UNDERGRADUATE RESEARCH DAY

MARCH 13, 2025

University of Missouri System

Dear Legislators,

As the state's only public research university, our students are provided unique opportunities to work alongside our talented faculty to conduct cutting-edge and groundbreaking research on our four campuses every day. These experiences, which range from science to medicine to the humanities, help to prepare our students for graduate and professional studies at prominent universities as well as careers in leading industries.

The University of Missouri System Undergraduate Research Day at the Capitol illustrates these student accomplishments and allows our elected officials to see, firsthand, the exciting innovations taking place at the University of Missouri–Columbia, University of Missouri–Kansas City, Missouri University of Science and Technology and the University of Missouri-St. Louis.

Enhancing student success and outcomes are central to our commitment to excellence in higher education. Thank you for joining us for this event and learning more about our undergraduate researchers who will also serve as the next generation of leaders.

Sincerely,

MUN Y. CHOI, PHD

President
University of Missouri

C. MAULI AGRAWAL, PHD

Chancellor
University of Missouri–Kansas City

MOHAMMAD DEHGHANI, PHD

Chancellor
Missouri University of Science and Technology

KRISTIN SOBOLIK, PHD

Chancellor
University of Missouri–St. Louis

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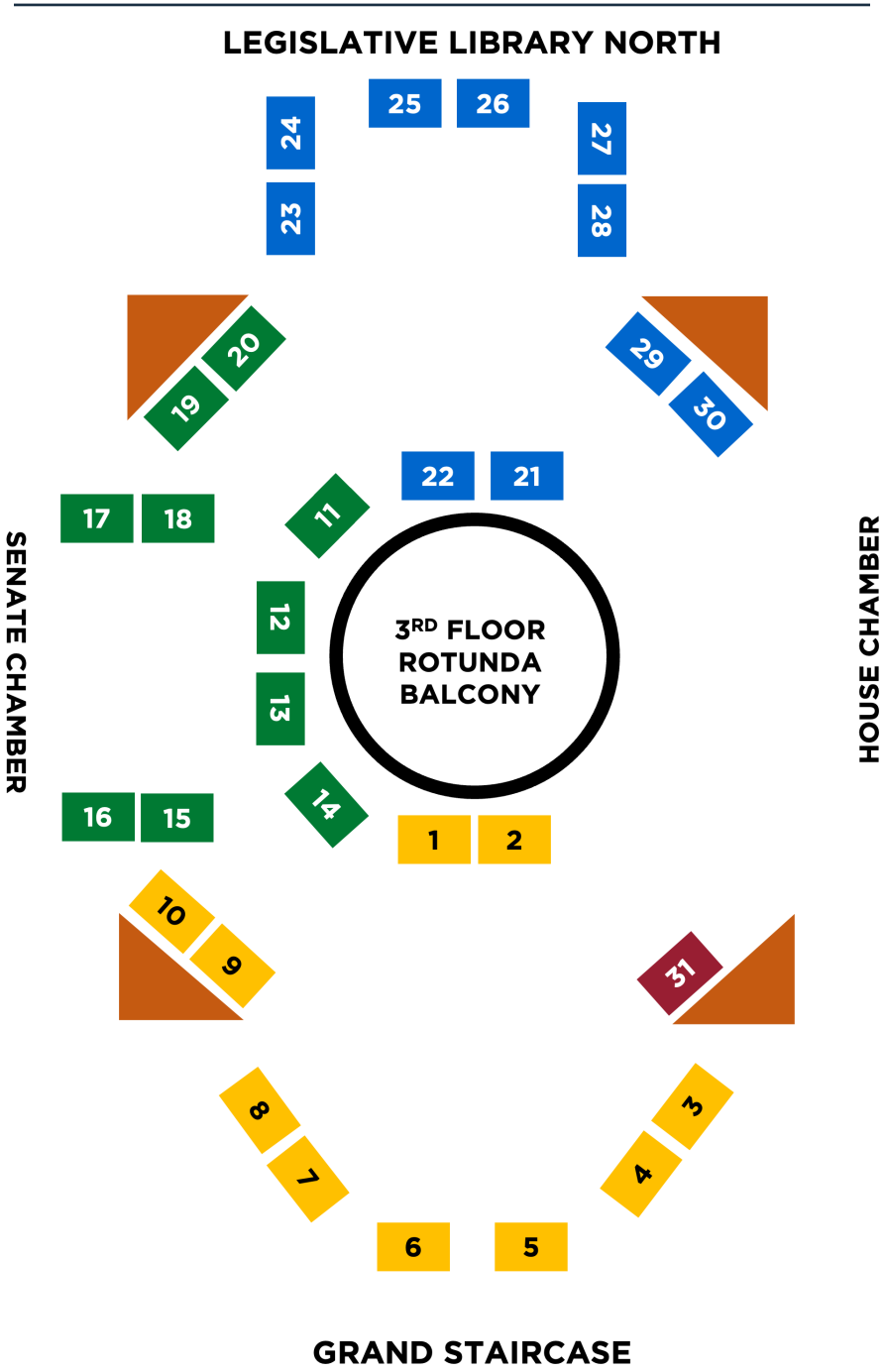
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SENATE CHAMBER
HOUSE CHAMBER
GRAND STAIRCASE

POSTER NO. 1

Regulation of Egg Quality and DNA Repair by the Cytoskeleton

AHMED EBADA

Columbia, MO

Senate District 19
House District 47

MAJOR
Biological Sciences

FACULTY MENTOR
Ahmed Balboula

MENTOR'S DEPARTMENT
Animal Sciences

Egg cells (oocytes) face environmental stresses (e.g., temperature, oxidation, water imbalance, etc.) during growth and maturation that can compromise their quality and reduce fertility (in animals and humans). The mechanisms that help oocytes manage stress and maintain their function are not fully understood. Using a mouse model of vitrification, a freezing and thawing process that induces oxidative and water imbalance stress, we investigated the role of the cell's structural proteins (F-actin and microtubules; MTs) in regulating cellular cleanup processes and keeping DNA intact. We found that vitrification disrupted F-actin and MTs, which coincided with a reduction in cellular cleanup activity. To confirm this connection, we used drugs to break down F-actin and MTs in non-vitrified oocytes and observed a corresponding decrease in cellular cleanup activity. Since cellular cleanup plays a critical role in DNA repair, we also assessed DNA damage and repair following vitrification. Mild DNA damage was detected immediately after thawing. Over time, this damage decreased as RAD51, a DNA-repair protein, was recruited to damaged sites. Vitrification caused slower RAD51 recruitment compared to chemically-induced DNA damage. Importantly, disrupting F-actin and MTs delayed the DNA repair process in both vitrification and chemically-treated oocytes, highlighting the involvement of these structures in cellular repair mechanisms. Our findings demonstrate a previously unrecognized role for F-actin and MTs in maintaining oocyte health by supporting cellular cleanup processes and DNA repair. This research provides valuable insights into improving fertility treatments for humans and production animals and understanding how egg cells respond to environmental stress.

POSTER NO. 2

Determining How Antidepressants Taken During Pregnancy May Affect the Mother and Offspring

DAVID ELLENBERGER

Branson, MO

Senate District 33
House District 138

MAJOR
Microbiology

FACULTY MENTOR
Cheryl Rosenfield

MENTOR'S DEPARTMENT
Veterinary School

Serotonin is a critical neurotransmitter involved in brain development in fetal animals and mood regulation in adults. Deficiency of serotonin during early development has been linked to issues like autism and anxiety in adults. During pregnancy, it is hypothesized that serotonin produced by the mother serves as the first source of serotonin for the developing fetus and is transferred to the fetus by a special protein that transports serotonin across the placenta. Selective serotonin reuptake inhibitors (SSRIs) are drugs commonly prescribed to pregnant women to manage depression. However, we predict that SSRIs may impair serotonin transfer from the mother to the fetus by binding to and inhibiting the serotonin transporter in the placenta. This disruption could cause an insufficiency of serotonin for the developing fetus, leading to neurobehavioral deficits and alterations to fetal brain and placenta functioning. To investigate this hypothesis, we created mice that lack the serotonin transporter specifically in the placenta (which is tissue made by the fetus). We predicted these mice, when compared to normal mice, would have different amounts of chemical signals present in placenta and fetal brain samples. To analyze neurobehavioral deficits, we used the Barnes maze to measure spatial learning and the elevated plus maze to measure anxiety-like behaviors. Our chemical analysis revealed no significant differences in serotonin levels in the fetal brain and placenta between the two groups of mice. However, fetal brains from mice lacking placental serotonin transporters had notably higher levels of epinephrine and metanephrine. The results from the behavioral tests show no changes in memory or anxiety-like behaviors for mice lacking the placental serotonin transporter. My research addresses a significant gap in understanding the effects of SSRIs on developing babies and has the potential to inform clinicians and improve outcomes for pregnant women and their offspring.

POSTER NO. 3

Tuning Peptide Amphiphile Micelle Properties for Anti-Cancer Drug Delivery Applications

EMMA McDOUGAL

Cape Girardeau, MO

Senate District 27
House District 147

MAJOR
Chemical Engineering

FACULTY MENTOR
Bret Ulery

MENTOR'S DEPARTMENT
Chemical & Biomedical Engineering

Current cancer treatments are infamous for their problematic side effects, which result from indiscriminate killing of healthy cells in addition to cancerous ones. To address this shortcoming, new classes of therapeutics must be developed to improve treatment efficacy and patient comfort. Protein-based therapeutics called peptides are a promising frontier, but delivery of these therapies in a living system is challenging because they are highly susceptible to degradation. Joining therapeutic peptides with fatty lipid tails yields modular peptide amphiphiles (PAs), which spontaneously congregate into peptide amphiphile micelles (PAMs) when exposed to water. The PAM structure, with the peptides positioned inside the structure, prevents degradation of the peptides so they can effectively destroy cancerous cells. Most previous work with PAs focuses on using only a few lipid types, particularly palmitic acid. My work examines six different fatty acids, exploring the impact that lipid-chain length and number of hydrogen atoms has on PAM anti-cancer properties, in an experimental human leukemia system. My preliminary findings show that extremely short fatty acids decrease the cancer-killing ability of this system compared to previous results. However, pentadecanoic acid seems to increase death of leukemia cells over the first forty-eight hours of treatment. Based on this work, newer lipids such as pentadecanoic acid can be used to improve material characteristics for drug delivery applications of PAMs, not only for cancer therapy but also a wide variety of other drug delivery applications.

POSTER NO. 4

Increasing power grid security using machine learning

BENJAMIN PETER

Kirkwood, MO

Senate District 24
House District 90

MAJOR
Electrical Engineering

FACULTY MENTOR
Mert Korkalo

MENTOR'S DEPARTMENT
Electrical Engineering & Computer Science

FUNDING SOURCE
College of Engineering Undergraduate Research Fellowship

Power grids are the backbone of modern society, supplying electrical energy for millions of homes and infrastructure critical to the security of the United States. These massive systems are operated and analyzed at various scales, ranging from interconnects spanning half the country to small-scale neighborhood distribution systems. Natural disasters like Hurricane Irma and the 2021 winter storm in Texas have led to significant blackouts, while many experts consider cyberattacks to be the biggest threat to grids across the United States. Human operators are insufficient at assessing massive amounts of data amidst catastrophic grid events; therefore, an efficient, rapid, and scalable method for assessing and heightening the security of power grids is needed. I created a program that uses machine learning to efficiently make critical decisions about how to reconfigure an electrical grid in emergency scenarios. Using a unique algorithm, we simulate various responses to grid events, such as a cyberattack, to test different power line switching options to avoid grid failure. I created this algorithm by combining various approaches from literature in the field. I tested the algorithm by simulating events to provide insight into the algorithm's proficiency and altered the machine learning parameters as necessary, eventually finding an approach which was >95% successful at avoiding grid failure across all test cases. While large-scale blackouts are uncommon in Missouri, our machine-learning enhancements could be implemented as a program working in parallel with human grid operators to take appropriate precautionary or responsive action to maintain optimal functioning of power grids.

POSTER NO. 5

Development of Theranostic Radiopharmaceuticals Using Tc-99m and Re-186 to Diagnose and Treat Cancer

NORA PRYOR

Lake Saint Louis, MO

Senate District 2
House District 108

MAJOR
Chemistry

FACULTY MENTOR
Heather Hennekens

MENTOR'S DEPARTMENT
Chemistry

FUNDING SOURCE
Internal funding, DE-SC00022550

The University of Missouri is one of the premier institutions in the nation for its chemistry research on radioactive materials, in part because the University of Missouri Research Reactor (MURR) provides on-site access to many radioactive elements. Radionuclides such as 177Lu, produced at MURR, are used in the fight against cancer because of their non-invasive, highly effective nature. Based on a radionuclide's mode of radioactive decay, it can either be used for diagnostic and/or therapeutic applications.

My research involves creating and testing new radiopharmaceuticals that can function as therapeutic and diagnostic pairs (known as a theranostic pair). Technetium-99m is the most widely used diagnostic radionuclide in the world, used for imaging of tumors. Rhenium-186, which is made at MURR, has similar chemical properties to 99mTc; however, its radioactive emissions can also damage DNA in cancer cells.

My project involves developing two drug scaffolds that can be tagged with either 99mTc or 186Re. To be a good radiopharmaceutical, my scaffolds will need to retain the radioactivity as well as direct it to the tumor site. My project involves synthesizing, tagging, and studying the stabilities of the four new radiopharmaceuticals in solutions that simulate the human body. I also investigate their affinities for water to determine how they will clear from the body. Ultimately, a theranostic pair where both imaging and treatment agents are metabolized the same way provides a more integrated patient treatment plan. My radiopharmaceutical research has the potential to save lives, right in the heart of Missouri.

POSTER NO. 6

The power of visibility in virtual communication

SYDNEY TURNER

Jackson, MO

Senate District 27
House District 146

MAJOR
Speech, Language, & Hearing Sciences

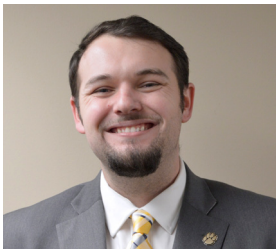
FACULTY MENTOR
Laura Morett

MENTOR'S DEPARTMENT
College of Health Sciences

Hand gestures are one of many important factors of effective communication. Gestures can be categorized into at least two types: 1) representational gestures depicting specific actions, objects, or ideas; and 2) rhythmic beat gestures that align with speech rhythm for emphasis. Previous studies have established links between facial cues, perspective-taking, and gestures; however, because of the rapid rise of virtual communication, I analyzed the gestures during videoconferencing to study the links individually. Sixty-six participants (speaker) watched a series of cartoon clips and individually described each clip to a research assistant (listener) using Zoom. The visibility of the listener and the speaker were experimentally manipulated during the interaction. Speakers could only see the listener's face or torso, or blank screen (the camera was off). Listeners could see the speaker from the torso up or blank screen. The speakers' descriptions of the cartoons were transcribed, and their gestures were coded. I found that, similarly to direct communication, speakers produced more representational gestures when they were visible to the listener than when they were not. However, when the listener's face was visible, the speaker produced a similar number of gestures as when the listener was not visible, which was different from face-to-face communication. Beat gesture production was similar across the various conditions. These results indicate the link between a speaker being visible to their listener and producing more gestures is stronger than the visibility of the listener. These insights could improve engagement during virtual meetings and inform strategies for public speakers and educators in virtual environments.

POSTER NO. 7

From Classroom to Community: The Role of Mentor Teachers in Supporting Missouri's Preservice Agricultural Educators



JARON VANHOUDEN

Oldfield, MO

Senate District 29
House District 140

MAJOR
Agricultural Education

FACULTY MENTOR
Rebecca Mott

MENTOR'S DEPARTMENT
Agricultural Education

Nearly 50% of K-12 teachers leave the classroom within their first five years of teaching. In Missouri, agricultural education faces a similar challenge, compounded by a shortage of agriculture teachers. These educators are especially crucial in rural areas, given agriculture's significance to Missouri's economy and community life. High school agriculture teachers operate within an intra-curricular model, requiring them to engage with students, parents, and community members. The purpose of my research was to explore how mentors help pre-service agricultural educators build connections with community members during their student teaching experience. Using Garland and Alestalo's Social Network Theory, my research identifies specific methods used by mentors during various school and community events to introduce student teachers to various stakeholders. To examine the nature of these connections and their perceived impact on the student teaching experience, my study included focus groups with student teachers from the University of Missouri, document analysis of communication materials, and field observations at community events. This research provides valuable information for teacher-educators and school administrators about how to improve teacher training programs to assist teachers in building robust social networks. This fosters stable, committed teaching staff, benefiting students, schools, and communities. My research could inform policies to address teacher shortages, enhance education quality, and build supportive networks for new teachers.

POSTER NO. 8

Machine Learning in Automated Oxygen Delivery to Neonate Babies

IZAIAH VASSEUR

O'Fallon, MO

Senate District 2
House District 107

MAJOR
Mathematics

FACULTY MENTOR
Roger Fales

MENTOR'S DEPARTMENT
Mechanical & Aerospace Engineering

In the Midwest, 10% of babies are admitted to Neonatal Intensive Care Units (NICU), where medical staff diligently monitor and care for their earliest stages of life. Within Missouri, NICU babies are cared for at a 4-to-1 staff ratio. With vital system regulation essential to a NICU baby's well-being, staff shortages exacerbate the difficulties found in fully staffed NICUs. Oxygen regulation systems used within NICUs are manually operated, resulting in babies being outside their prescribed peripheral oxygen saturation (SpO2) safe range 50% of the time. With low oxygen levels and high oxygen levels, babies are at risk of death and blindness. University of Missouri researchers have automated these oxygen regulation systems. While these systems can significantly increase time in the safe range to 80%, the clinical goal is to have infant oxygen levels in the safe range 99% of the time. This research uses a machine learning approach in automated industrial systems to improve infant oxygen-regulation systems. The algorithm uses information available through NICU bedside monitoring equipment utilizing health data to train a predictive algorithm to recognize shifts toward saturation events, increasing accuracy. Accuracy in predicting saturation events has increased to 75%, using data from 5 babies, with the desired goal being 95% to allow for accurate regulations of timespan a baby is in their SpO2 safe range. By increasing time neonatal infants are within healthy levels of oxygen, and decreasing NICU staff stress, the algorithm could potentially increase the healthy outcomes of the 7,500 babies admitted to NICUs in Missouri each year.

POSTER NO. 9

Improving Veteran Well-being: How Sleep Therapy Could Reduce PTSD Symptoms in Veterans with Alcohol Use Disorder

CHLOE VELCHECK

O'Fallon, MO

Senate District 2
House District 103

MAJOR
Biological Sciences

FACULTY MENTOR
Mary Beth Miller

MENTOR'S DEPARTMENT
Psychological Sciences

Many veterans struggle with both post-traumatic stress disorder (PTSD), a mental health condition triggered by experiencing or witnessing a terrifying event, and problematic alcohol use disorder (AUD). Some veterans drink alcohol to cope with their PTSD symptoms, which can create a harmful cycle. Knowing that poor sleep can worsen PTSD symptoms and contribute to alcohol use, this study explored whether a specific type of short-term therapy designed to improve sleep, Cognitive Behavioral Therapy for Insomnia (CBT-I), could help these veterans. We worked with a group of 51 veterans who reported both heavy drinking and trouble sleeping, randomly assigning some of them to receive five weekly sessions of CBT-I or general advice about healthy sleep practices, which we call sleep hygiene. We measured their PTSD symptoms and their reasons for drinking at the beginning of the study, immediately after the therapy, and again at a 3-month follow-up. We found that CBT-I was especially helpful for veterans who frequently drank to cope with their problems. Immediately after the therapy, those who used drinking as a coping mechanism and received CBT-I showed a significant decrease in their PTSD symptoms. Essentially, improving sleep through CBT-I also helped reduce PTSD symptoms. This research shows that addressing sleep problems through CBT-I can significantly improve the well-being of veterans struggling with both PTSD and problematic alcohol use. Through its effects on alcohol use and PTSD symptoms, insomnia treatments may be both effective and less financially straining in the ongoing effort to address public health concerns surrounding veterans' mental health.

POSTER NO. 10

A Breath of Fresh Air: comparing health promoting compounds between a forest and a city through the lens of forest bathing

RUTH WILLIAMSON

Raytown, MO

Senate District 9
House District 28

MAJOR
Plant Sciences

FACULTY MENTOR
Chung-Ho Lin

MENTOR'S DEPARTMENT
School of Natural Resources

FUNDING SOURCE
MU Office of the Provost, MU's Maximizing Access to Research Careers (MARC) Program via Grant T34 GM 136493

With a growing population, affordable and accessible public healthcare solutions are needed more than ever. Forest bathing is an East Asian medicinal practice that encourages people to experience nature using all their senses. Previous studies show that people who spent time in a forest experienced a wide range of health benefits, including reduced stress, improved immune system, reduced blood pressure, and improved brain health; however, the cause remains unknown. One hypothesis is that forest air, full of natural compounds given off by plants, interacts with the human body to promote well-being. These compounds, known as "phytoncides," are the plants' immune response to pests and predators. There is little information about which phytoncides humans are exposed to and the quantities present in forest and urban settings. Using a targeted analysis of 35 different health-promoting phytoncides, I designed an experiment to sample phytoncides from downtown Columbia, MO and near the McBaine trailhead.
For the collection, I used a coupled machine that functions like an electronic nose to detect minute levels of compounds from the air. To describe how these compounds fluctuated, I sampled during three different seasons and throughout the day. Preliminary data shows there is a difference in the amount and identity of these phytoncides between the location, time of day, and season. Going forward, I will continue to work on expanding the list of compounds and correlating what plants contribute to which compounds so as to inform city planners designing green spaces with health-promoting features.

MISSOURI S&T

POSTER NO. 11

Mitochondrial Introgression in Shiner Species

CARSON ARNOLD

Grandin, MO

Senate District 25
House District 153

MAJOR
Biological Sciences

FACULTY MENTOR
David Duvernell

MENTOR'S DEPARTMENT
Biological Sciences

FUNDING SOURCE
Missouri S&T's OURE Fellows Program

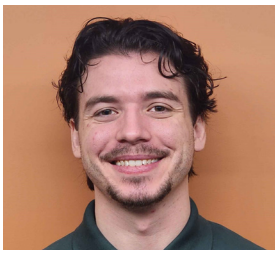
Hybridization is common among minnow species with historical precedent for mitochondrial introgression events throughout the Luxilus genius. Within the Ozarks historical hybrid introgression has led to the L. chrysocephalus mitogenome being replaced by L. cornutus. Also historically significant is the replacement of L. zonatus' mitogenome with L. chrysocephalus. This event was recorded within the Mermac and Gasconade River drainages, however the full range of the hybrid mtDNA was unknown. To determine this range the sampling was extended to the full extent of Luxilus zonatus' population within Missouri. With these samples, the ND2 gene within the mitochondrial genome was sequenced and used to sort the Luxulis specimens into a phylogeny. It was found that only Luxilus zonatus specimens from the Black and Current River drainages had mitochondrial DNA expected of the species and akin to its sister taxon. The remainder of L. zonatus specimens were found to have introgressed ND2 DNA of L. chrysocephalus, suggesting the range of the introgression between the two species was wider than previously recorded. This is interesting as it suggests that bleeding shiner mitogenome replacement predates the striped shiner genome replacement. Our results have practical implications as mitogenomes are commonly used for species detection and identification when applying environmental DNA metabarcoding.

MISSOURI S&T

POSTER NO. 12

The Deconstructed 555 Timer and Application Circuits for Interactive Educational Experiences

The Deconstructed 555 Timer and Application Circuits for Interactive Educational Experience offers interactional implementation of three fully discrete 555 Timer example circuits. The research project goal was to gain knowledge of the 555 Timer by deconstructing the device down to the component level. Three independent example application circuits, which showcase the application versatility of the 555 Timer in different modes, include Monostable, Astable, and Bistable circuits. Each mode has a hardware interface that can be used to adjust the operation of the 555 Timer allowing for a full interactive experience. The user can observe the differences in the internal working of the 555 Timer for the implemented applications. The built product is an educational and engaging interactive board which uses LEDs and OLED displays to describe the internal functionality of a 555 Timer and its application versatility. The undergraduate research concentrated on building skills in circuit design and product development.

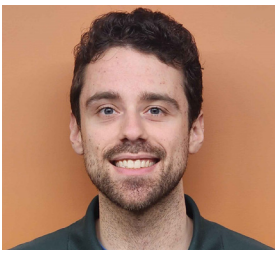


PRESTON CARROLL

Nixa, MO

Senate District 29
House District 139

MAJOR
Electrical Engineering

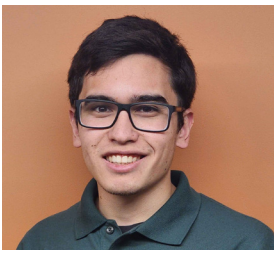


BENJAMIN CUEBAS

Springfield, MO

Senate District 30
House District 136

MAJOR
Electrical Engineering



JUSTIN FAUSTO

Pleasant Hope, MO

Senate District 28
House District 128

MAJOR
Electrical Engineering

FACULTY MENTOR
Rohit Dua

MENTOR'S DEPARTMENT
Electrical & Computer Engineering

FUNDING SOURCE
Missouri S&T and Bay Area Circuits

MISSOURI S&T

POSTER NO. 13

Lunar Surface Technology Research 2021 (LuSTR21)

BLAKE COFFMAN

Ballwin, MO

Senate District 15
House District 98

MAJOR
Aerospace Engineering

FACULTY MENTOR
Daoru Han

MENTOR'S DEPARTMENT
Mechanical & Aerospace Engineering

FUNDING SOURCE
NASA

This research project explores electrostatic sieving and magnetic separation for extracting valuable materials such as Au, Fe and Si from lunar regolith. Electrostatic sieving sorts different particles by their size, while magnetic separation isolates ferromagnetic components. These methods enhance in-situ resource utilization for sustainable lunar exploration.

MISSOURI S&T

POSTER NO. 14

Assessment of 1,4-Dioxane Phytoremediation by Determining In-planta Concentrations

KAYLEE DENBO

Rolla, MO

Senate District 16
House District 122

MAJOR
Environmental Engineering

FACULTY MENTOR
Joel Burken

MENTOR'S DEPARTMENT
Civil, Architectural & Environmental Engineering

FUNDING SOURCE
DoD - Environmental Security Technology Certification Program

Missouri S&T in a collaborative Department of Defense project aims to quantify 1,4-dioxane (1,4-D) in tree core samples related to an advanced phytoremediation project at the Twin Cities Army Ammunition Plant, Minnesota. The research group at S&T developed methods to measure 1,4D in plant tissues and to replicate the treatment approach in controlled experiments in the S&T Baker Greenhouse, to concurrently evaluate the growth and health of willow and poplar plants when grown in variable: growth media, bioaugmentation inoculations, and dosages of 1,4-D. The following materials have been utilized in reactors: willow and poplar cuttings, biochar, perlite, and Rhodococcus ruber DSM-44190. The plants are dosed with 1,4-D and the plant tissues are analyzed with Gas Chromatography-Mass Spectrometry (GCMS) to evaluate the in-planta concentrations above ground to assess the below ground biodegradation efficacy. Plant growth and health are also monitored and related to biochar amendment, growth conditions, probiotic inoculation with R. ruber DSM-44190 and pollutant exposure. Larger mesocosms have been initiated and will be dosed and will have in-planta analysis as well, while analysis of in-planta concentrations in living tissues has never previously been demonstrated.

POSTER NO. 15

Design of a Storage Heater for the Missouri S&T Supersonic Wind Tunnel

AIDAN DOLLAR

Hillsboro, MO

Senate District 3
House District 115

MAJOR
Aerospace Engineering

FACULTY MENTOR
Davide Vigano

MENTOR'S DEPARTMENT
Mechanical & Aerospace Engineering

FUNDING SOURCE
Future Research Pioneers Program (FRPP)

Supersonic wind tunnels accelerate air by expanding high pressure air through a converging diverging nozzle, trading a decrease in pressure and temperature with an increase in velocity. Accelerating the air up to Mach 4 decreases the temperature, so much so that it liquifies the air, making it difficult to perform tests and experiments. Therefore to accelerate past Mach 4, a heater is needed to increase the temperature of the air. This heater project aims to increase the temperature of the air in a range of 300 Kelvin (80F) to 1200 Kelvin (1700F), allowing speeds up to Mach 5. This is done by using a storage heater which uses a large mass that heats up over time, and can hold a stable temperature as air is passed through, heated up, then used in the wind tunnel.

MISSOURI S&T

POSTER NO. 16

Effects of Ally Confrontation on Target Outcomes

SOPHIE FIRLE

Festus, MO

Senate District 3
House District 115

MAJOR
Biological Sciences

FACULTY MENTOR
Jessica Cundiff

MENTOR'S DEPARTMENT
Psychological Science

FUNDING SOURCE
Missouri S&T's OURE Fellows Program

Everyday experiences of sexism in STEM are common and can lower women's sense of belonging, identity safety, and self-esteem. The purpose of this study was to examine whether the negative impacts of sexism could be mitigated if a male ally confronts the perpetrator vs. remains silent. Women STEM professionals (N = 311) imagined themselves in a scenario depicting everyday sexism in which a male classmate doubts their competence on a group assignment in STEM. Participants were randomly assigned to read that a male bystander either confronted the sexist behavior, remained silent, or there was no bystander present. Consistent with hypotheses, participants reported greater belonging and self-esteem when the bystander confronted vs. remained silent or was not present. Further, participants who perceived the incident as sexist reported higher identity safety when the bystander confronted vs. remained silent. Results suggest that ally confrontation can effectively mitigate negative effects of everyday sexism. Training interventions should focus on equipping individuals with the knowledge and skills to confront everyday instances of sexism.

MISSOURI S&T

POSTER NO. 17

Enhanced Soil Properties of Mine Tailings Using Arbuscular Mycorrhizal Fungi Combined with Biosolids and Biochar Sustained Phytostabilization

EMMA KETTLER

Festus, MO

Senate District 22
House District 114

MAJOR
Environmental Engineering

FACULTY MENTOR
Joel Burken

MENTOR'S DEPARTMENT
Civil, Architectural & Environmental Engineering

FUNDING SOURCE
Doe Run Mining, Missouri S&T

Revegetation poses an extremely cost-efficient solution to the remediation of mine tailings. However, appropriate amendments are required to promote sustained growth on these traditionally toxic substrates. This pot experiment aimed to examine the role of arbuscular mycorrhizal fungi (AMF) and locally available waste byproducts for their potential to support sustainable cultivation of ecologically viable native species on Pb/Zn/Cu tailings from a tailing's impoundment located in Viburnum, MO, USA. Substrates prepared by treating the top layer (10 cm) of tailings with different amendments including locally available biosolids as a primary amendment, alone or combined with biochar and native isolates of AMF, while the bottom layer (10 cm) left as untreated tailings. After a 6-year sustained growth period, the impact of amendments on physicochemical and biological properties was assessed. Prior to the research performed in this paper, phospholipid fatty acid analysis (PLFA) was performed on substrates associated with purple prairie clover (*D. purpurea*) cultivation. The findings of that study strongly indicate that AMF plays a critical role in the establishment of soil microbial communities, even in unamended tailings. Furthermore, the pattern of microbial community abundance indicates that roots of amended plants act as vectors of microbial community development, especially in tailings that do not traditionally support plant growth. The research performed in this paper primarily concerns the analysis of organic carbon (OC) concentrations in the soil in relation to the rooting depth of the treated plant. The results of this study, paired with the aforementioned PLFA data, strongly suggest the development of long-term substrate productivity at untreated depths as a result of surface-level amended phytostabilization.

MISSOURI S&T

POSTER NO. 18

Development of Perfusable Vascular Networks in 3D Printed Tissues Using Polymerization-Induced Self-Assembly (PISA) Printing

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FUNDING SOURCE
New professor startup funds, submitting to NSF and NIH

Localized drug delivery systems offer a promising solution for improving therapeutic outcomes in oncology and regenerative medicine by reducing systemic side effects and delivering treatments directly to targeted areas. This research explores the development of a novel solid-state material using Polymerization-Induced Self-Assembly (PISA) via Reversible Addition-Fragmentation Chain Transfer (RAFT) polymerization. The RAFT technique enables precise control over polymer chain architecture and properties, allowing the creation of physically cross-linked structures optimized for biomedical applications. The resulting materials demonstrate tunable degradation rates making them ideal candidates for controlled and sustained drug release. Furthermore, these materials are compatible with 3D printing technologies, facilitating the fabrication of complex, patient-specific drug delivery devices. This work highlights the potential of RAFT PISA materials to revolutionize localized drug delivery systems, advancing the fields of biomaterials and precision medicine.

MISSOURI S&T

POSTER NO. 19

Where Do Video Games Get Their History?

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FUNDING SOURCE
Missouri S&T
FYRE Program

The goal of this project was to determine how and where historical video game developers obtain knowledge, stories, and references to build their products. They are sources of media and should be studied just as books and movies. Our research compiled information from multiple developer studios and games across a variety of perspectives which demonstrate evidence of possible historical research, consulting, and sourcing. Early results yielded a wide range of results, as different studios, video game series, types of games, and sizes of companies all had different approaches to historical sourcing. As with many other products, the main goal is to generate revenue. Some studios utilize historical accuracy or correctness as a selling point, while others focus solely on entertainment value through other features. More often than not, games focused primarily on a story within a single-player campaign conduct more intense research with the goal of sending players back in time to experience a historical setting themselves. Many multi-player games are more concerned with how players interact with each other, and therefore, typically lack some of this research because history is not vital to making sales. Regardless of the extent to which a game tries to please the nitty-gritty historical accuracy experts, the common theme resulting from our research revealed many developers consulted other media, professional historians, the internet, museums, and on-site locations to obtain historical information.

MISSOURI S&T

POSTER NO. 20

ALC Lipid Nanoparticle Lung Cancer Drug Carrier Analysis

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FUNDING SOURCE
Missouri S&T's OURE Fellows Program

In recent studies polarized lipid nanoparticles (LNPs) have shown potential to advance the field of drug transport. ALC LNPs were the main method of drug transport used for the Pfizer-BioNTech's Covid-19 vaccine. This vaccine demonstrated the ability of LNPs and prompted further research into what other disease treatments could benefit from these methods. We synthesized the ALC LNPs by combining a stream containing a mixture of lipids and drug and a stream of citrate buffer in a microfluidic plate. In previously conducted research the ALC LNPs demonstrated an effective mRNA transfection efficiency (~93%) for human metastatic lung cancer. Inspired by these results we believe that the ALC LNP is a promising carrier for other drugs. We synthesized ALC LNPs containing a chemotherapy drug called Paclitaxel which were then analyzed and compared against free drug samples to obtain metrics such as size, zeta potential, drug encapsulation efficiency, in vitro drug release rate, and cytotoxicity. The findings indicate ALC LNPs are capable of encapsulating Paclitaxel effectively (85%) and successfully reduce cytotoxicity and controlled drug release. This suggests that the use of LNPs (particularly ALC) could enhance the therapeutic effect and also reduce the side effects of chemotherapy drugs by increasing circulation time and controlling drug release.

POSTER NO. 21

Custom-Trained AI for Substance Abuse Prevention

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Substance abuse prevention requires tailored, accurate, and responsive educational tools to effectively support families, individuals, and professionals. This poster presents a framework for developing a custom-trained AI model, leveraging Large Language Models (LLMs) and advanced techniques like Retrieval-Augmented Generation (RAG), to enhance substance abuse prevention efforts. The AI is fine-tuned using specialized datasets to address the unique needs of different audiences, including families, healthcare providers, and individuals at risk. Key features include customizable interfaces, integration with up-to-date scientific literature, and task-specific data training to improve relevance and accuracy. Data privacy, security, and legal compliance are emphasized to ensure ethical and responsible AI deployment. This approach aims to create an adaptive, secure, and effective digital resource that supports informed decision-making and fosters proactive substance abuse education and intervention.

POSTER NO. 22

The Vortex Funnel Elimination System and its Effect on Microsphere Production

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More than 1,600 people in Missouri are on a transplant waiting list. Tissue engineering uses a combination of cells and engineering to restore or improve different types of biological tissues, and the goal of tissue engineering is to dramatically reduce this number, or abolish it altogether.

Microspheres are small, solid spherical particles used to make scaffolds: small porous structures used for tissue engineering. While various microsphere production methods exist, the Büchi Encapsulator B-390 produces monodisperse microspheres (i.e., of the same size). But so far, in the lab's use the maximum yield for a given microsphere size has been limited to 60-70% in the desired size range of 106-180 µm. To prevent lumping of soft microspheres the collection solution is agitated by stirring, but the vortex formed during agitation has been affecting microsphere production. So, I hypothesized that by eliminating vortex forces in microsphere production, there can be a higher yield of microspheres in the desired size range. To eliminate the vortex forces I designed and 3D printed three 'column' models to shield the polymer stream from the vortex. This study showed that the microspheres made using all three models had a tighter size range than the control. For the model with the highest efficiency, about 82.7% of the microspheres produced fell within the desired size range (106-180 µm) vs. the control with only about 66.0%. The research showed that blocking the vortex with the column helps to reduce the microsphere's size spread during manufacturing.

POSTER NO. 23

Oral Literature In Modern Day Cusco: Language and Cultural Attitudes in Two Generations

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FUNDING SOURCE
SUROP (Summer Undergraduate Research Opportunity) Grant

Peruvian oral literature has an expansive history in the Andes region which dates back to the Pre-Columbian era. During the early Colonial period, these stories were translated from Quechua to Spanish, with some works being transcribed, such as the Huarochirí manuscript (1608) (Ballón Aguirre 531). Such documents became an important source for historiographic purposes as in Comentarios Reales de los Incas, by Inca Garcilaso de la Vega (1609). Later on, during the 20th century, anthropologists and intellectuals such as José María Arguedas documented the myths, legends and stories from Peru. This academic work is still active, with publications such as El Mito de Inkarri en Los Cantos Quechuas by Mauro Mamani Macedo (2021), on the myth of a returning leader. Now oral written stories have a tendency to change over time, or to become influenced by newer generations' cultural attitudes. This is because the effects of fictional narratives on oral narratives do increase over time (Markus Appel and Tobias Richter 2007). Current trends in the study of oral literature in Peru are focusing on changes in transmission and how age differences play a role in this phenomenon. This research aims to address how bilingual and heritage speakers of Quechua in Generation Z perceive and retain Quechua and Spanish oral literature and how their linguistic attitude has changed in contrast with their parents' generation by comparing the stories, myths, and legends of both age groups.

POSTER NO. 24

The Political Economy of Critical Material Acquisition: Regime, State, and Society

With states' technological advance and economic dynamism relying heavily on scarce critical materials, stable access to these materials becomes a strategic priority for governments. In this paper we develop a general framework for how variation in governance and property rights has a systematic and predictable impact on host states' ability to access and develop these materials. While assumed that quality of governance is the overriding factor driving successful and stable development, we draw on Acemoglu and Robinson's (2019) typology of the balance between state and civil society to develop predictions for material exploitation. In democracies, where state and society are balanced, neutral property rights facilitate the stable commercial development of critical materials which serve public interests. In contrast, in strong states with limited institutionalized civil society, property rights and development of critical materials is stable yet non-neutral, with benefits heavily favoring regime supporters. Lastly, in weak states where governments are unable to make and enforce stable rules, access to and development of critical materials will be unstable and often violently contested by non-state actors through violence. We apply our framework to three cases, Canada, China and Afghanistan, to illustrate our argument and trace the impact on stable access to these materials.

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POSTER NO. 25

The Effect of Alginate Beads on the Flow of PLA Microspheres During 3D-Printing

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Each year, around 2.2 million bone graft procedures are performed. This procedure leaves the patient open to risks of infection and rejection. In an attempt to lower these risks, researchers are looking into methods to regenerate bone tissue. Scaffolds, small porous structures created through extrusion-based 3D printing of microspheres, are utilized to stimulate bone growth. Scaffolds contain growth factors and other hormones that encourage tissue growth. Polylactic acid (PLA) microspheres are commonly used to produce the scaffolds. The printing of hard microspheres suffers from extrusion printing pressure fluctuations that require continuous adjustment throughout the process. The aim of the project was to establish whether using a combination of hard and soft microspheres helps to decrease the extrusion pressure as well as allow it to be more consistent.

PLA microspheres, mixed with alginate beads in a 1:1 ratio and a 3% carboxymethyl cellulose (CMC) solution, created the paste used for 3D printing of experimental scaffolds. Scaffolds 3D printed from PLA microspheres alone mixed with CMC served as a control. The addition of alginate microspheres mixed into the PLA microsphere paste allowed for a significant decrease in the extrusion pressure to 0.2-0.3 bar and created consistency. The control samples starting pressure was set to 0.8 bar and adapted up to 2.0 bar during the printing process. This study proved that using a combination of PLA and alginate microspheres leads to an easier material flow during the 3D printing process, utilizing less and more consistent pressure.

POSTER NO. 26

Appetitive Olfactory Memory Detection Utilizing Y-Maze Paradigm in Drosophila melanogaster

This project aims to investigate the mechanisms of associative learning in Drosophila melanogaster using a Y-maze appetitive olfactory conditioning paradigm, focusing on how flies form associations between specific odors (octanol/OCT, and methylcyclohexanol/MCH) and a sucrose reward. The study will build on established research that highlights the role of specific stimuli in associative learning, specifically olfactory conditioning in flies. The research question explores whether Drosophila can reliably form associations between odors and rewards and whether this varies with different odors. By using OCT and MCH as test odors, we will assess how flies' preferences are shaped by these associations. The significance of this research extends beyond basic insect learning, as it could inform broader understandings of neural circuits involved in memory and learning, offering potential applications in studying memory disorders and olfactory processing in higher organisms. Initial data suggests that flies show a clear preference for the CS+ odor-following training on the associated odor. Future trials will expand on these results, seeking to confirm the reliability and robustness of the odor-reward associations. Furthermore, these future trials will define the upper limits of memory retention with extended periods of time post-training/pre-testing. The expected outcomes will contribute valuable insights into how sensory and reward systems interact in the brain, with applications that reach beyond the Drosophila model.

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POSTER NO. 27

Habitat Relationship Between *Sigmodon hispidus* and *Microtus ochrogaster*

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The purpose of this study is to observe if a newly migrated species, the cotton rat (*Sigmodon hispidus*) competes with a species native to Kansas, the prairie vole (*Microtus ochrogaster*). Spatially-explicit capture-recapture analysis was used to determine if the two species segregate habitat.

Data was collected on a plot of 2 hectares for a period of 40 years. It was collected by recording the frequency of tagged mammals across 100 traps set up evenly through the plot. Program R was used to create population density maps of the months when there were significant populations of the mammals of interest (*Sigmodon hispidus* and *Microtus ochrogaster*). The maps show areas of greater and lesser mammal density through a difference of colors.

The results suggest that the populations of the cotton rat and prairie vole fluctuate throughout the year. The populations generally occupy the same areas even as the population numbers fluctuate. The change in population density over time implies that these mammals gravitate towards areas with abundant food and resources, and it suggests that the species may compete with each other for resources in the areas they occupy.

This data could be further used in a larger investigation to observe trends of the relationship between other small mammals in the habitat and temporal changes to the habitat itself. Using weather trends and this spatially explicit data, we can observe migration patterns by season and implications of the transfer of diseases the mammals may carry.

POSTER NO. 28

Insomnia & Nightmares; Effects on Suicide

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Previous research has separately shown that insomnia and trauma-related nightmares are related to suicide. However, the literature currently disagrees as to which is the true predictor of suicide, with some researchers suggesting that symptoms of insomnia explain the portion of the variance in nightmares. Thus, we sought to further explore this relationship by examining the effects of nightmares and insomnia on suicide in a model that accounted for each variable's unique influence. Methods: N = 117 participants completed questionnaires including self-reported insomnia total scores (measured via the Insomnia Symptom Index), frequency of trauma-related nightmares occurring monthly (measured via the Trauma-Related Nightmare Survey), and cognitions-related suicide (measured via the Brief Suicide Cognition Scale). A multiple linear regression was used to examine the effects of nightmares and insomnia on suicide while controlling for each variable's unique influence. Results: The regression analyses indicated that the overall model was significant (t = 7.61, p < 0.001). Within this model, we found that frequently experiencing trauma-related nightmares significantly predicted suicide cognitions (β=5.17, p < .05), as did insomnia symptoms (β=0.64, p < .001). Conclusion: Increases in suicide cognitions were predicted by both trauma-related nightmares and insomnia (while controlling for each variable's unique influence). These results lend evidence to the idea that both nightmares and insomnia independently impact suicide and that nightmares are not just an effect of insomnia. This is clinically relevant as it suggests two unique variables (insomnia & suicide) that could be targeted with interventions, with the overall goal of reducing the risk of suicide.

POSTER NO. 29

Monetary Sovereignty during the Debt Crisis: The Latin American Lost Decade

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During and after the COVID-19 pandemic, the level of debt incurred by governments around the world began to dramatically increase. This was exacerbated by US interest rate increases and has led to many poorer countries becoming increasingly financially vulnerable. These high amounts of debt have led many economists to question what may happen when the countries' governments default, and how it will affect their future development. However, there have been many periods in the past in which developing countries have defaulted on their debt. One of these periods was in the early 1980s, in which many countries in Latin America underwent a debt crisis that stalled their development, causing a "lost decade." My poster discusses how the Latin American debt crisis led to a loss of what is known as monetary sovereignty for the indebted countries, which is the ability for a government to implement its desired macroeconomic policy, and how monetary sovereignty can still be applied today to think about the consequences of a current debt crisis. I do this by analyzing the 1980s debt crisis and the lost decade that followed it in Latin America through historical data and scholarship from the period. Through this analysis, I conclude that to not harm the development of heavily indebted nations, their governments should be allowed to change the terms under which they repay debt, or simply have unpayable debt canceled so that they can have control over their futures.

POSTER NO. 30

New Evidence Towards Development of Non-Surgical Intervention for Birth Defects of the Face and Head

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FUNDING SOURCE
National Institutes of Health (NIH)
Robert Wood Johnson Foundation (RWJF)

Congenital anomalies, such as birth defects of the face and head, are the leading cause of infant death and pediatric hospitalization. Over 500 infants are born with birth defects of the face and head in Missouri every year, annually costing Missouri over $40 million for surgical correction. Greater understanding of the biological factors impacting face and head development will help researchers develop new, non-surgical therapies for patients, therefore decreasing the cost to Missouri to fund these invasive surgeries. Mutations in one such factor, Wnt family member 5A (WNT5A), results in Robinow Syndrome that is characterized by multiple birth defects of the face and head. Our objective was to determine the effect of a single supplemental treatment of WNT5A on facial bone development during bone mineralization.

Developing quail were injected with a single dose of extra WNT5A (eWNT5A) during early facial bone mineralization. Once their facial bones had mostly mineralized, their skulls were collected, scanned, and reconstructed into a three-dimensional rendering. Fourteen landmarks were placed on relevant anatomical features to quantify facial measurements. Unpaired, two tailed t-tests were performed to evaluate significance ($p<0.05$).

The treated quail had a significant shortening in their midface and premaxillary length, and demonstrated mild frontal bossing and an abbreviated, rounded premaxilla.

The facial differences noted in eWNT5A-treated developing quail resembled facial differences of patients with Robinow Syndrome. Further research on the role of WNT5A could provide information to develop non-surgical therapies for patients with Robinow Syndrome and other birth defects of the face and head.

UMSL

POSTER NO. 31

Effect of Diet On Hydrogen Sulfide Tolerance of Extremophile Fishes

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Poecilia Mexicana are a species of live-bearing fish that have adapted to surviving in hydrogen sulfide (H2S) abundant waters. Sites that are high in toxic H2S are also characterized by low levels of oxygen, making any organism that inhabits these tough conditions to be deemed extremophiles. Tolerance of these multiple stressors is impacted by numerous external environmental factors. The question being addressed in this study is if diet affects how well these fish tolerate H2S. I used 80 laboratory-bred female P. mexicana originating from two sulfidic and non-sulfidic population. Half of the fish from each population were separated into control and low-food groups. The low food group was fed three days per week while the control group was fed daily. The weights of the two groups were measured and compared at 30-day intervals. After a reduction in body mass is observed in fish from the low-food diet, all fish will undergo sulfide tolerance trials and results will be compared of the differing groups and populations. Results of these trials are still underway, but I expect to see higher H2S tolerance in the sulfidic population and for them to be less affected by a poor diet, as fish who naturally reside in sulfidic environments have lesser-quality diets.

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