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 8, 2023

Highlights

- **70 students**
- **From 11 Arkansas colleges and universities**
- **Presenting 40 different presentations of original work**
- **Encompassing all aspects of science and math**


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

Use of Micropropagated Solanum tuberosum as a Model for the Establishment of a Tissue Culture Laboratory and Greenhouse at UAM

M. Carter, K. Beck *[Mentor: A. Quintero Ferrer]*

University of Arkansas—Monticello - Biology

The common potato, Solanum tuberosum, is one of the world's most important crops. To illustrate, it serves as a staple food item in the everyday diets of over fifty percent of the global population. When a specific crop has a demand this high, usual methods of growth, which come with high rates of disease and low rates of multiplication, simply do not satisfy the levels of global consumption. One of the most versatile and cost effective ways to combat the ever-growing need for crops such as S. tuberosum is the use of plant tissue culture. One of the main techniques used is micropropagation. This technique involves taking pieces of desirable plant material for the production of thousands of pathogen free cloned plantlets. Usually, the Micropropagated plantlets are made from crop varieties that have desirable traits such as disease resistance, improved shelf life or higher yields helps to meet the standards for current agriculture. The micropropagated in vitro S. tuberosum (grown in culture media within a sterile environment) was then placed ex vitro (into a greenhouse) to test the quality of the micropropagated material. Our main objective for this project is to use S. tuberosum as a model to install both plant tissue culture through micropropagation and to produce full grown seed material in the greenhouse at UAM. With this, we expect to establish more state relevant crops such as tomato for either commercial use and/or research.

Microwave Synthesis of Bidentate NHC-Pyridine Ligands for CO2 Reduction Electrocatalysts

E. Hicklin *[Mentor: M. Massey]*

University of Central Arkansas - Chemistry

Energy usage continues to increase worldwide – creating concerns about how to meet growing energy needs. To mitigate high energy demands, and minimize environmental impact, one approach could be to reduce carbon dioxide into an alternative fuel. Manganese tricarbonyl bromide complexes containing N-heterocyclic carbene (NHC) and pyridine ligands have shown promise as carbon dioxide reduction electrochemical catalysts to produce CO, which can be used in the Fisher-Tropsch process to make fuel. This project focuses on how to synthesize bidentate NHC-pyridine ligands to be used in the manganese tricarbonyl bromide catalysts, fac-Mn(NHC-pyridine)(CO)3Br. Synthesis of ligand precursor N-(2-pyridyl)benzimidazole (Bim-py) was pursued using a microwave synthesizer under varying reaction conditions. The coupling reaction was optimized by modifying concentration, solvent, time, and temperature conditions in order to develop a faster, greener, and safer synthesis. Reaction times to make Bim-py were decreased by 96% compared to reflux with yields ranging from 8% to 71%. The Bim-py product was successfully isolated, methylated, and chelated to manganese pentacarbonyl bromide to create the catalyst, Mn(Mebim-py)(CO)3Br. Product purity and results were confirmed using 1H NMR and FTIR spectroscopy.

Accelerating Tissue Regeneration with Protein-Loaded Fiber Mats

C. Cole *[Mentor: S. Hamilton]*

Ouachita Baptist University - Biology

Nanofibrous webs produced by electrospinning polymers have long been investigated for potential biomedical applications. These fibers are ideal for wound healing as they mimic the characteristics of the ECM. Additionally, the natural polymer chitosan can be co-spun into fiber mats increasing the antimicrobial properties of the materials thereby reducing the risk of infection. It is anticipated that introducing an external source of thrombin via fiber mats will promote a faster clotting time. Thrombin is an ideal clotting factor for biomedical applications because it will induce a cellular response whether the pathway is intrinsic or extrinsic. The engineered protein s-FGF1 stimulates fibroblast activity. Fibroblast activity ultimately produces an increase in native collagen that sustains healing. The first objective of this research is to optimize the chitosan and PVA formulation to yield a fiber mat with the highest possible amount of chitosan while maintaining the integrity of the fiber mat. Utilizing uniform fibers will allow for a better understanding of cellular responses to the engineered fiber mats. The second objective of this research is to integrate optimized fiber mats with proteins thrombin and s-FGF1. These mats were analyzed via infrared (IR) spectroscopy and ELISA release assays. These results are indicative of the engineered fiber mat's potential application in treating active bleeds and chronic wounds.

Biological Significance of Comparable Amino- and Amidonapthoquinones

L. Beeser, R. Tyler *[Mentor: I. Nawarathne]*

Lyon College - Chemistry

Cancer is the second highest cause of death globally, accounting for about 30% premature deaths (ages 30–69 years) from non-communicable diseases worldwide. With ~85% non-small cell lung cancer, lung cancer is the most common cancer worldwide in terms of incidence and mortality (2.1 million new cases and 1.8 million deaths in 2018). The lack of successful preventive and screening measures to improve survival advocates for new therapeutics to increase the 5-year lung cancer survival rate. Amino acids and quinones play essential roles in metabolism. Moreover, the naphthoquinone scaffold is present in widely used antineoplastics such as Doxorubicin, Napabucasin, Streptonigrin, and Actinomycin. Despite apparent advantages, studies on developing amino acid/peptide derivatives of 1,4-naphthoquinone are inadequate. Herein, we report the synthetic development and preliminary anti-lung cancer activity assays of equivalent amino- and amidonaphthoquinones.

Prenylated Stilbenoid, Arachidin-1, Increases the Effectiveness of Chemotherapy Drug, Paclitaxel, in Triple Negative Breast Cancer

A. Weaver, S. Mohammadhosseinpour *[Mentor: F. Medina-Bolivar]*

Arkansas State University - Biology

Triple negative breast cancer (TNBC) is one of the deadliest forms of breast cancer. Investigating alternative therapies to increase survival rates for this disease is essential. Plant natural products, such as prenylated stilbenoid arachidin-1 (A-1) from peanut, have shown cytotoxicity in certain cancer cells. The goal of this study was to examine apoptotic effects of A-1 in TNBC cell lines MDA-MB-231 & MDA-MB-436 as well as to investigate the impacts of A-1 as an adjuvant for the chemotherapy drug paclitaxel (Pac). Apoptosis induction capability of A-1 treatment in TNBC cells was measured through the activation of apoptosis proteins via western blotting. Flow cytometry was used to detect apoptosis and cell cycle arrest in the A-1-treated cells. Additionally, cells were treated with concentrations of A-1 and/or Pac for 24 h and cell death was observed by AnnexinV-FITC/PI staining and flow cytometry. Results showed a dose-dependent increase in levels of cleaved PARP and cleaved caspase-9; additionally, the amount of survivin, an apoptosis inhibitor protein, decreased at increased A-1 concentrations. Flow cytometry indicated cell cycle arrest occurred in G2/M phase, leading to apoptosis. Cells treated with A-1 & Pac showed a statistically significant, dose-dependent increase of early apoptosis induction. This research accentuates the importance of further understanding the effects of stilbenoids as adjuvant treatments for TNBC.

Sulforaphane: A Natural Product Derived from Broccoli with Anti-Cancer Properties

M. Goodlow, K. Camp, L. Adams *[Mentor: Z. Habeeb]*

University of Arkansas—Pine Bluff - Chemistry

Sulforaphane is a molecule found in broccoli, and has recently been found to have medicinal properties, including anti-cancer. However, sulforaphane is an oil and does not dissolve well in water. This means as a medication it will be prematurely excreted from the body after consumption and not have a chance to reach the affected area in high enough amounts to have a therapeutic effect. A delivery vehicle can be used to package individual molecules of sulforaphane to improve solubility. This project investigates the development of drug delivery vehicles made from biocompatible unnatural peptides to encapsulate sulforaphane and treat triple-negative breast cancer, which is very aggressive, in vitro.

Novel N-Heterocyclic Carbene Phosphonite Ligands for the Amination of Aryl Ethers

K. Peters *[Mentor: K. Barnett]*

University of Central Arkansas - Chemistry

Aryl amination reactions are central to the production of bioactive organic molecules including pharmaceutical treatments for disease. The Hartwig-Buchwald Amination (HBA) reaction is the palladium catalyzed aryl amination of aryl halides and a variety of amines. However, palladium catalysts are high in cost due to the limited natural abundance of the metal ion. In addition, palladium catalysts have a limited electrophile scope for amination reactions. The use of nickel, also a Group 10 metal, in amination reactions proposes a solution to this drawback. The two main advantages to using nickel are cost effectiveness and it can oxidatively add to a wider range of electrophiles. Few studies aim to design ancillary ligands specific to nickel for the purpose of amination. It is understood that oxidative addition of Ni(0) complexes can be assisted by sigma donating ligands that create an electron rich metal center. The rate determining step is reductive elimination involving Ni(II). Studies have shown that the presence of an electron accepting ligand assists the reductive elimination step. To overcome this, our group has proposed a specific nickel designed ligand that includes both an electron donating (N -heterocyclic carbene) and an electron withdrawing (phosphonite) bond to the nickel atom. This advancement in nickel catalysis can contribute significantly to the production of pharmaceuticals and bioactive natural products.

The Effect of Varying pH on the Leaching of BPA from Panty Liners

K. Price *[Mentor: S. Hubbard]*

Ouachita Baptist University - Chemistry

BPA is an industrial chemical found in many everyday items, such as storage containers, food/drug packaging, and feminine hygiene products. BPA is an endocrine disruptor that has been linked to various health problems: reduced fertility, alterations in fetal development, and certain cancers. BPA can be absorbed dermally, which is a concern for women who use feminine hygiene products containing BPA. Previous work in our lab determined that it is possible to monitor BPA leaching from pantiliners over time into a 50% methanol/water solution using fluorescence spectrophotometry. My research focused on determining the effects on the leaching of BPA from pantiliners caused by pH changes of the methanol/water solution to mimic variations in vaginal pH. BPA leaching was monitored by measuring the fluorescence emission of samples using the FS-5 spectrofluorometer. BPA is a fluorescent compound that is excited at 278 nm and emits at 304 nm. A calibration curve was obtained for BPA emission versus concentration, which allowed us to determine the linear range, limit of detection, and limit of quantitation for our method. Due to the complex sample matrix and small concentrations of BPA in pantiliners, the standard addition method was used. Standard addition samples were prepared from solution aliquots for each time point. Fluorescence emission data were obtained and plotted in standard addition curves to calculate BPA concentration for each time point.

Binding study of small molecule inhibitors to KRAS G12C mutant protein

M. Rodgers *[Mentor: D. Muhoza]*

University of Arkansas—Monticello - Biology

This research involves the study of small biomolecules and the inhibition capability of these molecules to the cancer causing mutagen KRAS. Kristen Rat Sarcoma is prevalent in 25% of leading cancers such as pancreatic, colorectal, and colon cancer. The mutation involving the RAS-MAPK pathway responsible for the proliferation of cells results in an over proliferation of said cells and inevitably leading to the metastasis of cancer cells. Various computer programming software was used to find the binding affinity of small molecules to properly inhibit the GTP bound mutant KRAS protein. By using molecules that are already used in common cancer study such as AMG 510 or MRTX these molecules serve as a base point to compare the rest of the small molecules found and compare the various characteristics of the molecules to be able to find new molecules capable of inhibiting the cancer at different points of the pathway ultimately switching the protein from active to inactive.

Understanding the Mechanical Behavior of Nanoporous Amorphous Si by Molecular Dynamics Simulations

B. Crutchfield *[Mentor: R. Fleming]*

Arkansas State University - Engineering

Nanoporous materials are of great interest for developing low-density, high-strength materials for a variety of applications. These materials are often created from a ceramic or oxide matrix, with porosity generated by sacrificial polymer inclusions that are burned out during thermal processing. As a result, there is much interest in fine-tuning the structure of nanoporous materials and understanding how the mechanical properties are influenced by the porosity volume fraction. In this project, molecular dynamics (MD) simulations have been performed to better understand how porosity affects the stress-strain behavior of nanoporous amorphous silicon (a-Si). Structural models of nanoporous a-Si were created using melt-quench dynamics, followed by uniaxial tension to determine the stress-strain response. From these simulations, the elastic modulus and yield strength of a-Si were determined as a function of porosity and applied strain rate. These results give insights into the mechanical behavior of porous a-Si, and can be used to improve the understanding of structure-property-processing relationships for nanoporous materials.

Monitoring BPA Leaching from Feminine Hygiene Products using Fluorescence Spectrophotometry

M. Easley *[Mentor: S. Hubbard]*

Ouachita Baptist University - Chemistry

Bisphenol-A (BPA) is a compound commonly used as a stabilizer in plastic products. Because BPA is able to activate estrogen receptors, it is linked to reduced fertility and hormone-related cancers. A recent study at NYU Medical School confirmed the presence of BPA in several feminine hygiene products. This is concerning due to the high absorption capacity of the vulvar skin. For this research, the goal was to determine if fluorescence spectrophotometry could be used to determine the presence of BPA in feminine hygiene products by monitoring the release of BPA over time into a solution of 50% methanol/water. BPA is a fluorescent compound that emits at 304 nm. Due to the complex sample matrix and the small concentrations of BPA in these products, the standard addition method was employed for analysis. Pantyliners and tampons were tested for the presence of BPA. Samples were placed into beakers containing 100 mL of 50% methanol/water solution, one per time point to be tested from 0 minutes to 6 hours. At each time point, aliquots of sample solution were removed and transferred to 25-mL volumetric flasks containing various concentrations of BPA stock solution. Fluorescence emission intensities at 304 nm were obtained in quadruplicate, and standard addition graphs were utilized to determine the concentration of BPA that had leached from the sample at each time point. These values were graphed to give a visual of BPA leaching from the sample over time.

Waxworms Offer an Innovative Plastic Waste Management Solution for Long-Term Space Travel

H. Seats, J. Oster, M. Rhodes, L. Perdue, C. Greene, B. Whitfield, K. Willis *[Mentors: M. Dolan, S. Harris]*

Arkansas State University - Biology, Electrical Engineering, Chemistry

ASUs NASA Student Payload Opportunity with Citizen Science undergraduate team explored the biodegradative properties of the greater waxworm (Galleria mellonella) larvae, in a microgravity environment, as a waste management solution in space. This project launched to the International Space Station (ISS) in July 2022 and involved K-12 citizen science partners (CS) from local middle schools. Our team, along with our CS designed a fully automated experimental module and collaboratively generated data to establish experimental parameters for sustaining waxworm biodegradation for three weeks. These pre-launch experiments defined optimal larval size (40-45 mg), a simplified diet (beeswax), and plastic (Ziploc freezer bag) to augment plastic biodegradation. Onboard the ISS, inflight imaging confirmed waxworm survival and plastic consumption. Analysis of plastic mass confirms no statistical difference between plastic-fed waxworms on Earth and microgravity environment. Waxworm larvae and their excreta were preserved for ongoing gut microbiome analysis and ethylene glycol detection (signature terminal product of LDPE breakdown) respectively to better understand impacts of microgravity on waxworms and their ability to degrade plastic. This is the first successful ISS study with waxworms. We anticipate results may contribute to more sustainable methods of plastic waste management in space and on Earth.

Crime Prediction Using Machine Learning: The Case of the City of Little Rock

Z. Sabakhtarishvili, C. Jensen, S. Panday *[Mentor: R. Ghosh]*

Arkansas Tech University - Computer Science

The crime problem is pressing for the city of Little Rock, Arkansas. In this study, we aim to use machine learning algorithms to predict criminal activities in the city and help the Little Rock Police Department (LRPD) identify meaningful insights into crime patterns. Our research examines predictive modeling methods that can be used to establish better-informed decisions and minimize the number of resources used by LRPD. For our study, we examined publicly available datasets from LRDP with crimes reported in Little Rock from 2017 to 2022 and created digestible analyses and visualizations for presentation. The police have already adopted predictive policing in the developed world. Building onto this experience with new techniques, we hope to strengthen our communities in Arkansas and potentially forward our learnings to other researchers to fulfill the potential of a predictive policing system being more widely available. Throughout our research, we employed the Prophet model for time series forecasting to produce an outlook on the amount and distribution of crimes occurring daily. Currently, the Mean Absolute Error for our model forecasting the number of crimes per day is 6.9265, giving promising results for future improvements. In addition, our unified Prophet ML model could be deployed in any city based on data availability.

Programming Sequence Improvement Program

M. Rahaman, S. Katta *[Mentor: R. Ghosh]*

Arkansas Tech University - Computer Science

Every semester, students from various STEM (Science, Technology, Engineering, and Mathematics) majors at Arkansas Tech University take the programming sequence (PS) courses (over 650 students in the 2020–21 academic year). The Engineering and Computing Sciences Department has struggled to retain students in the PS courses. Minor efforts have been made to increase retention, but they have had little success. The Programming Sequence Improvement Program (PSIP) aims to increase retention and student success in three PS courses: Foundations of Computer Programming I (COMS 2104), Foundations of Computer Programming II (COMS 2203), and Data Structures (COMS 2213), reducing the rate of D, F, Withdraw, and Incomplete grades by 10% annually from the current average baseline of 32%, 35%, and 27%, respectively (2015-2019). The main goal of this PSIP project is to change the face of the PS program within the first two years of study by enhancing programming techniques for students. The project's interventions are likely to influence ATU students' academic performance and retention, leading to higher degree completion rates. This program used four different methods to reach its objective: creating a tutoring lab for students enrolled in a programming course, implementing communication and collaboration tools such as Discord and Webex for students, researching current pedagogies for teaching programming, and better aligning the curriculum with platforms like GitHub, Hackerrank & LeetCode.

The Effects of Light Intensity on Cell Population and Oxygen Production of Arthrospira platensis

S. Ward *[Mentor: J. Taylor]*

Ouachita Baptist University - Biology

As space exploration becomes more advanced, scientists look to find new ways to create nourishment and oxygen to maintain long-term space travel. Arthrospira platensis, commonly known as Spirulina, could be a possible solution to these problems. This cyanobacterium converts carbon dioxide into pure oxygen and the cell structure (coiled or straight) appears to trigger different oxygen and cultivation responses. Mixed (coiled and straight) and coiled Spirulina cultures were transferred into 2.5 L containers and placed in white light boxes with varying intensities of light: 15 µmol/㎡/s, 7 µmol/㎡/s, and 3 µmol/㎡/s. Each experiment lasted 72 hours and Spirulina's oxygen production and cell concentration in the cultures were measured at the 24h, 48h, and 72h marks. The higher-intensity light produced a significant amount of oxygen and oxygen per cell as compared to low-intensity light. As the experiment progressed, the higher amount of time produced a reduction in the cell counts. Although the coiled Spirulina produced more gas and had a higher cell count on average, the mixed culture in the medium and low light levels were found to have a higher oxygen per cell average.

Development of Efficacious Rifamycin Derivatives by Utilizing Click Chemistry

I. Beasley, B. Glenn *[Mentor: I. Nawarathne]*

Lyon College - Chemistry

In 1999, the World Health Organization estimated that one-third of the population had latent tuberculosis (TB) infection. This has since been updated to one-fourth of the world. The worrisome connection between COVID-19 and latent TB is that contraction of coronavirus by someone with latent TB could activate Mycobacterium tuberculosis (MTB), the pathogen causing TB, making the individual severely ill and a transmitter of both diseases. Thus, coronavirus indirectly spreads TB while also slowing global progress against TB due to health disruptions. While an estimated 60 million lives were saved through TB diagnosis and treatment from 2000 to 2019, the multidrug-resistant TB (MDR-TB) is becoming a public health threat amid the pandemic. Rifamycin, particularly rifampicin, is a mainstay of TB treatment since the 1960's; it binds the β subunit of the MBT RNA polymerase (RNAP) and blocks RNA synthesis. It becomes futile in TB therapy when MTB RNAP mutations disrupt key interactions between the drug and the target. 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. Our work highlights the first report of synthesis, isolation, and purification of rifamycin derivatives with azido, alkyne, and triazole functionalities, the innovative products of coupling complex rifamycin chemistry and simple click chemistry.

Sudden Surge: From Past-Aid to Future-Aid Healthcare in the Lone Star State

J. N. Parchman *[Mentors: I. Nawarathne, A. Yox]*

Lyon College - Medical Sciences

Through the vast medical innovation, Texas inhibits a majestical healthcare presence. This can be seen through the Texas Medical Center in Houston, with 60 institutions and 300,000 healthcare employees, the center is the largest conglomeration of medical care. On the other hand, the state's fantastic investment in modern medicine is improper with its history. The thesis of this research is Texas dramatized a "sudden surge" of medical coverage that occurred in the modern era, most notably in the 1970s. Texas amplifies an immense turnaround in outlooks towards medicine, particularly a mentality shift between "Aid of The Past Medicine" and "Aid for the Future Medicine". The state went from a lax medical backwater to an expansive medical city. Past-Aid Medicine is older indoctrination that acknowledged historical correlations with a retained hoax-thriving practice. By Future-Aid Medicine, I mean an exponential growth in societal healthcare and a belief that future medicine can be better than merely a compilation of the best past applications. Past-Aid Medicine is most notable through the 19th century from various Native American integrated practices and how these were translated into Texan society. Texan medical students became "American Gentlemen" rather than physicians. The start of the Future-Aid revolution was credited to the Pragmatic Era, which led to the steppingstone: Texas saw the greatest victory over the nation's worst disease and led to many more revolutions.

Investigating the molecular mechanisms regulating growth promotion and salt tolerance during interactions between rice and plant growth-promoting bacteria, Azospirillum brasilense

M. Galloway *[Mentor: A. Mukherjee]*

University of Central Arkansas - Biology

Major food crops display severe yield losses (50-80%) under moderate to extreme salinity. Problems associated with soil salinity are anticipated to worsen because of adverse climatic conditions. For improving crop performance under saline conditions, it is necessary to implement sustainable strategies. Several studies have suggested that plant growth-promoting bacteria (PGPB) improve plant growth via multiple mechanisms, including nitrogen fixation, hormone synthesis, protection against stresses, etc. Azospirillum brasilense is one of the most studied PGPB to mitigate salinity stress in different crops such as maize and wheat. However, not much is known about the molecular mechanisms by which A. brasilense mitigates salt stress. Recently, we optimized an experimental system where rice growth was improved in A. brasilense-inoculated plants compared to the uninoculated plants when grown under high salt concentration. We hypothesize that A. brasilense inoculation would enhance salt tolerance in rice via regulation of specific host genetic pathways previously reported to be involved in this association. Currently, we are initiating experiments to perform an RNA-seq study to identify the transcriptomic responses in rice plants during A. brasilense-mediated salt stress tolerance. Overall, our findings will provide a novel understanding of gene expression changes in A. brasilense-inoculated rice during salt stress.

Macroinvertebrate assemblage responses to land use, water chemistry, and habitat in low-gradient Arkansas streams

M. Wozniak *[Mentor: H. Halvorson]*

University of Central Arkansas - Biology

Anthropogenic changes around aquatic ecosystems can alter water chemistry and habitat availability, in turn affecting macroinvertebrates assemblages sensitive to environmental changes. Low-gradient streams are especially understudied and vulnerable to these changes. This study aims to address how land use, water chemistry, and habitat affect macroinvertebrate communities in lowland streams of the South Central Plains of Arkansas (SCP). We sampled eighteen sites monthly for water chemistry in February 2021 through September 2022. Stream habitat surveys were conducted in summer 2021 and macroinvertebrate samples were collected in winter 2021. Water chemistry and habitat variables were condensed using principal component analysis. Spearman correlations were used to correlate these variables to macroinvertebrate community metrics including abundance and taxa richness. Non-metric multidimensional scaling was performed to evaluate potential differences in macroinvertebrate communities across sites. Land use had no measurable effect on macroinvertebrates. Despite this, there were negative correlations between water chemistry, mainly total nitrogen and dissolved organic carbon, and both abundance and taxa richness. Macroinvertebrate communities varied across sites and primarily grouped by stream drainage. Continued sampling and analysis will improve understanding of these systems and lead to better water quality management across the SCP.

Automated Cosmic Ray Shield

T. Wakefield *[Mentor: S. Kher]*

Arkansas State University - Engineering

A Cosmic ray is a highly energetic atom or nucleus or other particle traveling through space near the speed of light. These particles which also include light are harmful to humans and electronics devices that are unshielded. Current solution to Cosmic ray shielding consists of steel plates with a small gap between them to block particles through sheer mass, is not completely effective. Particularly, after a spacecraft employing it leaves the Ionosphere, the cosmic ray intensity rises significantly. A more effective means of shielding from cosmic rays will need to be implemented to make space travel more viable. This project will logically simulate the sensor input output to control a gas to be ionized, like hydrogen to create the cosmic ray shield to react with various degrees of radiation dynamically. Due to the hazardous environment, the system will need to carefully control voltage, temperature, and pressure of the plasma used as a shield. The operation is as follows: 1. sensor detects cosmic rays. 2. system energizes gas to absorb / deflects rays with a variable voltage control. 3. system detects pressure, temperature and balances them within acceptable limits via a pump. 4. Warning lights energize based on detected cosmic ray levels. The approach is to find an equilibrium point between the temperature, pressure of the ionized gas, the absorption/deflection, and detection of incoming cosmic rays.

What are the Drug-to-Drug Interactions Between Xanax and Synthetic Cannabinoids?

I. Ahmed *[Mentor: G. P. Miller]*

Arkansas State University - Medical Sciences

During the COVID-19 pandemic, anxiety, and isolation caused by lockdowns and economic hardships drove substance abuse of both illicit and prescribed drugs to record high levels. Xanax, more commonly referred to as alprazolam, is an anti-anxiety benzodiazepine commonly prescribed to treat short term anxiety. Alprazolam is the most prescribed psychiatric drug, and according to figures from the United States Drug Enforcement Administration. Overdoses caused by alprazolam often may occur when combined with illicit drugs such as synthetic cannabinoids. Synthetic cannabinoids are commonly known as K2 and spice and induce a “high” similar to cannabis but cause significant adverse side effects, such as cardiovascular and gastric issues. There is no research on the impact of these drug combinations on metabolism and subsequent parent drug levels that could cause adverse drug effects. In response, this project was designed to study drug-to-drug interactions of the synthetic cannabinoid 5F-APINACA and alprazolam in humans based on steady-state kinetics studies using human liver microsomes. We will be comparing previous kinetic data of 5F-APINACA to the kinetic data after adding alprazolam to 5F-APINACA in kinetic assays using human liver microsomes. The metabolic kinetics in this study will be key to having a better understanding of the metabolic effects caused when substance abuse users mix alprazolam and synthetic cannabinoids.

Elucidating the role of Tsh & CtBP interaction on Drosophila eye development

R. Newton, H. Hines, H. Lomax *[Mentor: S. J. Banerjee]*

Arkansas Tech University - Biology

Organ development in multicellular organisms is dependent on regulation of transcription factors activation or inhibition. For example, specific combinations of transcription factors drive division of the eye precursor cells, followed by specification of photoreceptor cell in the Drosophila (fruit flies) larval eye precursor tissue called the eye disc. During the third instar larval life, a morphogenetic furrow (MF) made of indented cell layers originates at the posterior margin of the eye disc and propagates towards the anterior side of the eye disc. The cells anterior to the MF are in the proliferating stage, and cells posterior to it start to differentiate as photoreceptors. The differentiated retinal cells form the units of the compound adult eyes called ommatidia. Previous studies have shown that Teashirt (Tsh), a zinc finger transcription factor, promotes cell division anterior to the MF. The C-terminal Binding Protein (CtBP), a conserved transcriptional co-repressor, was shown to limit cell division in the eye disc. Our immunoprecipitation assays revealed that Tsh and CtBP molecules interact in vitro and in vivo in the eye discs. We aim to identify, how the molecular interaction between Tsh and CtBP regulates eye development. We have developed fly strains manipulating the expression of tsh & CtBP and evaluated the outcome of it on fly development. Our findings of genotype phenotype assays suggest tsh and CtBP possibly play roles in the same pathway of eye development.

Robotic Arms for S'more Construction and other Classroom Applications

K. MacNicol *[Mentor: A. Wright]*

Hendrix College - Biology, Computer Science

Articulated robots are becoming increasingly common in manufacturing and medicine as automation engineers implement robotic arms to perform repetitive and precision tasks. Articulated robots represent an integration of physics, mathematics, and computer science concepts to solve real-world problems in a multitude of fields. They would provide an excellent opportunity to demonstrate core STEM concepts to excite and teach students, but robotic arms are often too expensive or technically challenging to incorporate into a classroom syllabus. However, as technologies have improved and become more affordable, there are now robot arms kits that can be assembled and run on open-source software. My research was designed to critically assess the capabilities and applications of the Arduino-compatible Tinkerkit Braccio robotic arm. Forward kinematics was used to produce a visual representation of the range of movement for the robotic arm while inverse kinematics was used to enable real-world precision in spatial control and material interactions.

Carbonized Waste Cigarette Filters as Novel, Low-Cost Adsorbents of Methylene Blue Dye

S. Atif *[Mentor: N. Siraj]*

University of Arkansas—Little Rock - Chemistry

The textile industry contributes to a significant amount of water pollution each year. Cigarette filters are the largest plastic pollution globally, with trillions of cigarettes being improperly disposed of yearly. In this work, carbonized waste cigarette filters and new commercial cigarette filters were used as adsorbent to remove the pollutant dye, methylene blue using adsorption mechanism. It was hypothesized that the waste cigarette filters would have a higher adsorption capacity due to the heavy metals presence in the filters as a result of cigarette smoking. Cigarette filters were carbonized through a rapid, low-cost, microwave-assisted method and tested for their adsorption capacities and kinetics. The adsorption data was fitted to two common isothermal models, Langmuir and Freudlich, and the kinetics data was fit into pseudo-order plots. The adsorption of methylene blue dye onto waste cigarette filters was found to fit both Langmuir and Freundlich isotherm models well. It indicates that adsorption occurs spontaneously and via chemisorption mechanism. The maximum adsorption capacities of the waste and new commercial filters were calculated to be 103.1 and 48.3 mg/g, respectively. Thus, waste cigarette filters could be utilized to adsorb textile dyes from wastewater effluents. This project presents a low-cost adsorbent from waste materials which would simultaneously alleviate the pollution of water and the growing amount of cigarette waste in the environment.

Binding of Divalent Metal Ions to DNA Hairpins

D. Simmons *[Mentor: J. Gunderson]*

Hendrix College - Physics

DNA hairpins can form when palindromic or partially palindromic sequences of DNA pair up to form a stable loop. If left unrepaired, the formation of these extra helical three-way DNA junctions can result in the insertion or deletion of genes from the genome. Inefficient repair of hairpin loops underlies mutations responsible for over 30 neurodegenerative diseases and many cancers in humans. Previous work has shown that some hairpin loops have conformational dynamics that are dependent on the presence of divalent metal cations, so the binding of divalent metal ions to hairpins is important to its structure and function. The objective of this study is to quantify the number (n) and the affinity (KD) of Mn(II) binding sites within DNA hairpins using electron paramagnetic resonance spectroscopy (EPR). It was found that perfectly paired DNA hairpins have one binding site with a KD of approximately 40 μM for Mn(II). Imperfectly paired hairpins have multiple binding sites with weaker affinity for Mn(II) caused by base-base mismatches. This study will help us to determine the structural role that divalent ions play in slipped-strand DNA molecules and will ultimately help us predict the interaction of DNA processing enzymes with these structures.

Synthesis and Characterization of Cu(I) and Cu(II) Complexes Supported by Binucleating Ligands

N. Taylor *[Mentor: L. Yang]*

University of Central Arkansas - Chemistry

This project focuses on the development of binuclear copper complexes for CO 2 activation. So far, a group of Cu(I) and Cu(II) complexes have been synthesized by the reaction of copper salts and the N,N'-bis(2-pyridylmethyl) acetamidinato ligand. The resulting products were characterized by X-ray crystallography, FT–IR, UV–vis, EPR, NMR and cyclic voltammetry. Preliminary test of the Cu(I) complexes with CO 2 and O 2 showed some interesting results, and the characterizations of the products are under investigation.

FACT Interacts: Understanding how an important protein complex interacts with genes.

J. Beard *[Mentor: A. Duina]*

Hendrix College - Biology

The large amount of genetic information that serves as the blueprint for life is stored as DNA in cells. In order to fit within the cell, DNA needs to be compacted. During compaction, DNA winds around proteins to give rise to nucleosomes. Nucleosomes further condense to form chromosomes. Nucleosomes represent physical blocks for the enzyme that reads the DNA for the eventual synthesis of proteins, which carry out most cellular functions. One method of overcoming nucleosome blocks is through the function of a complex named FACT. Work from our lab using yeast cells has shown that specific alterations within the nucleosome impair interactions between FACT and DNA. In my research, I am investigating whether other mutations within the nucleosome also affect FACT-DNA interactions. Other labs have shown that some of the mutations we study have an association with specific neurodegenerative conditions in humans, possibly providing insights into human health.

Study of a putative F-box protein in Arabidopsis thaliana to improve cancer therapy using F-box protein inhibitors

A. Barker, A. Henderson *[Mentor: M. Seong]*

Central Baptist College - Biology

As critical roles of F-box proteins in carcinogenesis, metastasis, and drug resistance have been discovered, F-box proteins became the therapeutic targets for cancer and showed some promising results (Byun et al., 2018a). However, a single F-box protein can have multiple target substrate proteins for degradation that might be involved in different stages of cancer development. This suggests that comprehensive studies of individual F-box proteins are required for effective therapy. Here, we present how Arabidopsis thaliana protoplasts were used for transient gene expression to confirm a putative F-box protein AT1G20790 as a functional F-box protein that interacts with Arabidopsis-SKP1-like 1 (ASK1). Further studies such as identifying target proteins of AT1G20790, identifying the molecules that inhibit the function of AT1G20790, and the regeneration from protoplast after the treatment with inhibitors will help us better understand the role of F-box proteins in cancer treatment.

Modeling Pre-Euro-American Settlement Forest Composition, Structure, and Spatial Pattern in the Ouachita Mountain Ecoregion, Arkansas, USA

W. Harper *[Mentor: W. Flatley]*

University of Central Arkansas - Environmental Science, Geography/GIS

Shortleaf pine-oak woodlands in the Ouachita Mountain Ecoregion (OME) provide habitat for many of Arkansas' threatened species and are a focus of conservation. Logging, agriculture, and fire suppression during the 20th century altered these forests, leaving us with limited information on their composition, structure, and spatial distribution prior to the 20th century. However, General Land Office surveys collected in Arkansas from 1813-1843 provide descriptions of forests from the early 19th century, prior to the 20th century disruptions. The goal of this research was to model historical forest patterns for seven counties in Arkansas' OME using this historical survey data. Our objectives were to 1) map historical survey data; 2) assess relationships between individual species and edaphic site characteristics (topography and soils); and 3) model historical tree species distributions and landscape patterns. Location, species, and diameter of trees were extracted from historical survey notes using optical character recognition software. We then related the presence of each species to topographic and soil conditions at the individual mapped locations using the random forest algorithm. The result is a species distribution model that maps historical forest community distributions based on relatively permanent site conditions that persist today. The model can be used to help determine site specific objectives for contemporary forest restoration in Arkansas' OME.

Synthesizing CO2 reducing catalyst to create alternative fuel sources

H. Cox *[Mentor: M. Massey]*

University of Central Arkansas - Chemistry

The production of energy has been heavily based on the action of burning fossil fuels. However, this method produces a large amount of carbon dioxide which then is recycled, heating the earth's atmosphere. The synthesis of this carbene, bim-py, will act as a precursor to attach to a manganese complex surrounded by carbonyl groups.This then leads to carbon dioxide being reduced electrochemically. The amount of bim-py produced can be altered using different solvents. DMSO has been proven to be the most effective producing a 40-70% yield, however, it is toxic to the environment and overall difficult to work with. Currently, acetonitrile, a more green solvent, has been proven to produce bim-py, but yield has yet to be recorded. The synthesis of bim-py has been reported to take up to 18 hours to produce, however, this process can be sped up using a microwave reaction, only taking 30 minutes.

Molecular Dynamics of Dense Chlorine Liquids

E. Bittinger, A. Brister *[Mentor: S. Neidhart]*

Henderson State University - Chemistry

In our everyday lives we encounter many dangerous items with liquid solutes that are being heated. The mechanism of heat transport is nebulous. In this project, we examined the thermal conductivity of dense chlorine containing liquids. The goal is to determine how phonons move through and in different chlorine dense liquids. A greater understanding of heat transfer may make items like lithium-ion batteries safer since they are widely used in electronic devices, vehicles, and many other everyday items. This work utilizes molecular dynamics to measures thermal conductivities in four different compounds: carbon tetrachloride, chlorobenzene, chloroform, and 1,2 dichloroethane; to examine how the molecule size and polarity, which alter ordering, change the thermal conductivity length dependence of the simulation. In this project, we use three different box lengths to observe the phonon wavelengths based on the z-dimension: lengths 25 Å, 50 Å, 75 Å. This will allow for an 'infinite' box length to be extrapolated. Using reverse nonequilibrium molecular dynamics (RNEMD) we will measure the linear response after a steady state has been achieved. This method uses an unphysical flux on the systems and measures the gradient that is created where the slope is the thermal conductivity. Using these values, we can compare them to two other methods that we will be using, the Acoustic Mismatch Model and the Diffuse Mismatch Model after introducing an artificial barrier.

Studies in hydridic reduction of alkynyl hydrazones via sigmatropic rearrangement to form allenes

M. McAdory *[Mentor: B. Walker]*

University of Arkansas—Little Rock - Chemistry

Allenes are a distinct class of dienes, with contiguous carbon-carbon double bonds and unique chemical and physical properties. To date, there are about 150 natural products known to contain an allenic moiety. Many of these natural products that contain an allenic moiety have also been shown to exhibit interesting biological activity such as enzyme inhibitors, cytotoxic, or antiviral agents, and others.[1] Inspired by the interesting biological activities of many allenic natural products, allene moieties are now systematically introduced in pharmacologically active classes of compounds such as steroids, nucleosides, prostaglandins, and amino acids.[2] The functionalized allenes that have been studied so far often exhibit impressive bioactivities. Thus, further developments in this field requires reproducible pathways to incorporate allenes using mild conditions that are tolerated by other sensitive functional groups. The work described here is the progress in developing an efficient synthesis of allenes by a 1,5-sigmatropic rearrangement from alkynyl tosylhydrazones using microwave synthesis. As the synthetic protocol of this method is optimized, we will incorporate an allene in the common steroidal acids, cholic acid and chenodeoxycholic acid and test their bioactivities.

The Bolometric Lightcurve of SN 2018hna

H. Meraviglia, E. Stinnett *[Mentor: J. Lusk]*

University of Central Arkansas—Little Rock - Physics

A core-collapse supernova is the titanic explosion that ends the life of a star may times more massive than our sun. The light from the supernova easily outshines the hundreds of billions of other stars in the supernova's host galaxy, and astronomers on Earth can detect these events from across the visible universe. After a core-collapse supernova starts fading, its luminosity is powered by the decay of nickel-56 (Ni-56.) This isotope is a by-product of the reactions which take place as the explosion forces its way toward the surface of the progenitor star. As this radioactive element decays, it releases energy into the expanding supernova debris, keeping the supernova visible longer than expansion and cooling would ordinarily allow. Models of supernovae predict the amount of Ni-56 synthesized in the explosion, but need to be tested against observationally-determined Ni-56 masses. This requires computing a bolometric lightcurve -- a plot of the total radiated power of the supernova versus time -- from telescope observations of the supernova. Constructing a bolometric lightcurve requires us to work backwards – from the observed magnitudes available to an estimate of the total radiated power. The goal of this project is to make supernova bolometric luminosity software easily usable by other researchers, and apply it to the determination of Ni-56 yields from the well-observed supernova SN 2018hna.

Characterization of the effect of a PPAR-y Agonist on METH-induced inflammation in Rodent Hepatic Tissues

C. Barnes *[Mentor: E. Peterson]*

University of Arkansas—Little Rock - Medical Sciences

Methamphetamine (METH) use over an extended period can cause a state of chronic inflammation throughout the major organs (e.g., brain, liver, lungs, heart, etc.). Chronic METH use can also contribute to severe tissue damage in the liver which can lead to cirrhosis, hepatitis, and other liver diseases. This inflammation is partly mediated by METH binding to Toll-like receptor TLR-4, which induces a pro-inflammatory response in cells. We are pursuing pioglitazone (PIO) as a proposed treatment to mitigate the harsh effects METH causes with tissue degeneration, neurotoxicity, and liver toxicity. PIO is a PPAR-y agonist which supports anti-inflammatory response and inhibits TLR-4 which can lead to a lessened impact of chronic METH-induced inflammation. We hypothesize that in an in vivo rat model of METH chronic use, PIO can mitigate METH-induced pro-inflammatory cytokine and protein expression in the liver. We performed a behavioral model where 32 male Sprague-Dawley rats were randomly assigned 4 different treatments (vehicle/vehicle, vehicle/METH, PIO/METH, and PIO/vehicle over the course of 20 days. During this time the rats were measured for locomotor sensitization, and after the study tissues were collected. For my project I am analyzing liver tissues via western blotting to test for protein expression of important pathway proteins such as TLR-4, PPAR-y and key inflammatory cytokines. Overall, we expect to see a PIO-mediated decrease in METH-induced inflammation.

Inducing bacterial mutation for metal removal efficiency

M. Browning, R. Turner, K. Medina, E. Avalos-Reyes

[Mentor: S. Chatterjee]

Arkansas Tech University - Biology

Industrial processes release toxic metal contaminants such as Cr (VI) which is highly toxic, mobile, mutagenic, and carcinogenic (WHO, 2018). Cr (VI) can be detoxified by reducing to less toxic Cr (III) by bioremediation, i.e., degrading using natural biological processes which are relatively less expensive. Our previous research showed bacteria have been used to reduce Cr (VI) to Cr (III) from synthetic solution and tannery effluents through bioaccumulation and biosorption. A mutation is any heritable change in the DNA sequence of an organism. It is shown that mutation induced in bacteria such as Escherichia coli can produce strains that are significantly more effective for toxic metal reduction. We aimed to study how the Cr (VI) reduction ability of E. coli can be enhanced or reduced through mutation and elucidate the molecular mechanism of Cr (VI) detoxification. We will discuss our findings of inducing physical (ultraviolet) and chemical (nitrous acid) mutation in E. Coli and identification of mutants that can enhance Cr (VI) removal under laboratory conditions.

Microbial Communities Discovered in Two Tennessee Cave Systems: Potential Models for Life in Subsurface Mars

K. Farr, M. Robles, A. Huseman, M. Fairchild, T. Taylor

[Mentor: J. Engman, M. Taylor]

Henderson State University - Biology

Surface conditions on Mars are harsh: extreme cold, UV radiation, and little liquid water. However, the subsurface has stable temperature conditions, reduced UV, possible water availability, and compounds useful to chemoautotrophs. These conditions offer the possibility of sustaining life. Hypogenic caves on Earth have been proposed as potential models for life in subsurface Mars. In Cannon County, Tennessee, Secret Squirrel Cave (SSC) and Blue Lagoon Cave (BLC), contain chemolithoautotrophic elements and unique microbial taxa, including thermophiles, hydrocarbon degraders, and sulfur, methane, and ammonia oxidizers. In “Petroleum Passage” of SSC lies a pool containing oil-releasing “mini-vents” surrounded by colored bands of sediment. Metagenomic sequencing (16S rRNA) reveals microbial taxa, including thermophiles, hydrocarbon degraders, and sulfur, methane, and ammonia oxidizers similar to taxa found in chemolithoautotrophic systems. High densities of salamanders and cave-adapted millipedes occur there, further supporting the hypothesis of chemolithoautotrophy. Stable isotope (12C/13C) analysis partially supports this hypothesis. Time-lapse photography of the pool for suggests a correlation between rainfall and vent activity. In BLC, a rimstone pool contains a viscous blue-black material of unknown origin. This “Blue Goo” contains taxa similar to SSC. Further research on SSC, BLC, may provide insight into new examples for models of life on Mars.

Combination Therapy Approach To Combat Multi-Drug Resistant Bacteria

A. Mortazi *[Mentor: N. Siraj]*

University of Arkansas—Little Rock - Chemistry

The overarching purpose of this work is to discover a simple and concise method to combine two distinct killing mechanisms in a single compound. Bacteria have long been developing resistance to the drugs designed to eliminate them. Unfortunately, this has led to an emergence of infections that cannot be treated by conventional medications. According to the Center for Disease Control, approximately 2.8 million people are infected with resistant pathogenic bacteria. Of these infections, 35,000 cases result in death.1 Due to these staggering statistics, there is an urgency to discover a treatment that circumvents the resistance of the bacteria while preventing others to develop. One such method is to combine two distinct killing mechanisms in one drug. This type of combination drug enhances the potential to kill susceptible bacteria but also contains an alternate mechanism to kill any resistant cells present. In this work, we seek to combine a commercial antibiotic with a near infrared dye to acquire a chemical killing mechanism with a photoactive killing mechanism.

Up-regulation of Osh6 prolongs the G2 phase of the cell cycle

L. Xu, I. Kadhim, N. Begum, W. King *[Mentor: F. Tang]*

University of Arkansas—Little Rock - Biology

The progression of the cell cycle depends on temporal control of metabolism. While the cell cycle dependent metabolisms of proteins and DNA are extensively studied, the cell cycle-dependent synthesis and transport of membrane lipids is emerging as an active research topic. One of our longevity mutant PERG6-OSH6 in yeast has large cell size, a sign of elevated membrane lipids. Osh6 is a non-vesicular lipid transporter and traps one of its lipid ligand phosphatidylinositol-4-phosphate (PI4P) on the trans-Golgi network. To explore connections between Osh6 and membrane lipid metabolism, we compared the morphological changes of the budding process of wild type, PERG6-OSH6, and other Osh mutants upon titration of different lipid ligands of Osh6. This comparison showed that PERG6-OSH6 upon titration of PI(4,5)P2 prolonged the G2 phase while PERG6-OSH5 under the same manipulation extended the G2 and M phases. A fluorescent microscopy study showed that the PI(4,5)P2 level in PERG6-OSH6 was lower than that in wild type. The effect of up-regulated Osh6 on lowering the PI(4,5)P2 level has implications on studies of lipid metabolism in the cell cycle as well as pragmatic treatments of fungal infections by drugs targeting PI(4,5)P2.

Investigation of the mechanism of enhanced photothermal effect of combination ionic nanomedicines

A. Ishtiaq *[Mentor: N. Siraj]*

University of Arkansas—Little Rock - Chemistry

Cancer is still the second leading cause of death in the US only surpassed by heart disease. Nanotechnology has made great strides in improving treatment for the disease. Specifically, combination nanodrugs are gaining attention due to lessened side effects and tumor targeting ability of nanoparticles. In this work, we combined photothermal therapy (PTT) drugs with a chemotherapeutic drug to develop chemo-PTT combination drugs. Aqueous nanoparticles are derived from the therapeutic drugs using a simple reprecipitation method. The photophysical properties which influence the PTT performance and the light to heat conversion efficiencies are investigated in detail to determine the most promising combination for further in vitro studies. Cellular studies were performed to record the enhanced effect of the drug which resulted in abate values of inhibitory concentration at 50 percent.

Fake Profile Detection on social media using Generative Adversarial Networks (GANs)

E. Akpan *[Mentor: I. Dutta]*

Arkansas Tech University - Computer Science

The social networking trend has been on the increase. As of October 2022, there are 4.74 billion users of social media, which is 59% of the population of world. This is an increase of 190 million users since the same time last year. People are using newer versions of social media every day to keep in touch and follow trends. Since it is difficult to track the authenticity of a user, people use bots to increase their social influence. Bots are used in marketing and to sway political allegiance. The public's growing influence on popular opinions make bots creation lucrative endeavor. Trolls and other newbies are participating by running many social media profiles using stolen identities to further their own agendas. Recent hacks have made users scared. Additionally, since bot accounts and fake profiles have eluded detection by existing safeguards like captcha, we are looking into using GANs, a machine learning algorithm, to identify bots to tackle the threat of social media crimes. With the help of recognized bot accounts, GANs train their own generator and discriminator models to understand the patterns of such profiles and the relationship between the bio information, profile image, messages sent out, time frame of updates, and followers. It creates these false profiles and then uses the method to identify and categorize profiles. The effectiveness of a system will be tested on the generator and discriminator models to see how well they are able to identify phony profiles.

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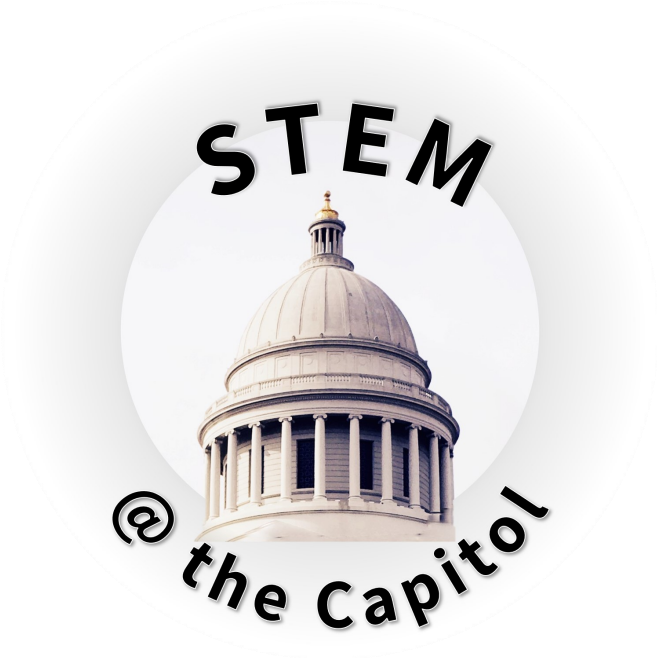

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