reduce time spent reading large volumes of text or listening to long lectures. Research has found visuals aids to be more effective for retention than text. As the speaker lectures to an audience, the audio is recorded using a microphone and is saved in wav/mp3 format. This audio is then pre-processed so that it is converted to a transcript using Azure's AI speech recognition system and batch transcription. The text is then processed by removing stop words, extracting concepts and relationships between the concept pairs. With the identified pairs of concepts connected with relationships, contextual proximity and weights are assigned to the pairs, and then they are concatenated to form a summary of the text. This leads to building a knowledge graph that will serve as a visual for the captured speech, and will enable the learner to completely understand with all the visuals on what is being said.

Performance Evaluation of Classification-based Anomaly Detection

Harrison Bounds *[Mentor: S. Ullah]*

University of Central Arkansas - Computer Science

The escalating expansion of attack surface imposes different cyber threats to individuals, organizations, and critical infrastructures within multiple domains. Anomaly detection through threat classification contributes to effective cybersecurity measures, enabling timely identification and response to various attacks. In this study, we conduct a systematic investigation of Machine Learning (ML) models for anomaly detection in different applications. Our approach analyzes the models on two diverse cybersecurity datasets: IoT (Internet of Things) attack data and malware data. The IoT attack dataset is notably large and contains different aspects of threats, demonstrating higher accuracy in our evaluation results. Conversely, the malware dataset is comparatively smaller and highlights the need for further improvement in classification accuracy. Our successful classification of this malicious data contributes significantly to immediate threat response and the improvement of anomaly detection methods.

Creation of a drug library to combat cutaneous leishmaniasis

Rachel Harmon *[Mentor: G. Naumiec]*

University of Central Arkansas - Chemistry

Neglected tropical diseases (NTDs) impact over 1 billon people, in typically impoverished areas where the typical treatments are not readily accessible: conflict zones, rural areas and areas lacking quality health care. The diseases are deemed neglected because they aren't apart of the global health agenda and programs have very little funding and resources. This research project aims to synthesize cost efficient multi modal drugs to combat and possibly prevent leishmaniasis, the most prevalent NTD. This NTD is caused by protozoan parasites transmitted by the bite of an infected female phlebotomine sandfly. There are 3 main forms with visceral leishmaniasis being the most fatal and cutaneous being the most common. Our focus is the cutaneous leishmaniasis caused by L. major. Our goal is to create a drug library to help treat this disease. The precursor was synthesized from commercially available diethylsquarate (75%) into our target disquaramides (70-90%).

Analyzing the Impact of Socioeconomic Factors on Cancer Clinical Trials Accessibility in the United States

Krysta Ray, Musfikur Rahaman, Hiromi Honda *[Mentor: R. Ghosh]*

Arkansas Tech University - Computer Science

While cancer impacts all segments of the United States population, specific groups experience a disproportionate burden of the disease due to social, environmental, and economic disadvantages. This study examines the complex relationship between socioeconomic status and the availability of cancer clinical trials in various counties throughout the United States. Using an extensive dataset from multiple open sources, this study investigates the factors influencing the number and accessibility of cancer-related clinical trials. The research analyzes key socioeconomic indicators such as poverty rates, population estimates, median incomes, cancer incidence rates, and mortality rates to uncover how these factors affect the accessibility of cancer treatments. Our approach employs data analytics, statistical modeling, and machine learning techniques to extract valuable insights from the dataset. This research provides valuable insights at the county and zip code levels, enabling a better understanding of healthcare disparities and potential solutions to address these disparities. Furthermore, clustering and sorting algorithms help us categorize counties with similar socioeconomic profiles and clinical trial accessibility. This research is a significant step towards understanding and resolving disparities in cancer clinical trial accessibility nationwide, ultimately leading to improved healthcare outcomes and representation for individuals affected by cancer.

Spot On

Corey Allen Naegle, Holden O'Neal, Chase Tallon, Caleb McClure *[Mentor: B. Ghosh]*

Arkansas Tech University - Computer Science

We are creating a solar power dog collar. We have researched how to use Cellular signals to pinpoint the collar and send it to a database, This proved challenging so we swapped it to a WIFI signal. The battery will run and be charged with solar energy.

Microplastic Identification in Rural North Central Arkansas' Water Sources

Hannah Reynolds *[Mentor: I. Nawarathne]*

Lyon University - Chemistry

Plastics are becoming increasingly pervasive in our environment through micro- and nanoparticles. They are found in water, soil, air, food, and wildlife and are considered a major environmental pollutant (Ivleva 2021). There are primary and secondary microplastics in the environment. Large plastic structures can deposit primary particles into the environment whereas secondary particles are usually a result of degrading plastic structures because of the environment. Plastics are not prone to quick decomposition and can take up to a few thousand years to break down. Due to this problem, microplastics are taking a toll on the environment that needs to be analyzed further in order to find a solution (Lai 2022). Microplastic contamination in rural Arkansas water systems remains an underresearched area. We collected water samples from multiple sources in glass vials and jars. We employed multiple analytical methods to identify the microplastics from each source with the main method being Fourier Transform Infrared Spectroscopy (FT-IR). In rural areas with minimal human interaction, we expect there to be less microplastic contamination concentration compared with our more urban sources with frequent human interaction.

Chemical Manipulations of Rifamycin Core Providing New Solutions to an Old Problem: Multidrug Resistant Tuberculosis

Braden Glenn, Wyatt Treadway, Zane Fountain, Hannah Davidson *[Mentor: I. Nawarathne]*

Lyon University - Chemistry

Amid the antibiotic resistance crisis, Mycobacterium tuberculosis (MTB)–the pathogen causing TB– has shown widespread resistance to rifampicin, making it futile in TB therapy as MTB RNAP mutations disrupt key interactions between the drug and the target. Rifamycin, particularly rifampicin, has been a mainstay of TB treatment since the 1960's; it binds the B subunit of the MBT RNA polymerase (RNAP) and blocks RNA synthesis. By utilizing the 'enabling reaction' of the rifamycin core and coupling it with click chemistry, we have exploited the thoroughly studied rifamycin scaffold to target MDR-TB and potentially treat other bacterial infections. Though click chemistry and other means we have added numerous functional groups to Rifamycin S. Assays have been conducted to test the antibiotic properties of these derivatives, both in vivo and in vitro, against both common bacteria genera as well as drug resistant strains of pathogens. In vivo data suggests some derivatives are highly effective against Staphylococcus aureus. Our work highlights the first report of synthesis, isolation, and purification of rifamycin derivatives with azido, alkyne, triazole, and benzoxazino functionalities, the innovative products of coupling complex rifamycin chemistry and simple click chemistry.

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Event website at
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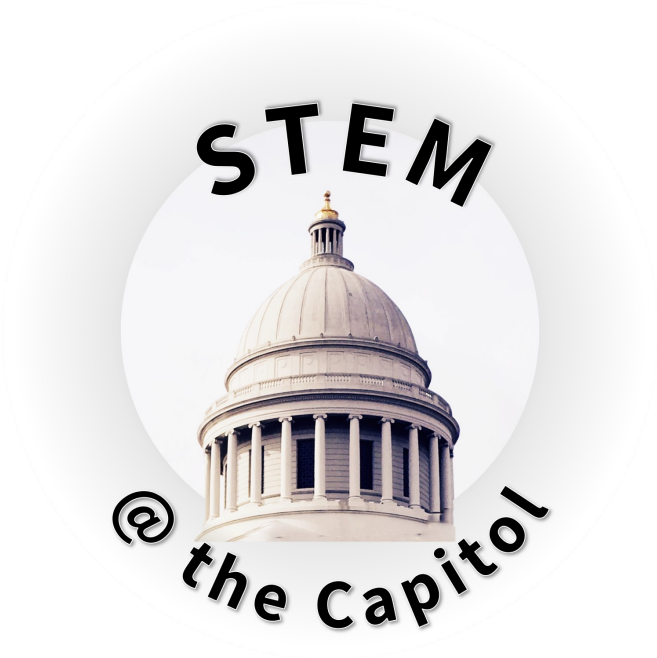

Stephen O'Connell
Department of Geography
University of Central Arkansas
Conway, AR 72035
(501) 450-5636
soconnell@uca.edu