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1. A Dynamic Bioeconomic Model for Aquaponic Farms

Ziqing Xie, UNM

Jane Sawerengera, UNM

In a rapidly growing world, conventional agriculture is under pressure from climate change and is struggling to meet the growing food demand while protecting the environment. Adopting new technologies like Controlled Environment Agriculture (CEA), where farming is done in controlled environments shielded from external climate fluctuations, can ensure climate resilience. Aquaponics, a high-yield CEA system, enables efficient fish and vegetable cultivation through a symbiotic exchange: fish waste enriches plant nutrients and plants, in turn, purify water. Despite its significant potential, small-scale aquaponic farmers often struggle to determine the optimal timeline to harvest their fish to maximize profits. Yet, aquaponics research has largely focused on biological aspects, with limited attention to economic feasibility and long-term sustainability.

The objective of this study is to develop a dynamic optimization model tailored to aquaponics operations, integrating both the fish and plant components. Specifically, the study seeks to identify optimal harvest periods that maximize net farm profit while accounting for key variables such as growth rates, feed costs, and market prices. By integrating real-world data with optimization techniques, the study will offer both theoretical insights and practical tools for farmers, investors, and policymakers. The model recommends harvesting plant every 27 days, reflecting faster turnover and revenue generation from the plant component. The optimal fish harvest occurs only at the final period. The preliminary results underscore the need for further analysis of cost structures and management strategies to improve long-term economic viability.

2. A New Stacking-Based Semi-Supervised Anomaly Detection Method for Water SCADA Systems

Christopher Montoya, NMT

Trevor Smith, NMT

Ivan Hinojos, NMSU

Monju Tanakajima, NKU

Patrick Duane, NMT

Jun Zheng, NMT

Supervisory Control and Data Acquisition (SCADA) systems are essential for the real-time monitoring and control of critical infrastructure, such as water treatment and distribution facilities. However, their reliance on networked sensors and actuators introduces significant cybersecurity risks. A successful cyberattack on SCADA-controlled infrastructure can lead to severe consequences, including service disruptions, equipment failures, environmental damage, and threats to public safety.

In this project, we propose a new semi-supervised stacking ensemble learning method for detecting anomalous events, including cyberattacks, in water SCADA systems. Traditional supervised learning methods require labeled data for both normal and anomalous events, which can be difficult to obtain in critical infrastructure environments due to the rarity and evolving nature of cyber threats. In contrast, semi-supervised anomaly detection leverages only normal data to train the detection model, making it well-suited for identifying previously unseen or unknown attacks. This capability is crucial for securing water SCADA systems, where emerging cyber threats and operational anomalies may not be represented in historical datasets.

The proposed method employs a meta-learner to strategically combine the predictions of multiple diverse base learners, enhancing both accuracy and robustness. To validate the effectiveness of our approach, we conducted evaluations using a real-world water SCADA dataset: the Secure Water Treatment (SWaT) dataset. Experimental results demonstrate that the proposed method significantly outperforms baseline semi-supervised anomaly detection models, including the individual base learners and the meta-learner used in our ensemble model.

3. A Sustainable Development Perspective of Atmospheric Water Harvesting Technologies

Dora Aidoo, UNM

Atmospheric water harvesting (AWH) captures and condenses water vapor directly from the atmosphere as an alternative water source for regions that lack liquid water resources or when conventional water supplies are interrupted during emergencies, such as by municipal or natural disasters. Thus far, AWH research has focused on material development, performance, and technoeconomic assessment of AWH. However, there are many other critical aspects to consider in the development and implementation of AWH technology. Specifically, looking at AWH from the lens of an environmental engineer such as sustainability of AWH technology considering material and energy use, and microclimate impacts, lifecycle costs/impacts of materials and energy used for AWH. The goal of this perspective study is to critically review prior research on AWH through a sustainability lens and to develop a sustainability framework through which the environmental, economic, and social opportunities and implications of AWH technology can be analyzed, with particular focus on environmental benefits and impacts of AWH. Our preliminary results show that AWH is aligned with various United Nations (UN) Sustainable Development Goals (SDGs). However, challenges such as high capital costs, variable energy demands, limited large-scale implementation, and socioeconomic/political factors such as affordability, governance and policy integration must be addressed to ensure that AWH systems are accessible, affordable, and sustainable over time. In ongoing work, we are analyzing environmental impacts associated with energy consumption, micro-climate impacts, and social impacts associated with AWH water quality.

4. Adversarial Attacks on Watermarking in Genomic Deep Learning Models

Clovis Barbour, NMT

Watermarking has been proposed as a strategy to protect intellectual property and verify provenance of genomic deep learning models, but the resilience of these schemes against adversarial attacks remains largely unexplored. Our work focuses on designing a pipeline to evaluate and stress-test watermarking methods in the genomic domain. The pipeline will integrate model training, watermark embedding, adversarial perturbation generation, and watermark detection to systematically assess robustness. By formalizing this process, we aim to provide a reproducible framework for benchmarking existing watermarking techniques and guiding the development of stronger, attack-resistant methods for genomic deep learning.

5. Analyzing how Experience Shapes interpretation of Scientific Graphs in STEM Education

Cesar Hernandez, NMHU

Justin Muller, NMHU

David Donley, NMHU

This study investigates how STEM faculty, undergraduate, and graduate students at a rural university interpret and analyze scientific material. Using iMotions facial recognition (Affectiva) and eye-tracking software, participants' nonverbal responses, such as facial expressions, eye movements, and gestures-were recorded as they examined two scientific graphs. Following each graph, participants completed short written questions assessing comprehension and interpretation. The collected data will be analyzed using heat maps and gaze-plot visualizations generated by iMotions. Specific regions of each graph will be defined as Areas of Interest (AOIs) corresponding to the graph title, axes, legend, and data trend regions. This approach allows researchers to determine which components of the graphs attract the most attention and how long participants fixate on particular elements. By comparing these patterns among faculty, undergraduate, and graduate participants, the study aims to identify differences in focus, visual strategy, and efficiency when processing scientific material. The findings are expected to reveal how increased STEM experience affects visual attention, interpretation accuracy, and emotional engagement with scientific data. These insights can inform instructional practices by highlighting which graph features are most intuitive or confusing to learners, ultimately improving how complex scientific information is taught and communicated across STEM academics.

6. Antimicrobial Properties and Mode of Action of Cinnamon and Cumin on Escherichia coli and Staphylococcus aureus

Reuben Enchill, ENMU

Manuel Varela Ph.D., ENMU

The growing problem of antimicrobial resistance highlights the urgent need to uncover new ways to fight harmful bacteria. The long-range goal of this research is to identify natural antimicrobial agents, specifically focusing on reducing reliance on synthetic antibiotics and preventing further resistance. This study will examine the antimicrobial effects of cinnamon and cumin against the Gram-negative Escherichia coli and the Gram-positive Staphylococcus aureus. The primary objective is to evaluate how effective these spices are at stopping bacterial growth and discovering how they work at the cellular level. The hypothesis is that cinnamon and cumin contain antimicrobial compounds that can damage the bacterial structure and function, leading to growth inhibition or even cell death. The experimental approach involves preparing ethanolic extracts of cinnamon and cumin and examining their antimicrobial activity using standard laboratory methods, such as broth microdilution assays, to determine the minimum inhibitory concentrations and minimum bactericidal concentrations against both bacteria. Additionally, Gram staining, live/dead fluorescence microscopy, and scanning electron microscopy (SEM) will expose cellular alterations. The rationale for this study is that understanding the mode of action will uncover novel therapeutic strategies. With antimicrobial resistance on the rise, the expected outcomes will highlight natural alternatives that could be used to treat infections more effectively.

7. Application and Analysis of Fourier Series

Micah Viera, ENMU

Hamid Allamehzadi, ENMU

In this research, we derive the Fourier series representation of periodic signals commonly used in engineering and the sciences. Then, we synthesize a periodic signal f(t) using MATLAB software and Operational amplifier circuits in the lab by adding successive harmonics in its spectrum and observing the similarity of the resulting signal to f(t). Various low- and band-pass filters were designed (both hardware and software) to extract a specific range of frequencies from a square-wave signal. Furthermore, we use a spectrum analyzer to observe the frequency spectrum of the practical signals and compare them with their derived Fourier series representations. Finally, we investigate the rate of convergence and frequency of oscillation of the Fourier series and their relationships to the Gibbs phenomenon. Fourier series has numerous applications in communications (Antenna Design), measurement error of harmonics with selected power quality analyzers, and speech modifications by selecting Fourier-Bessel series expansions of speech signals.

8. Assessing the Developmental and Cardiac Toxicity of Vanadium in Zebrafish Embryos

Richard Cooper, ENMU

Wildfires and industrial runoff are introducing increasing amounts of vanadium, a persistent heavy metal, into freshwater ecosystems. Although vanadium naturally occurs in trace amounts, its mobilization from ash and contaminated soils has raised concerns about bioavailability and toxicity in aquatic environments. As a non-degradable elemental metal capable of bioaccumulation in aquatic food webs, vanadium presents long-term ecological risks that remain poorly characterized compared with other trace metals such as lead or mercury.

This study will examine how chronic vanadium exposure affects early developmental processes in zebrafish (Danio rerio) embryos, a model widely used for evaluating aquatic toxicants. Embryos will be exposed to varying concentrations of dissolved vanadium from early cleavage through hatching under controlled laboratory conditions. Throughout exposure, they will be monitored for morphological abnormalities such as spinal curvature, cardiac and yolk sac edema, and other visible malformations. Quantitative imaging will be used to assess deformity frequency and severity, while heart rate and structure will be analyzed to evaluate cardiovascular disruption.

It is anticipated that higher concentrations will produce dose-dependent morphological and cardiac defects, indicating interference with normal development. These findings will provide new insight into how persistent trace metals influence embryonic growth and contribute to understanding the broader ecological risks associated with heavy-metal contamination following wildfires and industrial activity.

9. Calcination of Gypsum into Bassanite under Anhydrous and saline condition using X-ray diffraction

Charlotte Daniels, ENMU

The study investigates the calcination process of gypsum to produce bassanite under anhydrous and saline conditions and to analyze the results using powder X-ray diffraction. The experiment focuses on the formation of bassanite and its influence on gypsum calcination. Previous research on the playa at Arch Lake, New Mexico, found the metastable mineral in dunes during wet winter. A subsequent study was done on the playa during the scorching summer, and the sediments did not contain bassanite. Mars researchers also believe that environments like this are like those at the Jezero crater on Mars and serve as a terrestrial analog. The study also aims to provide insights into industrial applications and an understanding of gypsum transformation mechanisms. Initial experiments looked at the conditions under which gypsum undergoes dehydration to bassanite. Samples of pure gypsum were ground to a fine powder and analyzed for purity using powder X-ray diffraction. Assuming average summertime hot temperatures of approximately 40° C, the pure gypsum was heated in a furnace for 24 hours to test for the conversion to bassanite, and no conversion was observed either because the temperature was too low or because of a kinetic effect. Another sample was heated at 70°C for 24 hours, and the result was 75% gypsum and 25% bassanite. Based on the presence of salt on the playa, the hypersaline brine on the surface may facilitate (catalyze) the conversion of gypsum to bassanite under natural ambient conditions. Future research will investigate this process.

10. Characterization of the Conserved Motifs of LmrS of the Major Facilitator Superfamily Efflux Pump of Staphylococcus aureus

Ifeanyi Ugwuanyi, ENMU

Submission retracted

11. Classification of Endophytic Microbe Communities Contributing to Plant Growth in Greenhouse Crops

Malkiya Jim, NTU

Harrison W. Cayatineto, NTU

Palmer Netongo, NTU

Irene Ane Anyangwe, NTU

Plant growth promoting microbes (PGPM) are endophytic microbes such as bacteria and fungi that colonize the plant tissues of the stem, leaves, and roots causing no damage or harm to the plant. This symbiotic relationship is termed non-pathogenic microbes. PGPM are also capable of promoting healthy plant growth by providing nutrients and biochemicals required by the plant. While most PGPM are non-pathogenic, some are pathogenic leading a decline in forestry, gardening plants, and crops. This study aims to explore and classify the presence of endophytic microbes in the root of Solanum lycopersicum and Zea mays vegetables of produce. At various growth stages, the roots of each produce were cut and plated on Potato Dextrose Agar (PDA)and Nutrient Agar (NA). We also preformed rapid DNA extraction and utilize Polymerase Chain Reaction (PCR) to amplify the 16S rRNA gene for bacteria and Internal Transcribe Spacer (ITS) for fungi identification. Our results revealed that Rhizopus, Fusarium species, and Bacillus bacterial species were most identified in all root samples through sequencing. Although that it is not clear whether the strains of our identified microbes promote plant health, as certain strains of microbe communities can be pathogenic and/or non-pathogenic and harbor the root community of our produce. Key Words: PGPM, ITS, Endophytic, Pathogenic, Non-pathogenic

12. Collaborative Research: Rll FEC: Harnessing Controlled Environment Agriculture to Secure Sustainability and Economic Growth

Sarrah Trujillo, NMSU

Shaun Mckinley, UNM

Lois Stanford, NMSU

Kevin Lombard, NMSU

Tribal farmers have been dealing with drought that affects crop production, crop quality and food security. This project incorporates hydroponic systems onto Native American reservations to promote water conservation. The project spans across three states including New Mexico, South Dakota, and Wyoming, but our presentation is focused in New Mexico on the Navajo reservation.

The project objectives are to first, understand the hydroponic systems and work with the systems enough so that we can properly teach other farmers how to use them. In the second state, we will survey the community in order to better understand the potential social, economic and environmental impacts of these systems. However, there are cultural and social challenges, financial and economic barriers, technical challenges, and environmental and resource considerations. However, there are benefits such as year-round food production, water conservation, improved nutrition and a chance to educate. Finally, the goal is to introduce pilot hydroponic systems into the community and teach community members how to safely and effectively use the systems in their farming.

To date, we have built and started growing in both NFT (nutrient film technique) and AT (aeroponic tower) systems. We have also set up and plan on growing in DWC (deep water culture) systems as well. We have successfully grown both basil and lettuce with good results and plan on experimenting with other crops as well.

13. Comparing Beaver Ponds and Artificial Impoundments as Post-Wildfire Mitigation Tools for Aquatic Ecosystem Health and Metal Retention in New Mexico Headwater Streams

Jodie L. Montgomery, ENMU

Corey S. Green, ENMU

Zachary A. Mitchell, Texas A&M Kingsville

In the western United States, catastrophic wildfires are occurring with increasing frequency and severity. Alterations to forest and aquatic habitats from severe fires significantly impact ecosystems, reducing aquatic community abundance and species richness while altering metal concentrations and ecological structures. This study examines the impacts of the 2022 Hermits Peak and Calf Canyon wildfires on metal concentrations within aquatic systems and their effects on macroinvertebrate and fish communities in northern New Mexico. The primary objective is to evaluate differences in metal contamination between anthropogenic impoundments and beaver ponds. This may provide a natural mitigation strategy by reducing metal transport and supporting aquatic community resilience. However, additional data is needed to confirm their effectiveness. We focus on macroinvertebrates as bioindicators to better understand the protective role of impoundments against contamination caused by wildfire activity, providing insight into exposure pathways within these aquatic ecosystems. So far, ten field surveys have been conducted in impoundments across burned and unburned areas, emphasizing high-severity and unburned sites. Standardized D-frame kick net sampling was used for macroinvertebrate sampling, with further processing and identification currently underway at ENMU. Water and sediment samples are undergoing metal analysis at the UNM. Data is being analyzed using PERMANOVA, CCA, and GLM statistical approaches to evaluate the influence of metals on community structure. This ongoing multidisciplinary research increases our understanding of wildfire effects on aquatic ecosystems and the potential mitigating role of impoundments, offering critical insights for conservation and management strategies.

14. Comparison of Uranium Measurement Technologies for Community-Based Environmental Monitoring

Nikita Dougan, UNM

Ashley Apodaca-Sparks, UNM

Ashley N. Tafoya, UNM

Geisianny Augusta Monteiro Moreira, UNM

Kaitlin Fisher, UNM

Christopher Shuey, Southwest Research and Information Center

Greg Jojola, Pueblo of Laguna Environmental and Natural Resources Department

Abudulmehdi Ali, UNM

Nick J. Carroll, UNM

Jose M. Cerrato, UNM

Gabriel P. López, UNM

The legacy of uranium mining in western New Mexico has left many communities with elevated uranium concentrations in local surface waters. Currently used uranium detection methods, such as inductively coupled plasma mass spectroscopy (ICP-MS), while highly sensitive, are not suitable for rapid and user accessible field testing. This study evaluates the sensitivity of two emerging uranium detection technologies—the Alpha Measurement Solutions ANDalyzeTM and Lumex Instruments FluoratTM—in comparison to ICP-MS. The ANDalyze system employs a DNAzyme-based fluorescence biosensing method with a reported dynamic range of approximately 1–60 µg/L, while the Fluorat spectrophotometer system measures formation of luminescent uranium complexes over a reported range of approximately 1–2,000 µg/L . Both ranges span the value of the U.S. Environmental Protection Agency (EPA) maximum contaminant limit (MCL) for uranium in drinking water of 30 µg/L. Uranium detection, specifically the uranyl ion (UO22+) was evaluated under two experimental conditions: laboratory-prepared samples of known uranium concentration and surface water samples collected from the Pueblo of Laguna's Rio Paguate. Results demonstrate strong linear correlations among all three methods, especially in lab-prepared samples. However, both devices showed consistent underestimation of uranium levels under both testing conditions, with the greatest underestimations being UO22+ concentrations below the EPA's MCL in

collected field samples. These findings support the potential of ANDalyze and Fluorat as methods for uranium sensing in community-based environmental monitoring, while highlighting the need for further research into these technologies.

15. De-ashing filamentous algae in alkaline media for sustainable development of high value carbon materials.

Felix Donkor, ENMU

Carbon materials have proven to have enormous use in catalysis, electronics, and energy conversion and storage. Over the years, there has been an increased development of carbon materials (e.g., carbon nanotubes, graphene) due to their characteristic properties in energy applications. Filamentous algae contain high levels of convertible carbohydrates and can serve as a feedstock in the sustainable production of such materials via thermochemical processes such as slow pyrolysis. The use of the Algal Turf Scrubber system in the remediation of dairy wastewater resources tends to introduce exogenous compounds primarily entrained soils into growing algae. The conversion efficiency and the overall cost of production of these carbon materials can be improved significantly by pretreating algal biomass to remove substantial ash content. Additionally, characterization studies conducted on extracted algal lipids using Gas Chromatography-Mass Spectroscopy would probe the application of algae in biofuel production. This research seeks to de-ash filamentous algae in alkaline media at a low temperature while minimizing organic matter loss for efficient conversion processes.

16. Demographic Analysis of Giardiasis, Cryptosporidiosis, Amebiasis, and Cyclosporiasis in New Mexico, 2010- 2024

Talyia MacLeod, UNM

Sarah Shrum Davis, DOH

Background/ Introduction

Enteric parasitic infections in New Mexico receive limited recognition and public health resources. Little is known about the socioeconomic and environmental risk factors associated with these diseases. This study examines demographic and geographic patterns of infection to identify inequities and inform prevention and intervention strategies.

Methods:

Data from the New Mexico Department of Health (NMDOH) for Cyclospora cayetanensis, Cryptosporidium, Entamoeba histolytica (Amebiasis), and Giardia lamblia (Giardiasis) were aggregated by Public Health Region, sex, age group, race, and ethnicity. Population denominators were obtained from the UNM Geospatial and Population Studies (GPS) program to calculate average annual incidence rates per 100,000 population from 2010-2023. Descriptive analyses were conducted to assess temporal and geographic patterns of disease and to identify disparities across demographic groups.

Results:

A total of 2,592 incident cases were identified from 2010 to 2024, with Cryptosporidium accounting for 48.6% and Giardiasis for 48.9% (1,268 cases), representing the majority of infections, while Cyclospora (2.6%) and Amebiasis (0.2%) had the lowest case counts. Preliminary findings indicated that temporal patterns show peaks of Cryptosporidium and Giardia during the summer and fall seasons. Incidence rates varied across New Mexico public health regions, with the southeastern region having the highest rates, including 184 cases of Giardiasis (62.4 per 100,000) and 387 cases of Cryptosporidiosis (131.3 per 100,000). The age group 18–64 years exhibited the highest burden of disease across all parasitic infections. The largest burden of reported cases was observed among the Non-Hispanic White (N=1,060) and Hispanic of any race (N=904) populations, which together accounted for 75.8% of all cases.

Conclusions:

Findings reveal regional and demographic patterns of vulnerability to enteric parasitic infections. Strengthening hygiene education and sanitation infrastructure in high-incidence areas could mitigate disease burden and advance health equity.

17. Dietary Flavonoids as Small Molecule Inhibitors in Huntington's disease: A Quantum Mechanical Study

Bijili Navine Nanjo, NMHU

Huntington's disease (HD) is a neurodegenerative disorder caused by abnormal CAG repeat expansion in the HTT gene, leading to the production of mutant huntingtin (mHTT) protein. This misfolded protein aggregates into toxic oligomers and fibrils, disrupting transcriptional regulation, neuronal function, and ultimately resulting in striatal neurodegeneration. Dietary flavonoids, naturally occurring polyphenolic compounds with known antioxidant and neuroprotective activities, have shown to be potential small-molecule inhibitors of CAG repeat expansion.

In this study, a dataset consisting of 16 dietary flavonoid molecules and one synthetic drug (NA) is analyzed using density functional theory (DFT). Geometry optimization is performed to obtain the lowest-energy molecular structures using the M06-2X functional with 6-31G(d,p) and 6-31+G(d,p) basis sets. Calculations were carried out in both gas phase and solvent phase (water, DMSO, and ethanol). Solvent effects were incorporated to evaluate changes in dipole moments and electronic properties. The electronic structure of each optimized molecule was then examined to compute quantum mechanical descriptors, including HOMO–LUMO gap, chemical potential, electron affinity, ionization potential, electronegativity, electrophilicity index, global hardness and softness, Fukui functions, which provide insight into molecular stability, reactivity, and potential binding interactions.

The structure–activity–property relationship analysis helps determine which parts of the flavonoid structure such as the hydroxylation patterns (number and position of –OH groups), methoxylation (–OCH_3 substitution), planarity and conjugation (extent of π-electron delocalization) contribute most to binding to CAG repeats, antioxidant capacity, and overall neuroprotective potential.

18. DMSO Exposure Trials on Zebrafish

Alysa Benton, ENMU

Juanita Ramirez, ENMU

Corey Green, ENMU

DMSO is a universal solvent used in many toxicological exposures to help solubilize other contaminants. Recent attention has been brought to the potential of this solvent to cause biological effects in study organisms, which can complicate toxicological studies. Here we exposed early life stage zebrafish to various concentrations of DMSO to determine a safe threshold below which we no longer see biological effects and have a better understanding of its potential effects. Our first exposure emulates another study showing a positive correlation between mortality and DMSO concentration above 2%. The second exposure was focused on refining our concentration range and calculating an EC50 for physical endpoints. Both studies were carried out for 96 hours with acute exposure to our zebrafish ranging from 0%-5% in the first exposure and 0%-2% for the second. Measured endpoints include heart rate, mortality, pericardial edema, air bladder inflation, spinal defects, and yolk sack edemas. Based on data within the literature, we expect to see defects and mortality rise with the concentrations. In particular, we expect standard length and heart rate to be reduced in a dose-dependent manner. The severity of defects is expected to increase with DMSO concentration. The results of this study will be used to help future exposure studies understand the effects of a common solvent and the concentration thresholds that should be maintained.

19. Do Polyamines react with Cysteine and Cysteamine to form biologically relevant thiazolidines?

Lawrence Ongboja, NMHU

Steven Karpowicz, NMHU

Diamine oxidase (DAO) converts polyamines into small, reactive amino-aldehydes that are of biological significance. This work tests whether two such species; 4-aminobutanal (ABAL) and 3-aminopropanal (APAL) - are rapidly captured by the biological thiols cysteine and cysteamine. Raman spectroscopy is used to track real-time kinetics, while nuclear magnetic resonance (NMR) establishes product identities and mechanisms under controlled pH. The central expectation is that thiols form thiazolidine adducts that lower the pool of free amino-aldehydes, and the outcome will be like histamine. Conditions that favor trapping are then applied in human cell culture to assess downstream immune signaling, including markers tied to histamine pathways and potential inflammatory responses. Overall, the study identifies thiol availability, aldehyde identity and the outcome between biological thiols and polyamines.

20. Edge Computing based Approach for Fall Detection

Juana Martinez, ENMU

Sarbagya Ratna Shakya, ENMU

In today's world, a larger part of the population is growing to be elderly, because of a longer life expectancy and previous baby booms. Age-based medical conditions cause an increased risk of falls resulting in substantial injury. This is an increasingly prevalent health concern for the aging population. Preventative healthcare is one avenue of tackling this issue, especially with real-time monitoring devices using edge computing on wearable devices. The advancement of technology allows for better health care and preventative capabilities. Utilizing emerging technology of edge computing devices and TinyML, we can create systems that are power-efficient, cost-effective, high speed, and offer increased privacy and control of personal data. The ability to make and deploy models is easily available to the public through software such as Edge Impulse, TensorFlow, and hardware components, such as Arduino microcontrollers. Using Edge Impulse, a website based on simplifying TinyML model building process and deployment, we are developing a Convolutional Neural Network. We deployed this model onto Arduino Nano BLE 33 Sense Rev Board. Accelerometers and Gyroscopes sensors will be the primary data collection methods. Furthermore, test its accuracy in real time. If promising results are shown, the application of TinyML models in preventative healthcare can reduce the amount of injuries risk and allows elders to live more independent and secure lives.

21. Effects of microplastics on aquatic ecosystems in Roosevelt County, New Mexico

Zachary Tebay, ENMU

Corey Green, ENMU

This research explores the prevalence of microplastic contamination and its ecological impacts within freshwater systems in Roosevelt County, New Mexico. Our study is designed to measure the concentrations of microplastics in water bodies and fish populations, as well as to evaluate the biomagnification of these particles across food webs.

We will gather water samples from a range of habitats, including Oasis State Park, urban runoff drainage areas, wastewater ponds, and private ponds. These samples will be analyzed using microscopy and Fourier-transform infrared spectroscopy (FTIR) to ascertain both the quantity and composition of microplastics present. Furthermore, fish samples will be dissected to investigate the accumulation of microplastics in their gills, muscles, and digestive tissues.

By integrating this data, we aim to develop a biomagnification model that assesses how microplastics are transferred across trophic levels and their potential impacts on consumers, including humans and migratory birds. Our research is expected to reveal spatial patterns of microplastic pollution, identify likely sources of contamination, and evaluate the associated ecological and human health risks.

Ultimately, this study will deepen our understanding of microplastic contamination in freshwater systems, inform future water quality monitoring efforts, and support conservation and public health initiatives in the southwestern United States.

22. Empowering Teachers with GenAI: A Multimodal Open-Source ESL Quiz Generation

Caleb Parten, ENMU

Eduardo Ceh-Varela, ENMU

Yitzen Lizama-Peraza, ENMU

Personalized learning has become a key priority in education, but its practical implementation remains challenging. For English as a Second Language (ESL) instructors, this difficulty is especially pronounced, as they must accommodate students with varied proficiency levels, learning preferences, and cultural backgrounds. Preparing differentiated instructional and assessment materials under these conditions demands substantial time and effort. The rapid emergence of Generative Artificial Intelligence (GenAI) provides a promising opportunity to address these issues. Trained on extensive datasets, GenAI models are capable of producing human-like text and can support tasks such as lesson planning, explanation generation, and quiz creation. Within language education, this functionality has the potential to automate the development of customized assessment materials, thereby saving valuable instructor time and fostering more adaptive learning environments. Yet, the successful integration of GenAI requires more than technological availability, it depends on designing tools that align with educators' pedagogical objectives and workflows. A user-centered approach, which positions instructors as active decision-makers and keeps a 'human in the loop,' is essential to ensure AI complements rather than replaces teacher expertise. This research introduces a novel open-source, web-based platform for generating ESL quizzes from both text and image inputs. The system employs self-hostable, locally run language models that safeguard data privacy and eliminate dependence on proprietary APIs, offering educators an accessible, transparent, and practical solution for enhancing personalized learning.

23. Enhancing Enzymatic Oxidative Degradation of Lignin

Carina N. Anastasio, UNM

Telmo Díez Pérez, UNM

Adam Quintana, UNM

Nick J. Carroll, UNM

David S. Peabody, UNM

Gabriel P. López, UNM

Efforts to prevent forest fires typically generates large amounts of biomass through thinning operations in forest management. This biomass, while typically treated as waste, is rich in lignocellulosic material that could serve as a renewable feedstock for valuable products, such as biofuels and biopolymers. Lignin, which is a complex, heterogeneous macromolecule, remains a major barrier to valorization of woody biomass due to its resistance to degradation and tendency to repolymerize following oxidation. To address this challenge, we aim to optimize lignin degradation through laccase-catalyzed oxidative pathways. We explore how enzyme kinetics, substrate transport, and redox mediators can be optimized within engineered catalytic environments. We aim to develop a catalytic facilitator that promotes and stabilizes laccase activity under variable conditions and improves enzyme–substrate proximity. This configuration also should minimize radical recombination and repolymerization, resulting in a more selective and efficient depolymerization process. The goal of this work is to develop generalizable, rational designs for catalytic microenvironments that can directly enhance enzyme function, suppress undesired side reactions, and advance the controlled biocatalytic degradation of complex polymers. Our findings establish a foundation for scalable, enzyme-based lignin valorization strategies that support our goal of developing sustainable, engineered solutions for biomass utilization and wildfire mitigation.

24. Evaluating the Fracture Performance of the 3D Printed Concrete Beams

Reza Sedghi, UNM

Madura Pathirage, UNM

Maryam Hojati, UNM

The integration of 3D printing in construction necessitates a thorough understanding of the mechanical properties of printed concrete, which are inherently anisotropic due to the layer-by-layer deposition process. This anisotropy, primarily caused by interlayer voids and weak bonds, critically influences structural performance, particularly fracture resistance. This study systematically evaluates the fracture performance of 3D-printed concrete beams by investigating the effect of filament orientation. Notched beams with a notch-to-depth ratio (a_o/D) of 0.25 were printed at five different orientations (0°, 30°, 45°, 60°, and 90°) relative to the notch and tested to failure. Key fracture parameters, including the maximum load and Crack Mouth Opening Displacement (CMOD), were recorded for each specimen. The experimental data was subsequently used to calibrate a high-fidelity numerical model for deeper analysis. The results demonstrate a significant correlation between printing orientation and structural performance. The elastic modulus and cohesive properties of the interlayer regions were found to be highly sensitive to the orientation of the interfaces relative to the propagating crack. This research provides critical insights into the anisotropic fracture behavior of 3D-printed concrete and delivers essential data for calibrating predictive models, ultimately contributing to the design of safer and more reliable printed structures.

25. Finite Element Modeling of Traumatic Brain Injury During Helmeted and Non-Helmeted Ground Impacts in Bicycle Accidents

Sujata Ghimire, UNM

Madura Pathirage, UNM

Head injuries are one of the most severe outcomes of bicycle accidents, and understanding their mechanics is essential for improving safety. This research investigates the effectiveness of bicycle helmets in mitigating traumatic brain injuries (TBI) during ground impacts using finite element analysis. Although experimental studies have demonstrated that helmets reduce impact severity, computational modeling provides a controlled approach to quantify this protection under realistic conditions. In this study, a detailed headform model was developed in Abaqus, consisting of separated skull and brain components, and combined with a digitized helmet model featuring distinct polycarbonate outer shells and expanded polystyrene (EPS) foam liners. Impact simulations were conducted for both helmeted and non-helmeted conditions by applying identical velocities against a rigid surface. The results showed significantly lower stress, acceleration, and Head Injury Criterion (HIC) values in the helmeted case compared to the non-helmeted case, demonstrating the helmet's ability to absorb and dissipate impact energy effectively. These findings emphasize the critical role of helmets in preventing severe head and brain injuries and contribute to public awareness of helmet usage as a life-saving measure.

26. From Invasive Weed to a Resource: Evaluating Salsola tragus Potential Through Undergraduate Research

Audrey Lee, UNM

Jake Greenberg, UNM

Salsola tragus, commonly known as Russian thistle, is an invasive species in North America but has been traditionally used in Middle Eastern medicine for its antibacterial, antifungal, and anti-inflammatory properties. Despite its global distribution, research in North America has focused mainly on its ecological impact, leaving its bioactive potential largely unexplored.

This study addresses that gap by evaluating extraction methods to isolate essential oils and organic compounds from Salsola tragus. Four solvent-based techniques were tested: ethanol Soxhlet extraction, ethanol-based solvent extraction, acetone, and isopropanol, alongside hydrodistillation and microwave-assisted extraction. Ethanol Soxhlet extraction yielded the highest efficiency at 2.9%, compared to 2.2% for ethanol solvent extraction. Water-based and microwave-assisted methods were found to be ineffective due to contamination and low extraction performance.

Literature indicates that the species shows high genotype diversity and complex hybridization, which may contribute to regional variation in chemical composition. These findings support future work in compound identification using mass spectrometry and bioactivity testing through in vitro assays to validate medicinal potential and compare regional chemical differences between North American and Middle Eastern populations.

This undergraduate-led project also highlights how research with local plants can enhance STEM education. By using accessible materials and low-cost methods, the project shows that undergraduates can engage in meaningful chemical research. Integrating local flora into the curriculum promotes hands-on learning, increases engagement, and demonstrates that chemistry is not confined to labs but is part of the world around students, making science more inclusive and relevant.

27. From Phase Grounding to Intelligent Surgical Narratives

Ethan Peterson, NMT

Huixin Zhan, NMT

Video surgery timelines are an important part of tool-assisted surgeries, as they allow surgeons to quickly focus on key parts of the procedure. Current methods involve the surgeon filling out a post-operation (OP) report, which is often vague, or manually annotating the surgical videos, which is highly time-consuming. Our proposed method sits between these two extremes: we aim to automatically create a surgical timeline and narrative directly from the surgical video.

To achieve this, we employ a CLIP-based multimodal framework that aligns surgical video frames with textual gesture descriptions. Specifically, we use the CLIP visual encoder to extract representations from surgical video frames and the text encoder to embed the corresponding gesture sentences into a shared embedding space. We then train a linear probe to fine-tune this alignment, improving the matching between video gestures and textual tokens. Once trained, the model retrieves the top-matching gesture phrases for each clip, which are subsequently assembled into a coherent surgical timeline and textual summary. This approach leverages pretrained multimodal representations to bridge visual gestures and textual narratives, reducing the need for manual video review and documentation by surgeons.

28. Genomic Differentiation of Pathogenic N16961 and Non-Pathogenic PS15 Vibrio cholerae Strains: Identifying Antimicrobial Resistance Genes and Novel Virulence Mechanisms

Aida Rahman Maamah, ENMU

Manuel Varela, ENMU

Vibrio cholerae, a Gram-negative bacterium, is the agent responsible for cholera; a disease that leads to considerable morbidity and mortality globally. Pathogenic strains interfere with the balance of water and electrolytes in the gastrointestinal tract, resulting in severe diarrhea, whereas non-pathogenic strains are commonly found in aquatic ecosystems and do not cause cholera. Pathogenic V. cholerae strains exhibit distinctive genetic components associated with virulence, antimicrobial resistance, and metabolism that distinguish them from non-pathogenic strains. To test this hypothesis, we will conduct comparative genomic analyses between the pathogenic N16961 and non-pathogenic PS15 V. cholerae strains using whole genome sequencing data. We aim to identify variations in the core and accessory genomes present in N16961 but absent in PS15. These variations may encode virulence factors associated with colonization, antimicrobial resistance, and metabolic biosynthesis. Using BLAST and Autofinder, phylogenetic analyses will be carried out to compare the relationship between the PS15 strain and the pathogenic N16961 strain. The results will help us highlight unique genomic components that play a role in the pathogenicity and antimicrobial resistance patterns of V. cholerae. Discovering novel resistant genes and virulence factors may contribute to advancements in therapeutic approaches and enhance public health measures in response to cholera outbreaks. This study will also enhance our understanding of V. cholerae genomic diversity, bridging the gap between pathogenic and non-pathogenic strains while highlighting on their evolutionary adaptations.

29. Gravimetric Method for Vapor Pressure Determination

Charity Ohemaa Agyapong, NMHU

Joerg Kutzner, NMHU

The determination of vapor pressure is essential in understanding the volatility and intermolecular behavior of liquids. This study presents a modified approach to the traditional Dumas method to accurately determine the vapor pressure of volatile liquids like Methanol, Acetone and Ethanol. Eventhough the Dumas method effectively estimates the molar mass, it often produces deviations due to incomplete vapor condensation and unaccounted water vapor pressure. Based on this limitations, a gravimetric method to effectively determine the vapor pressure of volatile liquid has been modeled. The modified approach enhances accuracy and minimizes systematic deviation.

30. Green Reprieve: The Mitigating Impacts of Green Space

K. Brennan, CNM

C. Juarez, CNM

N. Pino, CNM

M. Will-Cole, CNM

Summers, and our cities with them, are only getting hotter. This trend is driven in part by the Urban Heat Island (UHI) effect, where urban environments retain and radiate heat. To investigate whether small-scale green spaces mitigate UHI in Albuquerque, New Mexico, a mobile transect study was conducted over a 12 week period in summer 2025. Three researchers collected environmental data along a 2.2-mile route with nine consistent stops, twice weekly and three times daily.

Air temperature, humidity, wind speed, surface temperature, and particulate matter were measured using three handheld sensors. Preliminary data analysis showed consistent diurnal variation, with peak surface and air temperatures recorded around between 2 and 3 PM. Asphalt was significantly hotter than vegetated or soil surfaces by an average of around 40 °F, but no clear numerical correlation was observed between park green space and reduced air temperature. Despite this, researchers consistently perceived thermal relief when passing through shaded parks, highlighting a potential mismatch between short-term measurements and human heat perception.

These findings suggest that while localized handheld data may not fully capture the cooling effects of small green spaces, they remain important for thermal comfort and health outcomes. Future work should include more heterogeneous transects with denser urban cores and parking lots, as well as shaded versus unshaded measurements under tree canopy. Integrating GIS or satellite imagery could strengthen spatial analysis and connect microscale field data with broader patterns relevant for urban planning and greening initiatives. This research was funded by NSF grant 2246468.

31. Ground Temperature Reduction of a Common Desert Bush

Jacob Tafoya, CNM

Skye Hembree, CNM

Trinity Swisher, UNM

Melanie Will Cole, CNM

The Urban Heat Island (UHI) effect is a well documented phenomenon that affects every metropolitan area. Exposed dirt and ground can absorb a great amount of thermal energy that later gets released at night contributing to the UHI effect.. The city of Albuquerque, New Mexico, USA, is located in the Colorado Plateau Shrubland ecoregion and is considered an arid landscape. Because of this, the typical remedies of increasing greenery to lower the UHI effect may not work in a desert city that must also consider its water use. Our research looks into the temperature reduction potential of local desert shrubs. We focused on a species of saltbush known as Atriplex canescens that grows naturally along the bike path at the Alameda Open Space Trail. We measured the surface temperature and the area underneath shaded by the bush using an IR gun, along with the surface temperature of the dirt surrounding the bush in full sunlight. After comparing the data we noticed a reduction in temperature in both the surface temperature of the bush and the shaded ground underneath the bush relative to the sunny dirt nearby. This temperature reduction of desert bushes can be of use for arid cities because they can utilize them as a cost effective and low water use form of greening to reduce the impact of the UHI effect. (NSF Grant Award 2246468. M. Will-Cole PI)

32. Hot in the City: Response to Northern Albuquerque's Urban Heat Island in Migratory Hummingbird Populations

Skye Hembree, CNM

Jacob Tafoya, CNM

Alex Maruszak, CNM

Trinity Swisher, CNM

Alyssa Johnson, CNM

Melanie Will-Cole, CNM

Like their bee counterparts, hummingbirds serve as important pollinators in North American ecosystems in part due to their seasonal migrations. Previous studies have mapped these migrations to see any trends induced by changing climate. However, the Southwest remains unexamined by this type of research, specifically in how hummingbird migrations relate to the Urban Heat Island effect. Our research focuses on these migrations in Albuquerque, New Mexico, a known hummingbird migration 'stop'. A small area within Albuquerque was chosen for this study as it provided a relatively untouched habitat along the east bank of the Rio Grande river next to a traffic-controlled street that showed substantial automobile concentration. A route along the border of this area was traversed twice weekly at three selected times each day over the summer. During these excursions, sensors were used to measure relative humidity, heat index, CO2 levels, and more. This was then compared to hummingbird sightings along the route and composition of the surrounding areas. Preliminary results suggest local hummingbirds somewhat avoid the urban side of the studied area. This trend remains even if strategically placed food sources are available in both urban and non-urban sub-areas of the transect. Additionally, observational patterns indicate an unwillingness to engage in behaviors such as insect-feeding and mating displays outside of the non-urban, riverbank section. These findings highlight an importance in the protection of migrational 'corridors' through urban areas in order to preserve pollinator populations as failure to do so could result in the decline of indigenous plants.

This work was supported by NSF Grant Award 2246468

M. Will-Cole PI

33. How do New Mexicans adapt to climate change?

Clinton Owusu, NMSU

Sawssan Boufous, NMSU

Brian Hurd, NMSU

New Mexico's climate is becoming warmer and drier due to regional and global warming trends, with earlier springs, warmer summers, unpredictable winters, and altered precipitation patterns marked by severe droughts and increased rainfall compared to snowfall. Moreover, climate change costs over $150 billion to the State in terms of economic impact, and $5.3 billion during the past 42 years (E2, 2022). Since the vast majority of New Mexico's land is farmland covering over 40 million acres and 78% of the State's counties are identified as rural, understanding the rural population's perceptions of climate change is crucial to developing efficient mitigation strategies to preserve the State's natural resources that support its agricultural strengths and improve its economic attractiveness.

In this study, we use survey data of individuals from rural New Mexico to (a) determine how they perceive climate change; (b) assess their knowledge of climate change concepts; and (c) portray individuals who adopted adaptation strategies. Daily behavior is expressed by four actions: recycling, energy saving, less food/clothes waste, and cleaning. Three main hypotheses are tested in this study: H1: Climate change perceptions are equally influenced by demographic characteristics and peer counseling; H2: New Mexicans lack literacy regarding current private & public efforts addressing the issue; H3: Adaptability behavior is influenced by place attachment, education, and gender.

Preliminary findings show that female respondents who perceive climate change happening and are attached to New Mexico are more likely to change their behavior and adopt more sustainable daily practices to accommodate climate change.

34. Impact of Science Communication Workshop on Researchers

Sumanth Reddy Nandhikonda, NMSU

Rigesh Krishnaraj, NMSU

Suparna Chatterjee, NMSU

Effective communication plays a crucial role in bridging the gap between scientific understanding and public perception. Many STEM (Science, Technology, Engineering and Mathematics) professionals struggle to translate complex ideas into accessible language, underscoring the need for communication training. The Decoding Science Communication Workshop for 23 participants (Ph.D students, postdoctoral fellows, staff and faculty) was implemented to strengthen the ability to convey research work with clarity and confidence, and engage the audience. This research explored: Participants' (1) Prior knowledge about the concepts, practices, and importance of science communication (2) confidence in communicating research effectively to people outside the research field, and (3) perceived usefulness and overall participation satisfaction. Evaluating pre-and post-workshop surveys measuring the marked increase in self-rated knowledge (from ~5.3 to ~8.5 out of 10) indicates that participants learned new content such as message framing, storytelling, audience presentation and engagement strategies, and design principles. Results for self-rated confidence pre-workshop ($M = 3.30$, $SD = 0.07$) and post-workshop ($M = 4.2$, $SD = 0.12$), showing a notable increase in participants' confidence in communicating their research to others from diverse fields of study. Post-survey Likert ratings demonstrated high satisfaction and perceived usefulness ($M = 4.6$, $SD = 0.4$). Applied confidence was further observed during several activities such as "Telling Your Story" and "Public Speaking" where participants demonstrated clearer delivery, narrative flow, and audience engagement due to their learning experience during the workshop. Overall findings suggest that the interactive workshops effectively enhanced researchers' confidence in science communication and application.

35. Impact on Albuquerque's Urban Heat Island (UHI) from Construction Materials and Anthropogenically-Produced Aerosols/Greenhouse Gases

Lauren Hill, CNM

J. Bermudez, CNM

J. Johnson, CNM

M. Will-Cole, CNM

Urban Heat Islands (UHI) are metropolitan areas that experience higher-than-average surface temperatures (as compared to rural areas) which are generated from anthropogenic activities. Since UHIs may potentially elevate regional surface temperatures and negatively contribute to global climate change processes, the goal of this study is to assess the impact of radiative effects generated from anthropogenically-produced aerosols, greenhouse gases, and construction materials on the neighborhood scale within Albuquerque's regional urban heat island. This study was conducted from May to August 2025 using the mobile transect method along a 2-mile closed loop located north of the Albuquerque airport. UHI data was collected twice a week, three times a day utilizing hand-held environmental sensors. Additionally, a rural stationary weather station located in Tijeras Canyon was used to calculate the strength of the UHI effect/intensity (UHIE/UHII). Analysis of UHI data revealed construction material temperatures reaching 153°F and particulate levels reaching 22 µg/m3 in the airport area. As a result, Albuquerque experienced a UHII of 11°F during the measurement interval from May to August. These results suggest anthropogenic influences at the neighborhood scale are important factors in contributing to the Urban Heat Island Effect in Albuquerque. The results underscore the significant role of localized anthropogenic factors—such as building materials and emissions—in intensifying urban heat regional effects. By focusing on neighborhood-scale dynamics, the study highlights the need for targeted mitigation strategies in urban planning and environmental management to address the growing impact of UHIs in Albuquerque, New Mexico.
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36. In-Situ Resource Utilization for Lunar Construction: Engineering Geopolymer Materials with Lunar Simulant

Sina Fakhraei, UNM

Maryam Hojati, UNM

The high cost of transporting and handling construction materials to the Moon, coupled with its logistical complexities, necessitates the use of locally available resources to create sustainable lunar infrastructure. Geopolymer concrete, produced by alkaline activation of aluminosilicate-rich materials, is a practical solution due to the chemical similarity of terrestrial materials to lunar soil. This study investigates the feasibility of producing geopolymer concrete using lunar soil simulant LMS-1E (with maximum particle size of 1000µm) and its activation with sodium hydroxide and sodium silicate solutions. Samples were prepared with different curing methods, including ambient curing, one-day heat curing at 60°C, and heat curing at 60°C, and evaluated at ages of 3, 7, and 28 days. The same method was also performed for terrestrial materials with a finer particle size (smaller than 150 µm)To assess the activation of the designed geopolymer, the compressive strength of the materials was evaluated as a function of sodium silicate solution type (considering water content and pH), curing conditions, age, and particle size. This study specifically examines the influence of fine particles, curing at room temperature versus 60 °C oven curing, and the role of soil particles on both the fresh and hardened properties of geopolymer concrete. The findings are used to identify optimal mix compositions and curing strategies that enhance mechanical performance and microstructural stability, supporting the development of self-sufficient construction materials for lunar habitation.

37. Influence of Histidine Protonation in Liquid-Liquid Phase Transition for Elastin-Like Polypeptides

Henry Weeber, UNM

Sanjna A. Bhakta, UNM

Ashley N. Tafoya, UNM

Telmo Díez Pérez, UNM

David S. Peabody, UNM

Nick J. Carroll, UNM

Gabriel P. López, UNM

Elastin-like polypeptides (ELPs) are recombinant biopolymers that exhibit a reversible, thermally induced liquid-liquid phase transition from a soluble state to a condensed coacervate state. We have synthesized an ELP variant, H24, incorporating histidine residues to introduce pH responsiveness through modulation of histidine protonation. The objective of this study is to characterize the phase behavior of H24 across varying pH conditions and elucidate how protonation-dependent interactions influence its transition properties. To investigate this, we measured the phase transition temperature (Tt) of H24 at pH 6.5 and 8.5 using a UV–Vis spectrophotometer, monitoring turbidity changes across a range of temperatures and protein concentrations to determine how pH and concentration collectively affect temperature dependent phase behavior. Preliminary results indicate that both protein concentration and pH significantly influence the phase transition temperature of H24. These trends suggest that histidine protonation plays a key role in modulating phase behavior. Ongoing experiments will explore additional pH conditions to refine our understanding of this relationship. Together, these studies will help establish how pH-responsive residues can be leveraged to design tunable, environmentally adaptive ELP systems.

38. Integrating CO_2 Mineralization into 3D-Printable Cementitious Mixes: Effects on Rheology and Printability

Maryam Hojati, UNM

Hamideh Shojaeian, UNM

3D printing is emerging as a transformative technology in construction, offering rapid production, design flexibility, reduced labor, and lower material waste. As the industry seeks more sustainable solutions, integrating CO_2 mineralization into fresh cementitious mixes presents an opportunity to reduce carbon emissions. However, carbonation can alter the fresh-state rheology, affecting printability, and requires careful optimization of mix design. In this study, we integrated CO_2 mineralization into 3D-printable concrete mixes, investigating the effects of water-to-cement (w/c) ratio, flowability, carbonation duration, and the inclusion of a high-range water-reducing (HRWR) admixture on fresh properties. A printable control mix was selected, and variations in water-to-cement (w/c) ratio, flow, and admixture dosage were systematically explored. Rheological behavior was quantified through controlled shear testing, focusing on static and dynamic yield stress and plastic viscosity. Results showed that the HRWR admixture rapidly induced a snap-set mechanism, thickening the paste and hindering rheology measurements. Conversely, higher w/c ratios, in the absence of HRWR, extended carbonation time, allowing the mix to reach rheological characteristics suitable for 3D printing. Additional strategies, including optimized carbonation duration and admixture adjustment, were required to balance flowability, extrudability, and buildability. These findings demonstrate that CO_2 mineralization can be successfully integrated into 3D-printable concrete, provided that fresh mix properties are carefully controlled. By understanding the interactions between w/c ratio, admixtures, and carbonation kinetics, this research advances sustainable additive manufacturing practices in construction, offering a pathway to high-performance, carbon-utilizing cementitious materials with tunable rheology for extrusion-based printing applications.

39. Integrating Technology and Tradition: A Navajo Language Learning Platform

Taili Begaye, NTU

Emillo Mitchell, NTU

This study explores the preservation and promotion of the Navajo language through the development of a web-based crossword puzzle game. The game, which utilizes Navajo words, was created using HTML, CSS, and JavaScript. The interactive nature of the game makes it an effective tool for language acquisition, particularly among younger generations. By providing an engaging and accessible platform, the game facilitates the intergenerational transmission of the Navajo language, enhances cognitive functions, and strengthens community bonds and cultural identity. The integration of modern technology with traditional linguistic knowledge promotes linguistic diversity; and contributes to the preservation of (minority) languages. This project gave us a sense of pride and belonging within the Navajo community.

40. Intersecting Identities: How Ethnic Identity, Discrimination, and BMI Shape Internalized Weight Bias Among Hispanic College Students

Emily Sanders, UNM

Sarah Erickson, UNM

Amanda Cipolla, UNM

Internalized Weight Bias (IWB), when someone applies negative attitudes about individuals based solely on their weight or size to themselves, is a growing concern in the Western world and can affect anyone at any size (Lucibello, 2021., Pearl, 2014). Evidence suggests that Hispanic individuals may experience IWB differently than White individuals, such as desiring a curvy body shape rather than thinness (Khazuom, 2021), yet research often lacks diverse participants. IWB is linked to higher risk for eating disorders, depression, anxiety, less physical activity, and lower quality of life (Emmer et al., 2020, Dorsey et al., 2009; Emmer et al.). This study examined the relationship between IWB and BMI (Body Mass Index), generational status, ethnic identity, acculturation level, and perceived discrimination in a Hispanic sample of college students of all genders (N = 177). In a multiple regression (R^2=.25, $F(7, 167)$=7.83, p<.001), BMI was the strongest predictor of IWB (β=.43, p< .001). Generational status also significantly affected IWB; 1st (β = .14, p = .048) and 3rd (β=.16, p=.023.) generations had significantly higher IWB when compared to 4th generation. Ethnic Identity (β=-.08, p=.26), Acculturation (β=.01, p=.85), and Perceived Discrimination (β=.06, p=.36) were non-significant predictors. Findings suggest that Hispanic college students may be more vulnerable to IWB if they have higher weight and are of first or third generational status. Future studies should focus on understanding how generational status affects IWB among Hispanic college students. This understanding could help inform IWB intervention efforts among Hispanic college students.

41. Investigating the reactions between Biologically relevant Thiols with Carbonyl Compounds

Paris MIkem Yambali, NMHU

The research seeks to investigate the reactivity of some biologically significant thiols within cells (Cysteamine and Cysteine) with some carbonyl compound, majorly the intermediates of glycolysis and the TCA Cycle (Pyruvate, Alpha ketoglutarate and Oxaloacetate) and Glyoxylate. Biologically occurring thiols are involved in so many biological processes such as antioxidant protection, enzyme activity and redox reaction. In this study, we hypothesize the formation of a thiazolidine ring compound arising from the reaction between these thiols (cysteamine and Cysteine) and the carbonyl compounds. Thiazolidines have been investigated to have so many pharmaceutical importance and can also be used in peptide and protein modification. They also have strong antioxidant activities. All investigations were done at a physiological pH of 7.2 and a temperature of 37.5°C to mimic the human system. Calibration curves for all the 6 reactants and 8 products were performed and used for Kinetic studies using the UV-Vis spectrophotometer which shows a rapid reactivity between the thiols and carbonyl compounds. With the aid of NMR spectroscopy, both the reactants and products were studied and the data obtained showed the formation of the said thiazolidine ring compounds. Subsequently, the products formed from this reactions (Thiazolidines) will be run using a protein translation kit in order to establish whether or not the thiazolidine ring compounds can be incorporated into proteins just like amino acids are incorporated into proteins.

42. Klebsiella sp. responds to competition and resource limitation by altering growth rate and oxidative phosphorylation of ATP..

Marquez, RL, NMHU

Donley, DW, NMHU

Klebsiella pneumoniae and Klebsiella aerogenes are opportunistic pathogens commonly associated with hospital-acquired infections and known for rapidly developing antibiotic resistance. These bacteria are facultative anaerobes that alter their respiratory strategies in response to environmental conditions, including oxygen levels and nutrient availability. This study investigates how K. pneumoniae and K. aerogenes metabolically adapt to competition and resource limitation. We generated conditioned media by growing each species to plateau phase, then filtering to remove live cells. The resulting depleted media contained metabolic byproducts that simulate a competitive environment. We then examined the growth and metabolic responses of both species. Our results show that oxidative phosphorylation–based ATP production is significantly reduced in conditioned media, while glycolytic ATP production remains stable. Growth curve analysis revealed a biphasic pattern in unconditioned media: a rapid initial growth phase followed by slower growth. In conditioned media, both species grew at reduced rates, mirroring the second, slower phase seen under normal conditions. This indicates that metabolic adaptation, likely in response to environmental stress or resource depletion,shifts these pathogens into a low-growth, survival-oriented state. These findings suggest that Klebsiella species initiate a metabolic switch under competitive or resource-limited conditions, likely as a survival strategy. While further work is needed to determine the underlying molecular mechanisms, these data provide insight into how pathogenic Klebsiella species persist in hostile environments, offering a foundation for the development of new therapeutic strategies.

43. LC-MS Analysis of the Liquid Products of Electrochemical CO2 Reduction on Cu

Hailey Cruz, ENMU

Electrochemical CO2 reduction (eCO2R) offers a sustainable pathway to transform CO2 into valuable fuels and chemicals. While Cu has been demonstrated to be the only catalyst that enables the formation of both single- and multi-carbon products, characterizing liquid-phase products remains a major analytical challenge. Gas Chromatography-Mass Spectrometry (GC-MS) is well-established for gaseous products but often requires dilution or derivatization for liquids, which can limit accuracy. Liquid Chromatography-Mass Spectrometry (LC-MS) provides higher sensitivity, lower detection limits, and compatibility with non-volatile or thermally unstable compounds. However, this powerful LC-MS method is underutilized for analyzing the liquid products of eCO2R. Establishing a robust LC-MS method is essential for reliable identification and quantification of liquid products, particularly given their complexity and low concentrations. This work focuses on developing and validating LC-MS approaches that can improve product analysis and support the advancement of eCO2R. Our study aims to accelerate the adoption of LC-MS as a standard technique, ultimately enabling deeper insight into reaction mechanisms and better manipulation of the product-specific active sites that ease downstream separations.

44. LC-MS Characterizations of Algal Extracts By Soxhlet Extraction of De-Ashed Filamentous Algae

Antonio Heheatror, ENMU

The characterization of natural bioactive compounds from algal biomass has attracted significant scientific attention due to their potential applications in pharmaceuticals, nutraceuticals, and environmental remediation. Filamentous algae have gained significant attention as a sustainable resource for high value carbon-based materials, due to their high productivity, adaptability, and biochemical diversity.This study employs, LC-MS (Liquid Chromatography–Mass Spectrometry) to identify and profile chemical constituents extracted from de-ashed filamentous algae using the Soxhlet extraction technique. Prior to extraction, the algal samples undergo controlled de-ashing to eliminate inorganic impurities and enhance organic compound recovery. Mass spectral libraries from the LC-MS analysis, revealing the presence of diverse biomolecules including lipids, fatty acids, phenolic compounds, pigments, and secondary metabolites.This study demonstrates the efficacy of Soxhlet extraction coupled with LC-MS characterization in profiling complex algal matrices and provides valuable insight into optimizing extraction and conditions for isolating high-value compounds from algal biomass. The findings will contribute to the broader understanding of algae as a renewable source of biologically active compounds, supporting future applications in green chemistry, pharmaceuticals, and environmental biotechnology.

45. Low Body Mass Index Differences in Menstrual Cycle Hormones and Vascular Function in Pre-Menopausal Women

Courage V. Mawuko, ENMU

Matthew A. Barlow, ENMU

Differences in normal hormone regulation in women can impair cardiovascular function. In previous studies, poor vascular conductance and reactivity have been associated with abdominal obesity, high BMI, and low estrogen in pre- and post-menopausal women. Similar to post-menopausal women with declining hormones, pre-menopausal women with low BMI can presents with hormonal dysregulation, which remains understudied and may have negative effects on vascular reactivity. We hypothesize that low BMI in pre-menopausal women will attenuate the vascular responsiveness, including arterial dilation, blood pressure, and vascular conductance to working muscle during exercise. To test this hypothesis, we will examine participants on two visits during the menses and proliferative phases to determine the role of variable estrogen and progesterone levelss on vascular conductance. During the visits, we will have participants engage in both upper and lower limb exercises of dynamic handgrip and single leg knee kick while assessing blood flow and conductance with Doppler ultrasound imaging. We aim to understand the comparative effects of low BMI, and hormone concentrations in both sedentary and highly active women with low BMI. Plasma samples will also be collected to measure the concentrations of progesterone and estrogen during the two menstrual phases to determine how the lower levels of these hormones in young women influence vascular health. The research will also help contribute to our previous laboratory studies that have examined pre-menopausal women with abdominal obesity, metabolic syndrome, and diabetes all of which have resulted in significant vascular limb deficits.

46. Mechanical Transfer of 2D Graphene from Sapphire to Silicon Substrates

George Teifel, UNM

Angel Mata, UNM

Sakineh Chabi, UNM

This work presents the successful transfer of two-dimensional (2D) graphene flakes from a sapphire substrate to a silicon wafer using a PMMA-assisted mechanical method. Unlike chemical etching approaches, this technique offers a cleaner and more scalable route for integrating graphene into silicon-based platforms. Over recent years, a variety of transfer techniques have emerged—including wet transfer, etchant-free transfer, dry transfer, and laser-induced methods—but for this experiment, we selected mechanical transfer due to its simplicity and suitability for the experimental setting [1].

The process begins with the deposition of polymethyl methacrylate (PMMA) onto a pre-cleaned sapphire wafer, followed by spin coating and soft baking. Delamination is initiated by immersing the donor sapphire substrate in slightly warmed deionized water, allowing the PMMA/graphene film to float freely. This film is then carefully aligned and transferred onto the target silicon wafer. PMMA is subsequently removed in acetone and rinsed with isopropyl alcohol (IPA).

PMMA is widely used for such procedures due to its excellent mechanical stability, consistent coating uniformity, and ease of removal with minimal residue [2]. As illustrated in Figures 1 and 2, optical microscopy at 10× and 100× magnification confirms successful transfer and structural integrity of the graphene flakes. These results demonstrate that PMMA-assisted mechanical transfer is a reliable, reproducible method for preparing 2D graphene structures.

Compared to other available transfer materials and methods, this approach exhibited improved reproducibility, reduced contamination, and greater handling ease—making it especially practical for limited lab environments. Overall, this technique provides a foundation for scalable integration of graphene with silicon electronics, an essential step toward the advancement of next-generation microelectromechanical systems (MEMS), quantum sensors, and photonic devices. Moreover, this transfer method holds promise for adaptation to other emerging two-dimensional (2D) materials, including 2D silicon carbide (2D SiC), broadening its applicability in future material integration and device fabrication efforts.

47. Microplastic monitoring in the Rio Grande: A baseline study

Kaitlyn Rivera, ENMU

Patricia Cabrales-Arellano, ENMU

Stephanie Martinez, ENMU

Andrea Velazquez, ENMU

Zachary Mitchell, TAMUK

Berenice Moriel, ENMU

Oluniyi Fadare, ENMU

Microplastic contamination in the Rio Bravo/Rio Grande represents an emerging environmental threat with significant implications for both human health and aquatic ecosystems. As larger plastic debris degrades, it fragments into micro- and nano plastics that disperse widely through water systems, accumulate in organisms, and transfer along the food chain. Although the United States has implemented bans on certain microplastic sources, such as cosmetic microbeads, these pollutants remain highly persistent in the environment.

Despite growing global concern, data on microplastic contamination in the Rio Grande remains limited, with only two previous local studies confirming their presence. To address this gap, the present study serves as a preliminary investigation aimed at establishing a baseline for the average concentration of microplastics per liter of water at multiple sites along the Rio Grande.

Water samples were collected from ten locations between Las Cruces-New Mexico, and El Paso-Texas. Samples were filtered, and microplastics ranging from 500 µm to 5 mm were quantified using stereoscopic analysis. Their chemical composition was further characterized by Fourier Transform Infrared Spectroscopy (FTIR).

Our preliminary findings indicate that microplastic concentrations range from 3 to 84 particles per liter of water across the sampled sites. The most prevalent type of microplastic identified was fibers and fragments primarily composed of polypropylene. These results correspond to the first of four planned sampling periods and will contribute to building a more comprehensive understanding of microplastic distribution and sources in the Rio Bravo/Rio Grande system.

48. Modeling PCB126 Toxicity and Stem Cell Dysregulation in the Drosophila Gut

Sydney Covington, ENMU

This experiment exploits Drosophila melanogaster gut as a model system to investigate PCB126-induced stem-cell defects. Flies will be exposed to PCB126 in food media, and we will measure effects on intestinal stem-cell activity using lineage-tracing methodologies coupled with stem-cell specific promoter systems. Such methodologies will permit the visualization and quantification of proliferation and differentiation in control and PCB126 exposed animals.

Functionally, to measure organismal aging we will incorporate several lifespan assays including climbing ability and overall activity while also performing molecular assays related to oxidative stress, DNA damage, and mitochondrial function.

Drosophila is a genetically tractable organism, which allows for site-specific manipulation of stem cell populations and separation of cellular responses to PCB126. Moreover, 75% of human genes with characterized functions have orthologs in flies, which make it a quick, inexpensive model organism that is also translationally relevant. By combining cellular, molecular, and behavioral methodologies, this experiment will build mechanistic knowledge of PCB toxicity, and how it intersects with stem-cell dysfunction and aging.

49. Optimization of extraction of natural products from Ericameria nauseosa

Paniz Aghapour Maleki, UNM

Antimicrobial resistance (AMR) poses a global risk as pathogens evolve mechanisms that render standard and last-resort antimicrobials ineffective. Natural products have historically provided the foundation for many novel drugs. An underexplored reservoir of medicinal plant knowledge lies within the Indigenous knowledge systems of the Southwestern United States. This study focuses on Ericameria nauseosa (rabbit brush), a shrub traditionally used in Indigenous medicine for its soothing and antimicrobial properties. Essential oils were extracted from macerated stem, root, and leaf tissues using ethanol. Our results indicate no statistically significant difference in yield among tissue types; interestingly, when accounting for the number of days elapsed after collection, product yields from stems and leaves increased as more days passed after collection—a trend that is still under investigation. Future studies will analyze extracts via gas chromatography–mass spectrometry (GC–MS) to identify bioactive compounds, including terpenoids and aldehydes, associated with antimicrobial activity. The identified compounds will be further evaluated for efficacy against Gram-positive and Gram-negative bacteria.

50. Phytoremediation in Ground Crops to Reduce Heavy Metal Contamination

Amanda Hinton, ENMU

Corey S. Green, ENMU

Anuoluwapo Ogunleye, ENMU

Wildfires have been a devastating part of New Mexico's current and most recent past. The combined Hermit's Peak and Calf Canyon fires burned 342,000 acres of forest in 2022, making it the largest wildfire in state history. Wildfires directly affect the physicochemical and biological properties of soil and cause erosion, releasing a mixture of contaminants and heavy metals into groundwater and surrounding water bodies, causing health issues in humans and livestock. Ground crops have successfully removed metals from the soil through phytoextraction, but have not been tested as a remediation tool after wildfire. This study aimed to determine the phytoextraction potential of five commercially available plant species: 'Hatchita' Blue grama (Bouteloua gracilis), Arriba' Western Wheatgrass (Pascopyrum smithii), Broadleaf Industrial Hemp (Cannabis sativa L.), Cereal Rye (Secale cereale L.), the Hermits Peak Restoration Blend, and a five-species mixture comprising all the plants. Plants were seeded and transferred into 9.5L planters containing mixtures of heavy metals at two concentrations, low (5 mg/kg) and high (10 mg/kg). Metals used included chloride salts: Pb, As, V, and nitrate salts: Cu, Cr, Cd, Ni, Zn. Commercial Timberline topsoil was used as a control. Given the current growth stages of each species, 'Hatchita' Blue Grama is expected to exhibit a higher capacity for metal extraction compared to Arriba' Western Wheatgrass. At termination, due to biodiversity-driven resilience, the five-species mixture is expected to extract more metals from the soil at both concentrations.

51. Polyphenol-mediated bioinspired strategies for CO_2 mineralization

Leila shahriari, UNM

Tyrus Antonson, UNM

Sang Eon Han, UNM

Sang M Han, UNM

Maryam Hojati, UNM

Sungjin Kim, UNM

Carbon dioxide (CO_2) mineralization offers a promising pathway for sustainable carbon management by permanently converting CO_2 into valuable carbonate materials. However, achieving high conversion efficiency with controlled particle morphology and polymorphism is a significant practical challenge. Conventional mineralization methods often suffer from low CO_2 conversion efficiency and limited control over crystal phase or morphology. In this study, we developed a bioinspired mineralization strategy that combines tannic acid (TA, a plant-derived polyphenol) with ultrasonic irradiation. Drawing inspiration from marine biomineralization, this combined approach enables precise control over the calcium carbonate polymorph and particle architecture. The integrated TA–ultrasound system achieved approximately threefold higher CO_2 conversion and up to four times the product yield compared to conventional conditions. Mechanistic analysis revealed that TA and ultrasound synergistically enhance Ca^{2+} chelation, gas dissolution, and nucleation kinetics while stabilizing the metastable vaterite phase of $CaCO_3$. As a result, the process produces uniform spherical vaterite microspheres (1–2 μm) via ultrasound-induced microbubble formation, which provides localized nucleation sites and improves CO_2 uptake. Overall, this bioinspired, energy-efficient approach establishes a scalable pathway for fabricating high-purity vaterite, advancing CO_2 utilization toward sustainable materials manufacturing.

52. Robust Reinforcement Learning for UAVs under GPS Uncertainty

Jose Jimenez, ENMU

Jiangqi Hu, ENMU

Unmanned aerial vehicles (UAVs) are increasingly used for data collection due to their rapid deployment and high mobility. However, their performance can degrade in real-world environments where localization data, such as GPS signals, are inaccurate. Traditional optimization and learning-based approaches often overlook this uncertainty, leading to unreliable outcomes. To address this issue, we propose a robust reinforcement learning framework that mitigates the impact of GPS errors on UAV decision-making. By introducing a robustness parameter θ, the algorithm adapts to varying levels of localization uncertainty, enhancing stability and efficiency. Simulation results show that the proposed method significantly improves learning performance and operational reliability under imperfect GPS conditions, providing a more dependable approach for UAV deployment in uncertain environments.

53. Secure Fine-tuning and Watermarking with Genomic Foundation Models

Rakibul Islam, NMT

Genomic Foundation models like DNABERT-2 and Nucleotide Transformer are rapidly becoming core infrastructure for downstream tasks including promoter prediction. These models are trained on large multi-species genomic datasets, generalize well, and adapt quickly to new tasks. Given their resource-intensive development, verifying ownership is essential for protecting the intellectual property, integrity, and trustworthiness. However, two significant challenges remain: ensuring watermark stability under complex genomic conditions and restoring weakened watermarks. Backdoor-based watermarking is a secure, black-box method that embeds hidden behavioral triggers which persist after fine-tuning. We encode model-specific metadata into a unique nucleotide signature, flanked by boundary sequences for stability and specificity, and embed the composite trigger into selected regions of the training data. Further fine-tuning the model with trigger-based sequences produces a shift in the latent embedding toward a specific region. While predictions on clean inputs remain unchanged—thereby preserving both task fidelity and biological validity—this consistent behavior on triggered inputs confirms that the watermark has been successfully embedded. In summary, our proposed approach establishes a resilient identification framework that protects model provenance and enables the trustworthy deployment of genomic foundation models without requiring access to model internals.

54. SIRT1's Impact on Mitochondrial Calcium Signaling in Hair Cells of Danio rerio

Christiana Concepcion, UNM

Andrea McQuate, UNM

Hearing loss is a significant health problem in America, where 1 in 8 people ages 12 or older have hearing loss in both ears. Hearing loss often results from loss of hair cells, the sensory cells located in the inner ear responsible for converting mechanical vibrations into electrical impulses. Hair cells depend on mitochondria to support the necessary energetic demand. For instance, mitochondrial calcium signaling is fundamental for neurotransmission of the mechanical stimulus. SIRT1 regulates many metabolic processes, including stress responses, DNA repair, and inflammation. SIRT1 activation has been shown to protect hair cells from damage, though the mechanism is unknown. We hypothesize that SIRT1 alters mitochondrial calcium signaling in hair cells. To test this hypothesis, we tested how SIRT1 inhibition affects mitochondrial calcium uptake in response to potassium chloride (KCl). We found that SIRT1 inhibition slightly modified mitochondrial calcium uptake, however a more sensitive assay is needed. To this end, we will create a zebrafish model expressing ChRmine, a redlight-activated ion channel. We first used Gateway cloning to create a zebrafish vector containing ChRmine. Next, we will use microinjection to introduce the vector to single cell embryos. After screening for ChRmine expression and establishing a stable transgenic line, we will repeat our calcium imaging assay with SIRT1 inhibitors and measure the effects on mitochondrial calcium uptake. In the future, this work may pave the way for interventions that slow down age-related hearing and potentially develop drugs that modulate SIRT1 activity to protect hair cells from damage.

55. Study of Fluoride Removal with Biocompatible Materials from City-Supplied Water

DennAsia R. Cordova, ENMU

Mhahabubur Rhaman, ENMU

Fluoride is added to toothpaste to prevent cavities, but too much fluoride in drinking water can cause dental and skeletal fluorosis, neurological problems, and has been linked to cancers. In Roosevelt County, New Mexico, groundwater naturally contains high fluoride levels due to the local geology and prolonged drought. The city water supply contains an average of 2.61 ppm fluoride, which is above the World Health Organization's safe limit of 1.5 ppm. Current water treatment methods for fluoride are costly and inaccessible to local communities and farmers. Since agriculture in this region relies heavily on groundwater, fluoride contamination also negatively impacts soil quality and crop yields. Affordable and effective solutions are urgently needed. In this study, we tested natural, low-cost, and biocompatible materials—including powdered eggshells, oyster shells, snail shells, fish bones, animal bones, hay, and graphene—for their ability to remove fluoride from water. Calcium-rich materials, such as eggshells, were of particular interest because fluoride binds strongly to calcium ions, forming insoluble compounds that can be filtered out. We prepared and processed these materials, then measured their ability to reduce fluoride concentrations. Preliminary results indicate that eggshells and other calcium-based materials effectively remove fluoride from water, demonstrating their potential as accessible and sustainable filtration methods. This approach may offer an affordable option for communities in New Mexico and similar regions that face fluoride contamination in both drinking water and agricultural use. Keywords: fluoride removal, eggshell, biocompatible materials, water treatment, New Mexico

56. Study of the binding strength of binuclear metal complexes with serum albumin in water

Climesia Elikplim Soglohu, ENMU

Soglohu Climesia Elikplim, ENMU

Mhahabubur Rhaman, ENMU

Chemical messengers interact with proteins, triggering numerous biochemical processes. Therefore, the development of the first raw transition metal complexes that interact non-covalently with proteins in aqueous solutions is an emerging field for manipulating biochemistry. The metal complexes can play a structural vital role in inducing a particular protein folding. It can also block the active site of a protein. There is a need to develop small molecules that influence or inhibit protein interactions through selective recognition for biomedical purposes. Drugs binding to serum albumin are the critical determinant of their distribution and pharmacokinetics. In our research, the interaction study of binuclear metal complexes with serum albumin was designed. At first, a benzene-based polyamine macrocycle was synthesized from the Schiff's base reaction of Terephthaldehyde and 2,2'-diamino-N-methyldiethylamine in methanol, followed by sodium borohydride reduction. After that, the synthesized ligand was converted to binuclear Co(II), Ni(II), Cu(II), and Zn(II) complexes. The binding strength of binuclear metal complexes with serum albumin will be studied by monitoring the quenching of the protein's fluorescence upon the gradual addition of the binuclear metal complexes at physiological pH. Based on the type of metal ions, the structure and positive charge density will vary, which in turn will control their interactions with proteins in water. The titration data will be analyzed with the Stern-Volmer model. In this poster, the detailed work will be presented.Keywords: serum albumin, fluorescence quenching, binuclear metal complexes, waterAcknowledgment: This work acknowledges ENMU for supporting the Graduate student, Ms. Soglohu Climesia Elikplim.

57. Study of the removal of heavy metals with water-insoluble urea and thiourea-based macrocycle

Dudzilah Gifty, ENMU

Mhahabubur Rhaman, ENMU

Groundwater is a vital source of drinking water and supports agriculture and dairy farming worldwide. Unfortunately, both natural geological processes and human activities have contaminated groundwater with toxic heavy metals. These metals are especially concerning because they do not break down over time and can enter the food chain through contaminated crops and livestock, posing serious health risks. Effective removal of heavy metals is therefore critical, but existing large-scale filtration technologies are often too costly. In this research, we designed and synthesized urea- and thiourea-based macrocycles to remove heavy metals from water. The ligands were prepared through the reaction of 2,2´-diamino-N-methyldiethylamine with 1,4-phenyldiisocyanate and p-phenyldiisothiocyanate. These compounds will be tested for their ability to selectively extract uranium and compared against their interaction with more common metals such as iron and manganese. Our findings aim to provide a more cost-effective method for addressing heavy metal contamination in groundwater. This research has the potential to improve water safety, protect public health, and support sustainable agriculture.
Keywords: groundwater, heavy metals, remediation, macrocycles, water safety

58. Sustainable Wastewater Treatment Using Attached Algal Flow-way System

Dave Aponte, Clean Aqua Solutions LLC & SFCC

Jade Whiting, Clean Aqua Solutions LLC & SFCC

Stephania Arbeleaz, Clean Aqua Solutions LLC & SFCC

Daniel Moore, Clean Aqua Solutions LLC & SFCC

Ryan D. Welsley, SNL

Jenna Y. Schambach, SNL

Stephen Gomez, SFCC

The goal of this project is to deploy a prototype pilot scale algal-based water purification system. The system uses patented technology from Sandia National Laboratories (Algal Turf Scrubber) to remove nutrients from wastewater. Our project is to validate biological nutrient removal as tertiary wastewater treatment and to assess yields of associated biomass.

The Attached Algal Flow-way (AAFW) treats wastewater from the plant after primary and secondary treatment and local algae species are grown in the system. Hach nutrient test kits, a Hach Spectrophometer, and Hanna multiparameter meter are used to take daily measurements of ammonia, nitrite, nitrate, phosphorus, total water hardness, total alkalinity, pH, dissolved oxygen, electrical conductivity, oxidization-reduction potential and temperature. Biomass samples were taken in the first weeks of the trial to identify and quantify algal species by metagenomic analysis and carbohydrate and lipid profiles. Bi-weekly harvests are taken to assess yield. We will present preliminary results regarding nutrient draw-down from the headworks of the flow-way to the discharge, as well as future use-cases for the AAFW.

59. Synthesis of aldehyde terminated hexa(p-phenylene) for probing electron delocalization

Azure Clement Akutam, ENMU

As the demand for renewable energy solutions intensifies, organic solar cells (OSCs) are gaining attention as a clean energy option due to their lightweight design, long-term stability, and ease of production. Current OSCs exhibit power conversion efficiencies (PCEs) up to 19%; however, their efficiency in converting sunlight into electricity still lags traditional solar technologies. The keychallenge lies in the synthesis of new organic conjugated molecules that effectively harvestlight, transfer, and transport charges. This research explores the synthesis of a new molecule aldehyde -terminated hexa (p-phenylene) designed to improve the performance of OSCs. By adding aldehyde groups, the molecule can help charges move more efficiently and remain stable, which may lead to better energy conversion. These aldehyde groups also act as infrared markers, helping scientists' study how electricity flows through the material. This work aims to support the development of more effective and affordable solar cells, contributing to the future of sustainable energy.

60. Synthesis of carbonyl-terminated ladder-type hexa(p-phenylene) for probing electron delocalization

Timothy Asem, ENMU

Juchao Yan, ENMU

p-phenylene derivatives terminated with carbonyl groups and alkyl side chains with a molecular architecture featuring a rigid, ladder-like backbone composed of fused aromatic units have emerged as promising materials for application in organic solar cells (OSCs), owing to their exceptional thermal resilience and electrochemical stability. These characteristics make them attractive for enhancing the performance and longevity of organic photovoltaic systems. In this work, we propose the synthesis of hexa(p-phenylene) carbonyl-terminated compound as an effective spectroscopic reporter for investigating charge carrier behavior, offering advantages over currently synthesized alternatives such as tetra, penta (p-phenylene) nitriles. Also, this study aims to deepen our understanding of structure–function relationships in conjugated polymer materials and contribute to the rational design of next-generation polymeric materials for efficient organic photovoltaics.

61. Synthesis of Dicarbaldehyde-Functionalized Ladder-Type Tetra(p-Phenylene) for Probing Electron Delocalization

Marissa Meierdierks, ENMU

Clinton Arthur, ENMU

Juchao Yan, ENMU

With energy consumption continuing to rise globally, renewable energy sources are in increased demand. Organic solar cells (OSCs) pose an opportunity to generate more of the renewable energy needed to sustain this higher demand. Current OSCs are lightweight and stable yet exhibit low power conversion efficiencies (PCE, up to 22%) compared to traditional photovoltaic technologies. The obstacle arises when trying to synthesize organic molecules that can effectively harvest sunlight, transfer it, and transport the charges. This work focuses on the synthesis and characterization of a dicarbaldehyde-functionalized ladder-type tetra(p-phenylene). The target conjugated molecule has a co-planar backbone and a pendant carbonyl group as an infrared reporter, enabling a real-time study of electron delocalization by time-resolved infrared spectroscopy followed by pulse radiolysis. This study supports a fundamental understanding of charge transfer and transport pathways to improve PCEs for utilization in the emerging generations of OSCs.

62. Synthesis of Naphthyridine-Based Polyamine Macrocycle and Study of Sulfate Binding in Water

Devyn Ericksen, ENMU

Mhahabubur Rhaman, ENMU

Sulfate anion causes problems by interfering with the vitrification process used for nuclear waste management in the US. An excess amount of sulfate in drinking water causes health-related problems. In biological systems, sulfate is important in biosynthesis and protein binding. Because of their detrimental effect on health and the environment, various artificial receptors were synthesized to mitigate their adverse effects. To address these effects, artificial receptors have been developed to capture anions through noncovalent interactions such as N–H…anion, C–H…anion, and anion–π interactions. This research area is expanding with diverse acyclic and cyclic systems with different functional groups, such as urea, thiourea, ammine, and amide, that are capable of hosting different anions in solution and the solid state. Macrocyclic polyamines are promising because they carry positive charges through protonation and create a positive molecular cavity, are capable of binding anions in aqueous solution, and mimic many biological polyamines. In this study, we will synthesize a bipyridyl-based polyamine macrocycle using the Schiff base reaction between 1,8-naphthyridine-2,7-dicarbaldehyde and 2,2’-diamino-N-methyldiethylamine under high-dilution conditions in methanol, followed by NaBH4 reduction. The purified macrocycle was subsequently converted into a sulfate complex through reaction with the corresponding acid. Single crystals of the resulting complex will be grown to figure out the detailed structural characterization. The macrocyclic system effectively will encapsulate sulfate via multiple noncovalent interactions, including hydrogen bonding and anion–π interactions. These findings will advance the design of synthetic receptors for selective sulfate recognition, with potential applications in environmental remediation, nuclear waste processing, and biomimetic chemistry.

Acknowledge: This project acknowledges ENMU for supporting an undergraduate student.

63. Text Embedding Performance Evaluation

George Candal, ENMU

Essa Imhmed, ENMU

Eduardo Ceh-Varela, ENMU

In this study, we evaluate the effectiveness of several text embedding models in clustering Java code samples that represent root causes of different error types. We evaluated six text embedding models trained on both natural language and code using a dataset of 63,923 Java code samples categorized into 16 bug types. To preserve the semantics of the source code, no text preprocessing was applied. Embeddings generated by each model were clustered using k-means, with the optimal number of clusters determined via silhouette scores. We then assessed how well the clusters aligned with actual error types using the adjusted rand index (ARI). The CodeT5 model achieved the highest silhouette score (0.41 at 3 clusters), while GraphCodeBERT achieved the highest ARI (0.1789 at 2 clusters), indicating weak alignment with error types. Overall, these results suggest that while the tested text embedding models capture some structural patterns in the data, they do not effectively cluster code samples by error type.

64. The Benefits of Art Therapy: Facilitating Emotional Regulation and Trauma Processing

Aaliyah Celeste Martinez, NNMC

Art therapy is a creative and non-verbal therapeutic approach that supports emotional regulation and trauma healing. This qualitative study explores how licensed and certified mental health professionals use art therapy to help clients process trauma and build emotional resilience. Using a social constructivist framework, ten semi-structured interviews were analyzed using template analysis to identify common themes across participants' experiences. The findings revealed four main themes: art as a tool in facilitating body awareness through sensory and grounding practices, art as a symbolic body that externalizes emotional and traumatic material, art as a language that facilitates non-verbal and unconscious expression, and art as a client-centered modality unique to individual needs. Based on existing literature, the study highlights how art therapy improves processes such as emotional resilience, self-discovery, and healing. By analyzing their insights into strategies, tools, and client outcomes, this research aims to deepen the understanding of art therapy's role in mental health care and its particular use as a traditional talk therapy alternative for individuals who struggle with verbal communication.

65. The Biological Role of Garlic and Chile in Fighting Foodborne Bacteria: exploring natural alternatives to antimicrobial agents

Getrude A. Amoah, ENMU

Manuel F. Varela, ENMU

The growing risk of antimicrobial resistance (AMR) in foodborne pathogens, including Salmonella typhi and Escherichia coli, has generated interest in natural alternatives to conventional antimicrobial agents. Garlic (Allium sativum) and chile (Capsicum spp.) exhibit antibacterial properties; garlic contains allicin, which disrupts bacterial metabolism, whereas chile has capsaicin, which compromises membrane integrity. The antimicrobial activity of garlic and chile extracts may offer a natural alternative to antimicrobial agents in the fight against foodborne infections. The aim of this study is to assess the antibacterial effectiveness of garlic and chile extracts, both separately and in synergy, against S. typhi and E. coli. We hypothesize that garlic and chile extracts will demonstrate significant antibacterial activity against these pathogens, with their combined use resulting in synergistic effects that enhance their efficacy. To test this hypothesis, we will evaluate the inhibitory effects of these extracts on bacterial growth and survival through agar diffusion experiments, growth curve analyses, and biofilm disruption studies. We predict these natural compounds may function as viable substitutes for synthetic antimicrobial agents, mitigate the risk of antimicrobial resistance, and enhance food safety. This research will provide essential data, including the inhibitory effects of garlic and chile extracts on bacterial growth, their synergistic antibacterial activity, and their ability to disrupt biofilms, which will support subsequent investigations into the utilization of plant-derived antimicrobials in food preservation and public health.

66. The Impact of Optogenetically-Induced Spreading Depolarizations on Brain Tissue Autofluorescence

Braylen Elzy, NMHU

Briana Montoya, UNM

Andrew Boyce, UNM

Following a stroke, waves of electrical activity called spreading depolarizations (SDs) move through the brain, temporarily silencing normal brain function. These waves originate in areas with poor blood flow before spreading out into nearby healthy tissue, where they can have various effects. SDs are usually harmful because neural cells require a lot of energy to recover. This can worsen brain damage following a stroke, especially in regions already under stress. However, the relationship between spreading depolarizations, blood flow, and brain tissue metabolism is still not fully understood. This project aims to investigate the impact of repeated SDs on the cerebral (brain) blood flow, along with its relationship to markers of tissue metabolism called autofluorescence. Tissue autofluorescence describes the process where certain cells in the brain glow when exposed to a specific wavelength of light. Optogenetics, a process that uses light to control certain brain cells, was used to induce spreading depolarizations in genetically modified mice using a 470 nm light. Laser Speckle Contrast Imaging (LSCI) was used to track changes in blood flow, while fiber photometry was simultaneously used to measure changes in autofluorescence. Together, this approach will allow us to compare these two measurements in real time, to determine how they relate over repeated SDs. The results showed that changes in this fluorescent signal, likely related to FAD, a molecule involved in energy production, did not depend on the direction of blood flow yet still responded to each SD. These findings suggest that brain tissue metabolism can react to SDs independently of blood flow, supporting the idea that tissue autofluorescence could be a reliable, noninvasive way to monitor these waves. This study also helps improve existing understanding of when SDs may prove more harmful or beneficial after a stroke, while potentially guiding the development of better treatment approaches.

67. The Influence of Urban Microclimates on Summer Insect Activity in a High-Desert Ecoregion: A Case Study in Albuquerque, New Mexico

Aleksandra N Maruszak, CNM

Skye K Hembree, CNM

Jacob Tafoya, CNM

Trinity Swisher, CNM

Melanie Will-Cole, CNM

Abstract:

Urban heat island effects create thermal stress for ectothermic organisms like insects, yet the role of fine-scale microclimate variation in mediating insect populations remains poorly understood in high-desert cities. This study investigated correlations between microclimate conditions and insect abundance across three distinct urban sites in Albuquerque, New Mexico, during summer 2025.

Methods and Study Design:

Over four weeks of peak season we conducted weekly insect counts at three microclimates: a park near a large body of water (Microclimate 1), an impervious construction zone near a busy road (Microclimate 2), and an economically advantaged park-like residential area (Microclimate 3). Mobile transect methodology employed four sensors, among them - an IR-Gun measured surface temperatures, while Kestrel and AirBeam3 sensors captured air column temperatures along a 2-mile closed loop.

Results:

An economically advantaged, vegetated, park-like, residential site with designed watering system supported the highest insect abundance, exhibiting a strong positive correlation with mean weekly temperature, suggesting conditions remained within an optimal thermal range. Conversely, a site dominated by impervious surfaces, otherwise categorized as a construction zone, with a busy road situated nearby, showed suppressed insect populations and a weak temperature correlation, indicating chronic thermal stress that may have been caused by high car activity. Additionally, a significantly higher diversity of insect species was observed at the economically advantaged microclimate site. Results revealed humidity as the primary driver of insect abundance, with extremely strong positive correlations ($r=0.81$ to $r=0.95$) between humidity and insect counts across all sites. Hostile microclimate 2 consistently exhibited the

lowest insect populations throughout the study period, indicating chronic thermal and moisture stress. Microclimate 3 (economically dominant) demonstrated slightly elevated humidity levels even during dry periods, supporting higher insect abundance and functioning as a critical micro-refugia. A dramatic population increase occurred in weeks three and four across all sites, coinciding with monsoon precipitation and elevated humidity levels (48-53%). These findings demonstrate that green infrastructure providing moisture retention and wind protection is essential for sustaining insect populations, and is a critical mediator of insect population dynamics in arid urban ecosystems, creating vital micro-refugia amidst escalating summer heat due to climate change predictions. As anthropogenically caused climate change progresses, this study demonstrates that solutions such as implementing wild species of plants and community gardens significantly affect the living environment and create refugees for many animals alike.

68. The Role of Higher Education and Vocational Training in Technology Adoption Across Time: A Longitudinal Study Using PSID Data

Mithila Gubba, NMSU

Alwin Dsouza, NMSU

Suparna Chatterjee, NMSU

Abhishek Kumar, Flame University, Pune, India

As trade and vocational education gain national prominence amid rising college costs and the digitalization of the workforce, questions arise about how different educational pathways, particularly higher education and vocational training, shape technology adoption and employment outcomes. Using longitudinal data from the Panel Study of Income Dynamics (PSID), this study examines how these two educational tracks influence technology use at home and in the workplace. The research is guided by three key questions: (1) Are individuals with higher education or vocational training more likely to adopt and use technology? (2) Are they more likely to be employed and maintain stable job outcomes? and (3) Do higher education or vocational training influence intergenerational income mobility?

We anticipate that individuals with higher education or vocational training will demonstrate distinct patterns of technology adoption and digital engagement. Specifically, those with higher education are expected to exhibit broader and more intensive technology use, while vocationally trained individuals may show greater practical application of digital tools in work settings. Both groups are expected to have high employment probability, reflecting the complementary roles of theoretical knowledge and applied skills in workforce participation. Moreover, higher education and vocational training are expected to positively impact intergenerational income mobility by enhancing digital competencies and improving economic opportunities. Nonetheless, disparities across income levels, geographic regions, and demographic groups are expected to persist, suggesting that educational attainment alone may not fully bridge digital and economic divides. These findings will inform policies promoting inclusive workforce development and digital equity.

69. Thermally Responsive Smart Microcapsules for Enhanced Geothermal Energy Recovery

Abigail Coffman, UNM

Andrew Shreve, UNM

Nick Carroll, UNM

Undesired Preferential fluid flow through large fractures in geothermal wells, a phenomenon known as thermal short-circuiting, poses a major challenge to efficient and sustainable energy extraction by limiting control over heat exchange with the surrounding formation. To address this issue, we are developing thermally responsive microcapsules for the targeted delivery of polymer-based sealing materials designed to modify fracture permeability. Using droplet microfluidics, we fabricated monodisperse microcapsules and microparticles with diameters ranging from 100 to 500 µm, with shell thicknesses spanning from several hundred nanometers to multiple micrometers. These thermally responsive microcapsules exhibit the unique capability of initiating epoxy hardening by triggered delivery of hardener at elevated temperatures (~220 °C) under ambient pressure. This approach represents a promising strategy for mitigating thermal short-circuiting in geothermal systems and enhancing long-term energy extraction efficiency.

70. TinyML: Human Activity Recognition using Edge Computing for Wearable Devices

Maya Fisher, ENMU

Sarbagya Ratna Shakya, ENMU

The application and adoption of Human Activity Recognition (HAR) capable wearable devices in industrial and academic research have been increasing in recent years. One of the biggest challenges it has faced has been to make it more efficient to implement without the need for high-performance computing. The ability to train and compile data on edge devices without the need to connect to remote servers, cloud, or powerful computing devices for processing and analyzing data can provide an advantage in terms of factors such as response latency, data security/privacy, communication network efficiency, data transfer speed, and power consumption. In this research, we implemented the concept of TinyML for activity recognition using a transfer learning model trained on a publicly available dataset. We used TensorFlow Lite to reduce the size of the model to be able to deploy the model in microcontroller units of portable wearable devices for on-device intelligence.

71. Understanding and Mitigating the Impacts of the UHI Effect by Utilizing Native Plant Species

Trinity Swisher, UNM/CNM

Jacob Tafoya, CNM

Sky Hembree, CNM

Melanie Will-Cole, CNM

Life on Earth would be impossible and would not exist to the extent it does today without plants. The role that vegetation plays within the city of Albuquerque is crucial for mitigating high temperatures, and the implementation of more vegetation would significantly reduce the Urban Heat Island Effect (UHI). The progression of climate change has been shown to increase the effects of the UHI in Albuquerque, New Mexico. Temperature data collected from May 21st, 2025, to August 6th, 2025, near the Rio Grande and surrounding roads have shown a positive correlation between vegetation-dense areas and decreased temperatures of the surrounding environment. All data was gathered along a 2.5-mile closed loop transect near the Rio Grande River using four handheld sensors. Surveys were also conducted to analyze plant health and plant abundances throughout the transect. It was found that plants such as Populus deltoides wislizenii (Rio Grande Cottonwood) and Atriplex canescens (Four Wing Saltbush) contributed the most in decreasing the UHI effect by lowering surrounding surface temperatures and reducing the exposed area of heat-absorbent materials. Other small plants were measured but showed a negative correlation with reducing the UHI effect among different areas of the transect, and they did not provide enough shading to mitigate the impacts of the UHI effect. This study defines the positive correlation of plants in mitigating the UHI effect and encourages heavy implementation of increasing vegetation densities within the city. This work was supported by the NSF Grant Award 2246468

72. Understanding the distribution of Rio Grande Cooters and examining spatial variation in their bacterial microbiota

Zoe Hutcherson, ENMU

Drew R. Davis, ENMU

The Rio Grande Cooter (Pseudemys gorzugi) is an aquatic turtle native to the Rio Grande Basin of New Mexico and Texas, USA. Listed as Threatened in New Mexico and a Species of Greatest Conservation Need in Texas, the species' population status and distribution remain poorly understood. Recently, an environmental DNA (eDNA) study helped define the distribution of the Rio Grande Cooter in the lower Pecos River in Texas, adding to the growing body of literature demonstrating the utility and efficacy of these methods; however, these methods have not been used in New Mexico. As a species of conservation concern, maintaining the health of populations is an important objective of wildlife managers. Microbiome composition is commonly associated with individual fitness and is known to be influenced by a wide variety of host characteristics and environmental factors. Here, we aim to better define the distribution of the Rio Grande Cooter in New Mexico through eDNA and traditional surveys and examine individual health through microbiome analyses. Field surveys will include visual surveys, hoop-net trapping, and the collection and filtration of water samples to collect eDNA. Additionally, the capture of individuals will allow us to collect swabs to compare microbiome assemblages among host and habitat characteristics. Differences in microbiome composition could provide insights into the health and ecological interactions of the species. These efforts will enhance our understanding of Rio Grande Cooter distribution and population health, inform conservation strategies, and contribute to the recovery efforts for this imperiled species.

73. Unequal Heat: Pavement, Green Space, And Climate Justice In Albuquerque NM

Neil Pino, CNM

Eren Brennan, CNM

Christian Juarez, CNM

Urban Heat Islands (UHI) disproportionately impact disadvantaged communities that are often the first to experience the effects of climate change. In Albuquerque, New Mexico, temperature differences of up to 17°F have been recorded across the city, reflecting deep environmental and socioeconomic inequities. Ranked among the lowest U.S. states in health, education, and economic well-being, New Mexico provides a critical context for examining how climate and infrastructure intersect with justice.

This study investigates (1) how pavement materials—such as asphalt, dirt, grass, and gravel—influence surface and air temperature variation, and (2) how urban green spaces mitigate UHI effects across neighborhoods of differing socioeconomic conditions. Over 12 weeks (May–August 2025), data were collected along a 2.2-mile transect sampled three times daily, twice per week, using three handheld sensors to capture fine-scale temperature and climate variation.

Preliminary results show that paved surfaces, particularly asphalt and cement, retained the most heat, aligning with broader UHI models. Conversely, areas with tree canopy and vegetation exhibited cooler temperatures, though these cooling benefits were unevenly distributed and concentrated in affluent neighborhoods.

These findings underscore the decisive role of pavement and green infrastructure in shaping Albuquerque's microclimates. Addressing UHI impacts will require reducing heat-retaining surfaces and expanding equitable access to urban greening, especially in frontline communities facing the greatest exposure.

74. Urban Heat Island Data Collection and Sensor-Based Solutions in Albuquerque, New Mexico

Tyliah Padilla, CNM

Andres Cuevas, CNM

Horizon Guillson, CNM

As climate change intensifies, the Urban Heat Island (UHI) effect presents growing challenges for public health, infrastructure, and environmental equity in cities like Albuquerque, New Mexico. Collecting accurate environmental data is essential for understanding these impacts and developing effective climate-resilient planning strategies. UHI studies often rely on manual data collection using portable instruments, which has provided valuable insight into spatial patterns of heat exposure. However, these methods can be time-intensive and lack the automation needed for scalable, long-term monitoring. This project examined UHI conditions across a rural-to-urban gradient in Albuquerque and explored how a centralized, sensor-based system could enhance environmental data collection for future research. A 3-mile transit route was sampled twice weekly from May through August 2025, beginning at Piedras Marcadas Canyon Trail (rural) and ending in a neighborhood near a golf course (urban). Measurements were taken at three daily intervals—8:00–9:30 a.m., 2:00–3:30 p.m., and 7:00–8:30 p.m.—every 5–7 minutes using four handheld sensors. Data revealed clear thermal and air quality differences between rural and urban sites, with higher temperatures and reduced air quality in developed areas. These results underscore the importance of consistent, location-based monitoring. Building on this work, we are currently prototyping a Bluetooth-enabled mobile app to automate data collection, centralize analytics, and allow for real-time, geo-tagged UHI tracking. In parallel, an all-in-one environmental sensor is in the conceptual stage and seeking funding for development; At present, visual prototypes have been created; physical devices are planned as the next stage of development.By integrating multiple sensor functions into a single system, this proposed solution would reduce the need for multiple sensors, improve data efficiency, and create the capacity for global-scale UHI monitoring through connected networks. Such advancements would provide researchers, city planners, and policymakers with powerful tools for guiding climate-adaptive urban planning worldwide.NSF Grant Award 2246468 M. Will-Cole, PI

75. Urban Heat Island Effect Amplifies Cabin Temperatures in Parked Vehicles

Christian Juarez, CNM

Neil Pino, CNM

Eren Brennan, CNM

Melanie Will-Cole, CNM

The Urban Heat Island Effect (UHIE) causes cities to absorb and retain more solar energy than rural areas, raising surface and air temperatures due to heat-absorbing materials and limited green spaces. This study examines how UHIE conditions intensify the greenhouse effect inside parked vehicles—turning already dangerously hot vehicles into even more severe heat traps that pose growing public health risks as cities expand and global temperatures rise. While prior research has

shown that vehicles heat rapidly under sunlight, fewer studies have investigated how UHIE may amplify the internal greenhouse effect by elevating ambient and surface temperatures surrounding the vehicle. This study was conducted in Albuquerque, New Mexico. A 2.5-mile mobile transect was conducted to capture the inner conditions of parked vehicles and their surrounding environments. Data collecting occurred twice weekly across morning, afternoon, and evening periods. Results revealed that afternoons produced the most extreme cabin heat buildup, with evenings retaining significant warmth. Vehicles parked in dense urban microclimates consistently reached higher interior temperatures—especially on dashboards and seats—than those parked near green spaces. Weather and vehicle variables also played a role in cabin heat levels. Our findings show that UHIE amplifies cabin temperatures through the combined influence of environmental context and vehicle-specific factors. This supports the need for improved urban planning and heat-mitigation strategies. Utilizing these insights can reduce exposure risks and help build urban resilience to climate change—especially as heat-related illnesses and child fatalities in parked vehicles remain persistent risks across the United States.

76. Which Sources are Contributing? A Source Characterization of VOC Concentrations Outdoors in Albuquerque, New Mexico

Jaimie Ritchie, UNM

Anjali Mulchandani, UNM

Patrick Hudson, City of Albuquerque

Sheryne Morales, UNM

The prevalence of VOCs from manufacturing and other sources is increasing as industry develops, leading to higher exposure in industrial and environmental justice (EJ) communities, such as the South Valley of Albuquerque, a low-income, Hispanic region. In response to the community's air quality concerns, the City of Albuquerque began measuring Volatile Organic Compounds (VOCs) but has not reported the results due to data processing challenges. Many VOCs have adverse health impacts due to carcinogenicity and respiratory repercussions, but no ambient air regulations exist. The quantity of VOCs adds to the complexity of analysis, which can be simplified through source characterization. This project will conduct high quality data analysis with community input and communicate the results to the community to help them understand their air pollution.We hypothesize that VOCs from similar sources (industrial, construction, motor exhaust, etc.) will have similar trends in peaks and frequencies. We are conducting a variability analysis of 124 VOCs measured by GC-FID in the South Valley. We are performing source characterization of VOCs utilizing Positive Matrix Factorization (PMF), the results of which are being used to assess temporal variability of sources and analyze wind direction tendencies. This analysis will illuminate what emission sources may be contributing to air pollution in the South Valley and facilitate interpretation of future values measured at the site. The results will inform the community what is in their air, and the assessment process can be shared with communities elsewhere who are facing similar challenges.

77. Working with Hózhó

Horizon Gillson, CNM

Tyliah Padilla, CNM

Andres Cuevas, CNM

Erik Andries, CNM

Melanie Will-Cole, CNM

The Urban Heat Island Effect (UHIE) in high-desert climates poses growing challenges for sustainability, livability, and public health. Albuquerque, New Mexico, an arid, high-elevation city, offers an ideal setting to study how rapid urbanization amplifies UHIE in desert regions. While UHIE has been well documented in temperate metropolitan areas, rural and underserved regions remain understudied. Using Albuquerque as a proxy for the Navajo Nation, where data collection is often restricted, this research examines UHIE dynamics in desert environments.

From May through August 2025, a 3-mile closed-loop transect beginning at Piedras Marcadas Canyon Trail (rural) and ending near a residential neighborhood by a golf course (urban), on Albuquerque's west mesa, was surveyed twice weekly at three daily intervals. Four handheld sensors recorded air temperature, surface temperature, and air quality.

Results show consistent temperature and air-quality differences between rural and urban sites, with developed areas exhibiting elevated heat retention and particulate matter. These findings show how land use and surface materials intensify UHIE in arid settings. The study highlights the importance of localized monitoring and proposes mitigation strategies, such as xeriscaping, urban geometry optimization, and heat-conscious design, to guide sustainable development and inform future planning for the Navajo Nation.