2022 Section Abstracts

59th Annual Meeting

Central Methodist University

April 22-23, 2022

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Letter from the MAS President

On behalf of the Missouri Academy of Science (MAS) and Central Methodist University (CMU), I would like to welcome you to the 59th Annual Meeting in Fayette! MAS was founded in 1934 to serve as a regional outlet for a broad range of scholarship. We welcome poster and oral presentations in agriculture, atmospheric science, biochemistry, biomedicine, biotechnology, biology, chemistry, computer science, mathematics, conservation, geography, geology, geosciences, physics, engineering, science education and social and behavioral sciences. In addition to presentations by academic and professional scientists, we are particularly proud of the findings communicated by undergraduate and graduate students. Thank you all for supporting the MAS by attending and sharing your work with the broader scientific community in our region.

Our meeting opens on Friday, April 22, with the Missouri Junior Academy of Science State Competition. Middle- and high-school students will have the opportunity to showcase the work that they have completed over the past year. I want to thank these students, their families and their mentors for the effort that has gone into these research projects. I hope that you will be able to attend the Junior Academy and support our next generation of scientists. An awards ceremony held on Friday will highlight the most outstanding projects presented.

The Senior Division of the MAS will begin on Saturday, April 23, with poster sessions and a business meeting in the morning. After lunch, Dr. Dana Morris (CMU) will deliver our plenary session with a presentation entitled "Think Like a Bee: Creating Pollinator Friendly Landscapes." Afterward, oral sessions will be held. We hope that you will be able to attend all of these events.

I would like to close by thanking everyone involved in preparing for and making this meeting a success. On behalf of all participants, I want to sincerely thank CMU President Drake and Provost Gulstad for inviting us to hold our meeting on the CMU campus. Thank you to Dr. James "Tiger" Gordon for simultaneously serving as our local host and Senior Division Director. Thank you to Dr. Teresa Boman and Dr. Katie Kilmer for serving as Junior Division Directors. I also want to thank members of the MAS Executive Committee, Business Manager and Section Chairs/Vice Chairs for their efforts in making each MAS conference possible.

Again, thank you to all attending and participating in this year's meeting. I hope that you enjoy the presentations, and I hope to see you all at next year's conference in Joplin!

Regards,

Jim Campbell
MAS President (2021-2022)

About the Missouri Academy of Science

Scientists of the State of Missouri organized in 1934 to form the Missouri Academy of Science. By Apri16, 1934, a Constitution and By-Laws were prepared and on August 14, 1934, the organization was incorporated.

The purposes of this Academy were presented in the fourth "article of agreement" as follows: "This corporation is organized, not for profit but for the purposes of promoting the increase and the diffusion of scientific spirit, and of promoting cooperation between the scientific interests of Missouri. It proposes to accomplish these purposes:

a. By holding meetings for the presentation of scientific papers embodying the results of original research, teaching experience, or other information of scientific interest.
b. By fostering public interest in scientific matters, through open meetings, press releases and in such other ways as seem feasible.
c. By encouraging local scientific organizations in every possible way.
d. By promoting acquaintance in harmonious relationships between scientists in Missouri and among all who are interested in science.
e. By supplying, so far as finances permit, a medium for the publication of results of original work, particularly those of special interest in this state.
f. By concerning itself with legislation on scientific matters and providing opportunity for discussion of such legislation.
g. By working in any and all other ways which may prove feasible, for the advancement of science in Missouri."

The Academy held its organizational meeting on April13-14, 1934, with 250 people attending. At the December 1934, meeting, more than 400 people registered and by May 1935, there were approximately 750 members of the Academy. Statewide interest at a high level continued until activities made necessary by World War II caused disruption of Academy affairs except for some activity in the College Section.

Post-war revival of Academy activities started at a meeting on April 20, 1963, at Drury College. From the group of twelve persons who initiated the reactivation of the Academy in 1963, the membership has grown steadily to more than 800. Activities of the Academy have expanded to include the awarding of modest grants for projects proposed by high school and college students, and to sponsor the establishment of a Junior Academy of Science.

The Missouri Academy of Science is a non-profit organization and is supported solely by membership dues and donations. That is why we appreciate each new member and the current members who renew so faithfully each year. And it is because of their interest that the Academy continues its success as a fine scientific organization.

2022 Section Abstracts

Agriculture Section

Oral Presentations:

S.E. Svenson, Charles Nemanick Alternative Agriculture Garden, Department of Agriculture, Southeast Missouri State University. **NATIVE PERENNIALS FOR BUTTERFLY AND POLLINATOR GARDENS: SEVENTH YEAR PERFORMANCE IN SOUTHEAST MISSOURI.** Perennials native to Missouri were evaluated for survival, growth, and flowering from seventy-six to ninety-eight months after planting into a compost-amended urban soil in Cape Girardeau, MO. Twenty-eight container-grown plants of each species were planted in late August 2014 in a butterfly-shaped garden under full sun growing conditions. Two plots per species were planted in each wing of the garden, providing four replicated plots of seven plants of each species for analysis. During the seventh full year after establishment, only *Rudbeckia fulgida* var. *umbrosa* had 100% survival, excellent growth, and 100% flowering. Species having 75% to 86% survival, good growth, and 100% flowering during the seventh growing season included: *Eryngium yuccifolium, Eutrochium purpureum, Penstemon digitalis, Rudbeckia missouriensis, and Symphyotrichum oblongifolium. Ascelpias tuberosa, Asclepia incarnata, Echinacea pallida, Echinacea paradoxa, Echinacea purpurea,* and *Zizia aurea* had less than 10% survival, poor growth, and 100% flowering of surviving plants. *Amorpha canescens and Veronicastrum virginicum* had less than 50% survival, but living plants had good growth and flowering. *Rudbeckia fulgida* var. *umbrosa, Rudbeckia missouriensis,* and *Eryngium yuccifolium* have spread at the location, populating additional area in and around the experimental plots. None of the original *Coreopsis lanceolata* or *Glandularia canadensis* specimens remained alive in the seventh growing season. Data will help guide the selection of plant species used for urban or suburban butterfly and pollinator gardens in southeast Missouri.

Nolan Brown and Indi Braden, Department of Agriculture, Southeast Missouri State University. **EVALUATION OF A SOUTHEAST MISSOURI FARM MANAGEMENT PRACTICES USING GRID SAMPLING.** Today's agricultural practices involve applying technology to management decisions. Producers are faced with challenges to produce more yield and higher quality crops on less acres and with fewer resources. Use of technology and more site-specific management provides producers with options to consider all inputs on a smaller and more precise scale. Every decision made by producers impacts final yields, such as seed variety, fertilizer rates and timing, and pest management. For this project, a family farm in southeast Missouri will be evaluated to determine best management practices. Soil samples were collected on a 1-ha (2.5-acre) grid. The grid was developed using GIS (geographical information systems; ArcMap 10.8.1; ESRI). Locations were identified by latitude and longitude. Samples were analyzed for essential nutrients, pH, and organic matter. Maps including soil analysis will allow comparison of soil characteristics and management practices. Recommendations of best management practices will provide the producer with options for production while protecting environmental qualities.

Killian Delaney and Indi Braden, Department of Agriculture, Southeast Missouri State University. **SERICEA LESPEDEZA: A REVIEW**. Within the world of agriculture and natural resources, there are many different species that were once seen as a cure-all but are regarded as more of a nuisance now. This seems to be the case with Sericea Lespedeza (*Lespedeza cuneata*). This warm season legume was introduced for erosion control and wildlife habitat. Over time, this plant species has demonstrated competitive characteristics to become invasive and difficult to control. As a portion of an ongoing project with the Missouri Department of Conservation, this review will provide a foundation of past and current research published on Sericea Lespedeza. This review will include: the history of Sericea Lespedeza, such as where it first originated and why it was introduced to the United States as well as predicted advantages of the plant. The review will also include concerns regarding challenges of management and control of the introduced and invasive plant. While the field work is ongoing, this review will provide researchers and producers with a foundation for understanding the plant species and its management.

Z. Baker, W. Hiler, T. Owen. Department of Math and Science, Missouri Valley College. **EFFECTS OF AGRICULTURAL PRACTICES ON WATER QUALITY AND SUSTAINABILITY OF A CENTRAL MISSOURI WATERWAY**. Investigation of the water quality of the Salt Fork Creek in Saline County, Missouri has been ongoing, beginning in 2019, to better understand the effects and impacts from surrounding agricultural practices on this system. Recently, four Salt Fork Creek locations were sampled weekly from August 2021 - present for standard water quality parameters such as: pH, dissolved oxygen, temperature, total dissolved solids, conductivity, salinity, nitrate, and phosphate levels. It is hypothesized that fertilizer use in nearby agricultural fields increases nutrient runoff, modifies the water quality of the creek, and potentially causes eutrophication. Aquatic life is dependent on stable water conditions and humans have changed it drastically due to many factors such as: industrialization, urbanization, heavy fertilizer usage, etc. Disturbances in water quality can cause an overall loss of biodiversity. This research examines the influence of nutrient over-enrichment in a waterbody affected by agricultural practices. It has been found that a pH change of 0.75 units across sites and an increase in nitrate levels by 300% has occurred. In addition, the distribution and community composition of fish sensitive to water quality perturbances have been measured to correlate with the water quality findings. This data is part of a long-term study to understand the relationship between industrial agricultural practices and water quality in affected aquatic ecosystems.

Poster Presentations:

J. Addo-Chidie[a,]*and T. Hurisso[a], [a]Department of Agriculture and Environmental Sciences, Lincoln University. **WINTER COVER CROPS IMPACTS ON SOIL HEALTH AND WEED SUPPRESSION IN CENTRAL MISSOURI.** Recent surveys of Missouri vegetable farmers showed a growing interest in the use of cover crops as a management tool for weed suppression and soil health improvement. The objective of this study was to assess the suitability of winter cover crops for improved soil health and weed control in soils of central Missouri. In fall 2020, five individual cover crop species and all possible four-way mixture combinations of those species were planted at Lincoln University's George Washington Carver farm (38°3″N, 92°08″W; 178 m above sea level). Prior to termination of cover crops in the spring of 2021, aboveground plant biomass was collected to determine weed abundance. Following termination of cover crops, a suite of soil health indicators including total carbon (TC), total nitrogen (TN), permanganate-oxidizable carbon (POXC), mineralizable carbon (Cmin), autoclave citrate extractable protein (ACE protein) were analyzed on soil samples collected from 0-20 cm depth. Weed abundance was lower by more than 88% ($p<0.05$) under monoculture winter rye and hairy vetch cover crops than all other species considered in this study. However, growing cover crops alone or in combination did not alter any of the soil parameters (TC, TN, POXC, Cmin, or ACE protein). These results demonstrate that while winter cover crops, such as cereal rye and hairy vetch can suppress weeds more quickly, their benefits in terms of soil health improvement may only be obvious in the long-term. This work is financially supported by USDA NIFA (Evans Allen grant, Accession No. 1019603) and USDA NRCS (Award No. NR196424XXXXG010).

Atmospheric Science Section

Oral Presentations:

L. Orr[a], P. Market[a], and G. Mann[b], [a]School of Natural Resources, University of Missouri, [b]National Weather Service Detroit, National Oceanic and Atmospheric Administration.
DOWNDRAFT CHARACTERISTICS OF ELEVATED CONVECTION IN THE PRESENCE OF SIGNIFICANT MESOSCALE WAVE DISTURBANCE. On 13 April 2018, a series of strong storms passed through the states of South Dakota and Minnesota. The winds in these storms were amplified by the presence of gravity waves, which formed in eastern South Dakota and moved into mid-Minnesota. This case study focuses on the gravity wave passage through Sioux Falls, South Dakota (FSD) and used both observed data and 3-km experimental WRF model output to analyze the event. The gravity waves were observed using 1-minute surface pressure data and corroborated with radar reflectivity data. Approximate wave speeds were calculated for each. 1-minute observed pressure data from Sioux Falls, SD, Redwood Falls, MN, and Flying Cloud Airport, MN were obtained and plotted. Each of the consecutive stations showed a notable spike in pressure during the time in which the gravity waves were projected to pass over them, and the wave speed (23.3 ms^{-1}) was calculated from this method. Radar data depicting the motion of the line of significant convection past the FSD station was gathered and, once again, used to estimate a radar-observed wave speed (20.6 ms^{-1}). WRF model soundings taken from the FSD station at the time of wave passage were used to examine the stable layer of the atmosphere and calculate the phase speed of the wave (25.7 ms^{-1}), which provided a good estimate for the observed wave speed. The radar and sounding methods for calculating the wave speed correlated with the surface pressure approach, with wave propagation speeds centered around the observed 23.3 ms^{-1}.

B. Herzog. National Weather Service, St. Louis, **MO. CHALLENGES AND SUCCESSES OF THE OCTOBER 24TH, 2021 TORNADO OUTBREAK**. A regional tornado outbreak occurred across the Midwest on October 24, 2021, resulting in at least 15 tornadoes in Missouri. Six of these tornadoes were on the ground for at least 10 miles, and four of the six tornadoes were significant (EF-2 or greater). Three of the significant tornadoes were focused in southeast Missouri, causing damage and destruction to a number of homes and buildings in the Fredericktown (MO), St. Marys (MO)/Chester (IL), and Farmington (MO) areas. Despite significant damage to more than 100 buildings, there were no fatalities and only 2 minor injuries reported across the state. These positive outcomes are notable for a number of reasons, including the challenges posed by several forecasting and warning issues. This presentation will review these challenges from the perspective of the St. Louis National Weather Service weather forecast office (NWS St. Louis), including questions about convective initiation and mode, radar quality issues, confirmed tornadoes in close proximity to one another, and decisions whether to issue a tornado emergency. The ability of the NWS St. Louis to effectively assess and respond to these challenges played a key role in the protection of life and property, and resulted in a warning performance featuring considerable lead time ahead of each significant tornado.

Biochemistry, Biomedicine, & Biotechnology Section

Oral Presentations:

D. Morrone, Department of Basic Sciences, University of Health Sciences and Pharmacy in St. Louis. **GENOMIC MINING AND INITIAL BIOCHEMICAL CHARACTERIZATION OF A LIBRARY OF PLANT CYTOCHROME P450 NADPH REDUCTASES.** Cytochrome P450 NADPH reductases (CPRs) are responsible for supplying reducing equivalents to P450s in the course of the P450 catalytic cycle. While P450s often receive attention for the complex and crucial reactions they catalyze, less work has focused on their required catalytic partner, the CPR. Plants in particular serve as a rich genetic source of P450s, primarily due to the plant's ability to produce a wide array or natural products compounds that required the P450 to generate oxidized compounds. While plants may have many dozens or hundreds of different P450s, they often contain genes for only two to five CPRs within their genomes. To date, relatively few CPRs have been characterized, particularly compared to the abundance of plant P450s that have been characterized. We mined plant genomic and sequence expression databases to assemble a candidate pool of about one dozen potential CPR genes from plants that have known agricultural or medicinal use. Additionally, we used consensus engineering to produce an entirely artificial CPR that has no known sequence in plant genomes. Upon assembling and cloning our small library of CPR genes, we performed expression analysis and solubilization from *E. coli* hosts, followed by initial biochemical characterization. In this case, all variants of our plant CPR library show significantly greater expression, stability, and preliminary biochemical activity than the *Arabidopsis* variant used in most applications. This presentation will share our approach to genomic mining and the results of our initial biochemical characterization of this library of plant CPR genes.

N. Dascher, M. Becker, J. Wilson, J. Long, P. Thompkins, and D. West. Department of Natural Sciences, Southwest Baptist University. **IN-HOUSE CONSTRUCTION AND VALIDATION OF A CAPILLARY ELECTROPHORESIS INSTRUMENT.** Capillary electrophoresis (CE) is a versatile tool used in a variety of chemical, biological, and medical subdisciplines. Development of the CE instrument was a cost-effective way for Southwest Baptist University to provide research opportunities for undergraduate students and increase instrumental capabilities. An Ocean HDX spectrometer, deuterium tungsten source, fiber optic cables, collimating lens, and OceanView software license were purchased from Ocean Insight. All optical materials were assembled and optimized in the laboratory by an undergraduate research team. A window was created on the Thomas Scientific polyacrylamide coated silica capillary by heat treatment. The capillary column was then conditioned and filled using a combination of gravity and negative pressure. The power supply utilized was an Acopian P030HA1M power supply. Electrodes were designed and built to fit within the microcentrifuge sample tube. AutoDesk Fusion360 was utilized to design the optics holder and printed on a Creality LD-200 3D Printer. A rotating, multiple microcentrifuge tube holder was designed and printed on a Qidi X-Pro 3D Printer. A software program was designed to interface with the detector. The data acquisition program has adjustable detection wavelength, data point collection frequency, and run duration. Data acquisition has been achieved with a low volume cuvette with the developed optical system and software program. Currently, final adjustments and optimizations to the CE instrument are being performed to complete and validate the instrument. Future methods to be developed and validated include a

urinalysis of aspirin metabolite method and serum cortisol quantification for investigation of cattle weaning methods.

J. Selaya, L. Losey, J. Wilson, M. Becker, J.T. Murphy, J.D. Patton, and D.M. West, Division of Natural Sciences, Southwest Baptist University. **FORENSIC DNA FINGERPRINTS OF BUCCAL CELLS.** Prepackaged Deoxyribose Nucleic Acid (DNA) fingerprinting kits are easily purchased for utilization within undergraduate coursework. These kits are convenient for understanding the primary methodologies but do not allow for forensic sample collection analysis and neglect the experience of collecting and working with complex biological matrices. A robust and validated method was developed for on-campus forensic sample collection and analysis of buccal cells to enhance undergraduate student laboratory and interdisciplinary collaboration. Buccal cells were collected and lysed with Proteinase K. DNA was extracted from the matrix utilizing a DNEasy spin column. The isolated DNA quality and quantity within the eluate were verified through two methods: UV absorbance and gel electrophoresis. An amplified fragment length polymorphism procedure was developed using EcoRI adapters and primers. The isolated DNA was fragmented by EcoRI, ligated with EcoRI adapters, and amplified using EcoRI primers for polymerase chain reaction. The fragmented DNA was then separated through gel electrophoresis. A DNA fingerprint was yielded from the buccal cells. The fingerprint bands were faint and require further optimization of the method for distinguishability between individuals. A more accurate method of establishing DNA concentration within the eluate, the introduction of an additional high-frequency restriction enzyme, and utilization of a polyacrylamide gel for electrophoresis are currently being evaluated.

L. Losey, J. Selaya, M. Becker, J. Wilson, J. T. Murphy, J. D. Patton, D. M. West, Division of Natural Sciences, Southwest Baptist University. **DNA EXTRACTION AND FINGER-PRINTING.** A deoxyribose nucleic acid (DNA) fingerprint method was developed and validated for utilization within undergraduate coursework at Southwest Baptist University. Rather than the use of a pre-packaged kit, the developed method allows for student experience with sample collection, preparation, and analysis of complex biological matrices to yield a DNA fingerprint. Manually extracted human hair follicles were lysed with Proteinase K. DNA was extracted from the lyzed sample with a DNeasy spin column. The spin column both purified the DNA and increased the concentration of DNA within the sample volume. The amplified fragment length polymorphism (AFLP) method developed utilized the restriction enzyme, EcoRI, for complete digestion of DNA within the eluate. After digestion, the DNA restriction fragments were ligated with EcoRI adapters and then amplified by polymerase chain reaction (PCR) in the presence of EcoRI primers. The amplified sample was separated by gel electrophoresis through a prepared Sybr Safe agrose gel. An adequate DNA integrity check by gel electrophoresis was not able to be achieved prior to the AFLP method due to the low concentration within the eluate. After amplification, faint DNA fingerprint bands were visible for DNA extracted from hair follicles. Further optimization of the method is necessary to yield a more distinguishable DNA fingerprint between individuals. Optimization parameters currently being evaluated include the initial amount of sample lysed, lysing time, and use of a restriction enzyme.

R. Sweyko, M. Nagel, and A. Barry. Department of Biology, Missouri Southern State University. **PATIENT CASE STUDY CONCERNING METASTATIC UROTHELIAL CARCINOMA OF 95-YEAR-OLD WHITE MALE WHOLE BODY DONOR**. This case study investigates probable cause of death of a 95-year-old male Whole Body Donor with observable lower extremity edema and a 4-inch diameter hematoma located on the left cubital fossa. Investigation was conducted through a full body dissection under the supervision Dr. Alla Barry M.D. as part of the Missouri Southern State University Advanced Human Dissection course. This included gross anatomy dissection, collection of tissue samples for histological analysis, and a computed tomography (CT) scan of the whole-body donor. Findings that lead to a cause of death determination included histological evidence of urothelial carcinoma that metastasized to both kidneys, the liver, spleen, and bones, presence of gross anatomical irregularities such as male osteoporosis, abnormal kidney tissue, extensive calcification of the arteries, and evidence of extensive subarachnoid hemorrhaging. Due to presence of extensive anthracosis in the lung tissue and cervical lymph nodes, long-term smoking was determined to be the most likely cause of these conditions. Overall, based on the evidence that was collected, it was determined that due to long-term smoking, the patient developed urothelial carcinoma that metastasized to the kidneys, liver, spleen, and bones, causing other conditions such as chronic kidney disease, possible Hypercalcemic Paraneoplastic Syndrome, and severe osteoporosis. These conditions led to the development of Mönckeberg arteriosclerosis and increased blood clotting, all of which led to the need for blood thinning medication use. Finally, due to the patient's age, existing conditions, and use of blood thinning medication, extensive subarachnoid hemorrhaging occurred, leading to death of the patient.

E. Jackson[a], R. Shaker[a], E. Schilling[a], N. Dietzen[b], W. Cheng[b], G. Blankson[a], A. Vummenthala[a], N. Ulrich[a], [a]Department of Chemistry, Maryville University, [b]Department of Anesthesiology, Washington University St. Louis. **SYNTHESIS OF BROMINATED PHOSPHOLIPIDS FOR FUNCTIONAL CHARACTERIZATION OF LIPID-ION CHANNEL BINDING**. Lipids regulate the structure and function of ion channels. While cryo-electron microscopy (cryo-EM) has recently revealed the structures of numerous lipid-bound ion channels, the mechanism by which lipids modulate these membranes is still poorly understood. Understanding the mechanism of lipid-ion channel interactions is a vital first step toward designing efficacious drug molecules. Pentameric ligand-gated ion channels (pLGICs) are lipid-sensitive channels that mediate synaptic signaling and regulate neuronal excitability and are drug targets for anesthetics and anti-epileptics. One technique used to identify lipid-ion channel binding sites includes quenching the fluorescence of tryptophan residues on a protein by brominated phospholipids. In the present study, we present our synthesis of three brominated phospholipids (brominated POPC, POPE, and POPG), as well as preliminary data to determine the identity of the phospholipid bound to the tryptophan residue W206 of the prokaryotic *Erwinia chrysanthemi* ligand-gated ion channel (ELIC).

C. Nichols, K. Kendrick, B. Macander, C. Rivas, and R. Ulbricht, Department of Biomedical Science, Missouri State University. **TISSUE AND SEX-SPECIFIC CHANGES IN RNA EDITING DURING INCDUCED ACUTE INFLAMMATION.** A-to-I RNA editing is a process where adenosine (A) nucleotides are deaminated by an editing enzyme, ADAR1, to become inosines (I) in select RNA transcripts. RNA editing can affect the sequence of the encoded protein and the regulation of the RNA. ADAR1 also plays a role in regulating innate immunity and its expression is upregulated during inflammation. Current data on the effects of increasing

ADAR1 on RNA editing is limited, and most studies are completed only in male mice. We are interested in expanding RNA editing data to include female animals. Lipopolysaccharide (LPS) was used to induce acute inflammation and increase ADAR1. Organs were dissected four hours after LPS injection and RT-PCR was used to amplify regions around editing sites of known targets. The amplicons were sequenced and analyzed by measuring the amount of nonedited nucleotides and edited nucleotides at select sites. Inflammation was verified in the LPS injected mice through qRT-PCR of ADAR1 and inflammatory cytokines. The increased levels of ADAR1 did not affect levels of RNA editing. There was also no significant difference in editing between males and females. However, our analysis did reveal a difference in editing between the heart and brain. This indicates that despite an increase in enzyme concentration, the level of RNA editing is discretely regulated to maintain tissue-specific function. The process by which this RNA editing is maintained is currently unknown. Overall, this work helps us understand how the effects of infection and inflammation are regulated to minimize damage and unwanted physiological consequences.

Poster Presentations:

C. Rivas, H. Marino, J. Wang, R. Ulbricht, Department of Biomedical Sciences, Missouri State University. **SEX-DEPENDENT ROLE FOR P2Y2R IN GLUCOSE METABOLISM AND INFLAMMATION**. The P2Y2 receptor plays an important role in the inflammatory responses. Activation of P2Y2R potentiates inflammatory responses by producing pro-inflammatory cytokines and mediators, such as I1-6 and TNF-alpha. These cytokines and mediators play a role in development of insulin resistance. P2Y2R potentiates insulin resistance, as well as pathogenesis of obesity. Together, these findings suggest that P2Y2R activation during inflammatory responses increase insulin resistance, therefore affecting glucose metabolism in a negative way. Another factor that plays an important role in inflammation and glucose metabolism is sex. Females have a lower fasting glucose levels and are able to metabolize glucose faster than males. During inflammation, females have a more robust innate immunity response compared to males. This means that females are efficient at activating and releasing cytokines. In order to investigate the compounding effects of sex, inflammation and P2Y2R on glucose metabolism, we subjected mice to glucose tolerance testing (GTT) to see how well they metabolized sugar in the presence of inflammation. To induce inflammation in wild-type on P2Y2R knockout mice, mice were injected with lipopolysaccharide (LPS) a well-known robust inflammatory trigger. Our findings show that LPS treated mice had lower blood glucose, indicating that inflammation induces glucose metabolism in both sexes. However, P2Y2R knockout affected blood glucose in inflamed male animals, but not in females. Therefore, P2Y2R's role in glucose metabolism and inflammation is sex-dependent. This study demonstrates a need to consider sex when designing studies or treatments for controlling blood glucose levels during chronic or acute inflammation.

A. Johnson, and D. Morrone, Department of Basic Sciences, University of Health Sciences and Pharmacy in St. Louis. **BIOCHEMICAL CHARACTERIZTION OF MANGANESE INHIBITION OF HORSERADISH PEROXIDASE.** Horseradish peroxidase (HRP) is one of the most widely used enzymes in the world and the purpose of this study was to increase our mechanistic understanding of this important enzyme. As an enzymatic tool, HRP is used to detect hydrogen peroxide. Specifically, HRP will oxidize a colorimetric or fluorometric substrate probe in the presence of hydrogen peroxide. Due to its extreme sensitivity, robust catalytic activity, low

cost, abundance, high stability, and ease of chemical modification, HRP has found many uses in clinical tests, immunological assays, and biotechnology applications. There are a variety of small molecule organic substrate probes - such as DAB, TMB, and OPD - used in these assays with HRP; however, Amplex Red is considered the best probe due to its extreme sensitivity, ease of detection, and higher pH stability. Our previous work characterizing the HRP oxidation of these colorimetric probes showed that Mn^{2+} selectivity inhibits Amplex Red oxidation by HRP, but Mn^{2+} does not inhibit oxidation of the other probes. We have characterized the nature of this Mn^{2+} inhibition of HRP catalyzed Amplex Red oxidation. Mn^{2+} inhibits HRP using a non-competitive mode and has a Ki value in the sub mM range, of similar magnitude to HRP inhibition by glutathione and ascorbic acid. As HRP catalyzed oxidation of Amplex Red is used in many applications, these results suggest some consideration for assay conditions wherein Mn^{2+} may be present. This data is presented along with potential implications for Mn^{2+} as an HRP effector in vivo.

K. Thapa[1], S. Han[1], W. Liu[1], S. Yang[1], and R. Wang[1]*, [1]Department of Chemistry, Missouri University of Science and Technology. **NANOMATERIAL-ENHANCED FABRICATION OF ULTRASENSITIVE ELECTROCHEMICAL DNA BIOSENSOR.** DNA nanostructures and other nanomaterials have been extensively explored for the highly sensitive and selective detection of many different disease-related biomarkers and targets. DNA-based electrochemical biosensor has attracted broad scientific and clinical interests in the past decades due to its unique hybridization specificity, fast response time, and potential for miniaturization. In order to achieve high detection sensitivity, the design of DNA electrochemical biosensors depends critically on the improvement of the accessibility of target molecules and the enhancement of signal readout. Here, we presented novel strategies to enhance the sensitivity of DNA biosensors on both directions. A novel DNA origami-supported DNA probe immobilization method was introduced, which provides the opportunity to rationally control the distance between probes and keep them in upright confirmation to dramatically increase the target hybridization yield. The second biosensor was based on "urchin-like" carbon nanotube-gold nanoparticle (CNT-AuNP) nanoclusters serving as signal amplifier for DNA detection. The application of nanomaterials, such as AuNPs, CNTs, and DNA origami nanostructures has demonstrated their great potential for sensitive, selective, and label-free determination of targets in biomedical research and clinical applications due to their large conducting surface areas, convenient customization of probes on the sensing surface, as well as the contribution in enhancing the signal amplification. Supported by NSF, CBR, Missouri S&T, and Ozark Biomedical Initiative program.

S. Yang[1], W. Liu[1,2], Y. Zhang[1], and R. Wang[1]*, [1]Department of Chemistry, Missouri University of Science and Technology. [2]Center for Research in Energy and Environment, Missouri University of Science and Technology. **BOTTOM-UP FABRICATION OF LARGE-SCALE GOLD NANOROD ARRAYS BY SURFACE DIFFUSION-MEDIATED DNA ORIGAMI ASSEMBLY.** Self-assembly of anisotropic metal nanoparticles serves as an effective bottom-up route for the nanofabrication of novel artifacts. However, there still are many challenges to rationally manipulate anisotropic particles due to the size and geometric restrictions. To avoid the aggregation and mis hybridization from DNA sticky-end-guided assembly in buffer solution, in this work, we utilized a novel surface diffusion-mediated DNA origami assembly method for the fabrication of plasmonic nanomaterials into well-ordered structures through π-π stacking interactions. Highly ordered 1D and 2D arrays of AuNRs were constructed by employing DNA

origami frames as scaffolds with the surface mobility of DNA origami in a liquid environment manipulated by divalent (Mg^{2+}) and monovalent (Na^{+}) cations. To facilitate the further manipulation of those patterns, a novel pattern transfer method was introduced to transfer the arrays of AuNRs from a liquid to a dry ambient environment with high yield and minor structural damage. The results demonstrated a cost-effective and reliable strategy of DNA origami-assisted, large-scale assembly of AuNRs for constructing complex superstructures with potential applications in the nanofabrication of plasmonic and electronic devices, and the capability to integrate with many advanced lithography techniques. Supported by the NSF under grants CCF-1814797, and Office of Research, Missouri University of Science and Technology.

L. Bloodgood, T. Mull, and J. Baker, Department of Biology, Missouri Western State University. **IDENTIFICATION AND CHARACTERIZATION OF SOIL MICROBES PRODUCING ANTIMICROBIAL COMPOUNDS.** Our project focuses on isolation and identification of soil bacteria that exhibit inhibitory properties, a key step to unearthing new antimicrobial compounds. 48 soil samples yielded 7 candidate soil bacterial species for evaluation. Six are Gram-positive bacilli (all *Bacillus* or *Brevibacillus* species) and one a Gram-negative bacillus (*Escherichia fergusonii*). All candidates inhibited *Staphylococcus aureus* and three also inhibited *Escherichia coli* in initial plate-based screening. PCR amplification and sequencing of the 16s ribosomal gene has allowed us to identify six of the seven species. Because of their novelty in the literature, we remain focused on five of the candidate species. We are currently quantifying the inhibition strength, inhibitory spectrum, and stability of each antimicrobial compound. Supported by Missouri Western State University's PORTAL program funding.

A. Agah, Department of Chemistry, Park University. **CLASSIFICATION OF HEART DISEASE DATA SET USING DATA MINING.** Over eighty million individuals suffer from cardiovascular disease making it a leading cause of death in the United States. Risk factors include age, gender, hereditary, stress, smoking, diet, high blood pressure and high cholesterol. This research introduces the basic concepts of classification, describes some of the key issues such as model overfitting, and presents methods for evaluating and comparing the performance of a classification technique. Classification, which is the task of assigning objects to one of several predefined categories, is a pervasive problem that encompasses many diverse applications. Recursive partitioning is a fundamental tool in data mining to explore the structure of a set of data, while developing easy to visualize decision rules for predicting a categorical outcome. In this study, we utilized heart disease dataset, and all of its attributes to determine what constitutes an above average chance of disease dataset. We used the R statistical computing language to conduct the analyses in this report utilizing the data found on the UC Irvine Machine Learning Repository and identified a number of attributes for prediction of cardiovascular disease.

Biology Section

Oral Presentations:

A. Peters[1], K. Monahan[1] and N. Weaver[2]. [1]Department of Biology, [2]Department of Biochemistry, Missouri State University. **EFFECTS OF ZnO AND CuO NPS ON HUMAN THYROID CANCER (ML-1) VS RAT MEDULLARY THYROID CARCINOMA (CA77) CELLS.** Nanoparticles (NPs) contribute to the technologies in agriculture and food development, but there is little understanding of how nanoparticles impact human health. To further understand the effects of NPs, this study investigates metal nanoparticles (Me-Nps) including CuO, ZnO, TiO2, and SnO on ML-1, CA77 and non-cancerous fibroblast cells to discover their impact. The cytotoxicity of the selected NPs was explored through an XTT viability assay, a reactive-oxygen species (ROS) assay and an apoptosis analysis on these cells. XTT results conveyed ZnO and CuO having the greatest decreased viability. Therefore, CuO and ZnO were selected for a further gene expression study. Similar to the ML-1 cells, CA77 cells also showed a decrease in cell viability quantified by an XTT assay. The production of ROS in the ML-1 cells when treated with CuO and ZnO was found to be not significantly altered during 48-hour incubation with both nanoparticles, but showed a slight increase at 24 hours. The apoptosis assay revealed that ZnO and CuO increased cell death, which led to the conclusion that the cause of decreased cell viability comes more from apoptosis, rather than ROS. Consistently, our RNAseq studies illustrated upregulated apoptotic, inflammation, DNA damage response (p53), and xenobiotic metabolism genes with the ZnO treatment. Downregulated genes in ZnO-treated experiments include Golgin family and cytochrome p450 family genes. When treated with CuO NPs, DNA regulation, apoptotic process, cell migration, abiotic stimulus, and DNA repair genes are all upregulated. Cell-cell adhesion, synapse organization and cell proliferation are all downregulated. -These experiments give powerful insight on potential Me-Nps effects on the human body. Future comparison experiments such as ROS, apoptosis and RNA seq on CA77 will provide further understanding.

B. Barbour and M. Preuss. Department of Biological Sciences, Webster University. **ISOLATION AND GENOMIC SEQUENCING OF A BACTERIOPHAGE**. Bacteriophages are viruses that infect and replicate within bacteria cells. The isolation of bacteriophages is important because they can be used for research, such as the penetration of biofilms. Many pathogenic bacterial species are capable of forming biofilms that are resistant to antibiotics. Further research could potentially lead to the successful treatment of these bacterial infections in humans that are otherwise difficult to eradicate. A new *Microbacterium* phage has been identified with characteristics of a lytic life cycle and *Siphoviridae* morphotype. It was isolated from the host *Microbacterium foliorum*. Its genome has been sequenced, and it is an EA cluster phage with 63 genes showing similarity to phages BonesMcCoy, Convict, Knox, and Den3.

N. Le, J. Routh and K. Kim. Department of Biology, Missouri State University. **AN INVESTIGATION OF THE IMPACT OF CADMIUM SELENIDE ZINC SULFIDE QUANTUM DOTS ON *SACCHAROMYCES CEREVISIAE* YEAST CELLS.** Quantum dots (QDs) are nano-sized semiconductor crystals that are highly utilized for research and medical purposes. Although recent studies have hinted at the toxicity of QDs, their impact on fungal cells remains unclear. The purpose of our research was to examine the trafficking route of red

Cadmium Selenide Zinc Sulfide Quantum Dots (CdSe/ZnS QDs), as well as the phenotypic changes it induces in budding yeast cells. We tracked CdSe/ZnS QDs' subcellular location by using yeast strains expressing different reference markers, including plasma membrane reference marker GFP-2PH, early endocytosis vesicle reference marker Abp1-GFP, late Golgi/trans Golgi network reference marker FAPPI(PH)-GFP, and late endosome reference marker Vps10-GFP. We found that immediately after treating, CdSe/ZnS QDs interacted with yeast cells. However, CdSe/ZnS QD only co-localized with the plasma membrane reference marker after 3 hours of treatment, suggesting that CdSe/ZnS QDs require at least 3 hours to arrive at the plasma membrane. Around 6 hours after treatment, CdSe/ZnS QDs were found at the plasma membrane, the early endocytosis vesicle, and the late Golgi/ trans Golgi network. QDs were never found co-localizing with the late endosome, suggesting that this is not a destination for CdSe/ZnS QDs intracellular trafficking. The rest of QDs' intracellular trafficking route is in need of further investigation. We also treated yeast with different concentrations of CdSe/ZnS QDs (4 µg/mL, 12 µg/mL, 50 µg/mL) and studied the integrity of the actin cable upon QDs exposure. After 6 hours, a higher percentage of cells showed actin cable fragmentation in 12 µg/mL and 50 µg/mL of QDs treatment. Furthermore, we performed a recovery assay by removing QDs from the culture media. After 3 hours of incubation in QDs-free media, partial actin cable recovery was observed, hinting that the effect of QDs toxicity is reversible. Additionally, our viability assay data reveal that 6 hours of QDs exposure led to a significant decrease in the yeast sample's optical density for all treatment concentrations. Interestingly, there was no significant difference in optical density between the treated samples and the control samples after 24 hours of treatment, indicating that QDs exposure only causes an inhibitory effect on yeast growth.

M. Kilmer. Department of Biology and Environmental Health, Missouri Southern State University. **EFFECTS OF ALTERED TEMPERATURE ON THE TOXICITY OF ZINC TO *DAPHNIA MAGNA*.** The Tri-State mining industry led to the contamination of many soils and waterways in and around Joplin, MO, with excessive levels of pollutants, including metals such as zinc. While zinc can be toxic to humans, a greater danger lies in its toxicity to other organisms, particularly those at the bottom of the aquatic food chain. Aquatic organisms also tend to be sensitive to temperature changes. The combined effect of warming (due to climate change) and metal exposure could have potentially significant and detrimental effects on aquatic organisms, leading to ecosystem disruptions. The objective of this study was to examine the effects of altered water temperature on the toxicity of zinc to aquatic organisms. *Daphnia magna* was used as a model organism and was exposed to environmentally relevant zinc concentrations under a range of temperature conditions, using lethality as an endpoint for acute toxicology tests. The results showed that as water temperature increased, the toxicity of zinc to test organisms also increased, with significant increases in toxicity in response to changes of just 5°C. This is likely due to increased metabolic activity caused by temperature increases, leading to increased intake of metals from the environment. Given the known contamination in this area and the increasing likelihood of environmental temperature changes, it is important to better understand how the combination of environmental stressors and pollutants impact organisms and thus impact ecosystem structure and function.

T. Blakley and C. Lupfer. Department of Natural Applied Sciences, Missouri State University. **THE EFFECTS OF HYPOCHLOROUS ACID AGAINST INFECTIOUS MICROBES.** Disinfectants are important for maintaining clean environments in the home, work, food industry, and especially the healthcare setting. Although necessary, some of these chemicals can be harsh on surfaces, personnel, patients, and the environment. In collaboration with Pure&Clean (Nixa, MO), we have completed research testing whether different concentrations of hypochlorous acid (HOCl) can destroy infectious microbes. HOCl contains an oxyacid of chlorine with a monovalent chlorine molecule. This monovalent chlorine molecule in HOCl acts as an oxidizing agent. HOCl is effective, but as an oxidizing agent, it is unstable. This has pros and cons. Stability is an issue, but it degrades into saltwater, making it environmentally safe. Therefore, I am not only testing the effects of HOCl, but I am also testing the stability of the acid with different wipe-cloth materials and how long that material is effective at disinfection. When adding the HOCL immediately to cotton wipes, the HOCl was effective at killing microbes. However, the HOCl was inactivated after contact with the cotton wipe material in less than 6 hours. Further testing revealed that polyester and rayon-based wipe material did not inactivate the HOCl. In conclusion, HOCl is a safe and effective disinfectant, but must be used with synthetic wipe material or it is oxidized quickly.

T. Santana Baez, E. McHugh, J. Campbell and A. Campbell. Department of Natural Sciences, Northwest Missouri State University. **COMPARATIVE GENOMICS OF CADMIUM-RESISTANT *COMAMONADACEAE* ISOLATES FROM CONTAMINATED SOILS OF PICHER, OKLAHOMA.** The abandoned town of Picher, Oklahoma, was the site of active mining from 1904-1970 as part of the Tri-State Mining District of Kansas, Missouri and Oklahoma. Mining and smelting activities in this area led to extensive heavy-metal contamination that ultimately resulted in the evacuation of the town. Isolations from soil samples produced cadmium-resistant alphaproteobacteria from the family *Comamonadaceae.* Genomes of two isolates have been sequenced: *Comamonadaceae* sp. EM25 and *Comamonadaceae* sp. EM38. Phylogenies indicate that EM25 belongs within the genus *Mitsuaria*, and EM38 is placed within the genus *Xenophilus*. Their genomes contain multiple copies of genes CzcCBA, which encodes efflux pumps for cobalt, zinc and cadmium resistance. Also, analyses of average nucleotide identities of genomes of close relatives show that EM25 represents a new species within *Mitsauria*.

Poster Presentations:

D. S. Kim, M. Zhang, N. Le, S. Harris and K. Kim. Department of Biology, Missouri State University. **ML-1 THYROID CANCER CELLS ARE MORE RESISTANT TO PLATINUM-BASED CHEMOTHERAPEUTIC AGENTS.** Recent literature demonstrates that platinum-based chemotherapeutic drugs in physiological solvents display higher efficacy in destabilizing cancer cells. As human cancer cells come in over 200 different varieties, it would be beneficial to test the efficacy of these drugs using a wider spectrum of cells. Utilizing the well-tested HeLa cervical cancer cells as a control for the effects of these drugs, we assessed the impact of the platinum-based cisplatin, carboplatin, and oxaliplatin on ML-1 thyroid cancer cells. Through the XTT Viability assay, we found that ML-1 cells are more resistant to cisplatin and oxaliplatin with an IC_{50} value at least two times higher than those for the same drugs in HeLa

cells. It has been consistently shown that the oxidative stress caused by these chemicals were more pronounced in HeLa cells than in ML-1 cells, but the only measurable results were found 24 hours after treatment. We also show that a high percentage of HeLa cells displayed apoptosis with even 20 μM of these chemicals, which is directly comparable in effect to the 100 μM of chemicals in ML-1 cells. Upon comparing the expression levels of pro-apoptotic enzymes in HeLa and ML-1 cells, we observed that when treated with 40 μM of these chemicals, the levels of pro-apoptotic enzymes were modestly increased in both cancer cells. Our research will provide new insight into the different capacities of each cell line and the treatment regimen for cancer patients in the future.

M. Zhang[1], D. Kim[2] and K. Kim[1]. [1]Department of Biology, Missouri State University, [2]College of Arts and Science, Emory University. **INTRACELLULAR DISTRIBUTION OF CD AND INP QUANTUM DOTS IN HELA AND ML-1 THYROID CANCER CELLS.** The study of interaction of engineered nanoparticles, including quantum dots (QDs), with cellular constituents and the kinetics of their localization and transport has provided new insights into their biological consequences in cancers and for developing effective cancer therapies. The present study aims to elucidate the toxicity and intracellular transport kinetics of CdSe/ZnS and InP/ZnS QDs with late-stage ML-1 thyroid cancer and HeLa cells. Our XTT viability assay showed that ML-1 cells and non-cancerous mouse fibroblast cells exhibit no changes in viability, compared to non-treated control, whereas HeLa cell viability decreases in response to QDs. These results suggest that HeLa cells are more sensitive to the QDs than ML-1 cells. To test the possibility that transporting rates of QDs are different between HeLa and ML-1 cells, we performed a QD subcellular localization assay by determining Pearson's coefficient values and found that HeLa cells showed faster QDs transporting towards the lysosome. Consistently, ICP-OES tests showed the uptake amount of CdSe/ZnS QDs in HeLa was significantly higher than in ML-1 cells. Together, we conclude that high levels of toxicity in HeLa cells is positively correlated with the traffic rate of QDs in treated cells.

A. Gooden and H. Marsh. Anthropology Department, University of Central Missouri. **DNA SURVIVAL IN WATER IMMERSION FOR FORENSIC IDENTIFICATION APPLICATIONS.** DNA recovery is crucial to forensic anthropology and is frequently the basis for a positive identification of skeletonized remains. However, DNA survival in exposed remains is highly impacted by the depositional environment. Whereas DNA does degrade over time, water and other harsh environments can lead to a greater decrease in DNA survival. This research seeks to document DNA survival from a Central Missouri lake to compare not only the concentration of DNA but also the efficiency of a DNA extraction strategy that is available and cost-effective for investigators. Two pig hemimandibles were immersed in a lake for two months, and two hemimandibles were preserved in a freezer for the same timeframe. After the exposure period, the mandibles were sampled for DNA using the DNEasy Blood and Tissue kit. The goal was to assess whether the post-exposure DNA concentration in bone met thresholds for positive identification sequencing. DNA survival levels in both the immersed and frozen samples were lower than a fresh specimen, although there was no statistically significant difference between the immersed and frozen samples. Importantly, in the majority of samples, enough DNA survived after the two-month exposure to hypothetically be sequenced for a positive identification. In cases of longer immersion, we hypothesize that there could be a dramatic decrease in DNA survival. Pertaining to short-term immersion, this research shows that

bone can retain an adequate amount of DNA, which could be sequenced and result in a positive identification in forensic work.

O. Bockover, L. Martin and S. Lankford, School of Natural Sciences, University of Central Missouri. **EFFECTS OF SUBLETHAL NITRATE ON THE METABOLIC RATE OF WALLEYE EGGS.** Runoff from agricultural, industrial, and urban sectors has resulted in nitrate accumulation in our waterways. While many environmental variables are measured, dissolved nitrate is often ignored. This studies purpose is to measure nitrate's effects on the metabolic rate of walleye (*Sander vitreus*) eggs. Walleye are found in the Midwest, and are important for consumption and sports angling, which exposes them to increased nitrate in both the cultured and wild environments. Eggs were treated with 0 (control), 50, or 500 mg/L of sodium nitrate with constant oscillation (15℃) overnight. The oxygen consumption of 15 eggs/respirometer were measured to estimate metabolic rate with a Witrox 4 (Loligo® Systems) meter. Data were analyzed with a 1-Way ANOVA model with significance level set at $p \leq 0.05$. Results are pending final analysis; however, pilot data from our lab suggests a positive association of lactate and metabolic rate. With finite energy in each egg, an increase in metabolic cost could negatively affect hatching, growth, or development in eggs and juveniles. This would have direct negative results on the fish farmer and the wild populations of walleye, but is also important to understand under the lens of global warming and water shortages. Eggs provided by the Lost Valley Hatchery, Missouri Department of Conservation. Funding provided by UCM UG Research.

M. Gibson and A. Elias. Department of Biology, Missouri Western State University. **DNA BARCORDING FOR FISH SPECIES IDENTIFICATION.** The goal of this project is to use molecular techniques for species identification of fish caught in ponds on Missouri Western State University campus. Multiple techniques were used to identify and confirm the species of fish sampled across the nine campus ponds. Some of the campus ponds are stocked for recreational fishing and the ponds vary in biotic and abiotic factors. Research on species combinations and fish densities is important for determining fish-stocking policies. While some fish are more easily identified in the field, sunfish and their hybrids can be phenotypically difficult to distinguish, so identification can be done using DNA sequencing. This idea is also referred to as DNA barcoding which involves using a short, standardized DNA region that is known to distinguish species. Hybrids can only be identified by using nuclear genes. The nuclear gene, internal transcribed spacer 1 (*ITS1*) was sequenced and did not yield enough information to differentiate sunfish. Interestingly, there was product number variation, which may correspond with species and be useful as a screening method. Taxon specific beta-actin primers and the resulting sequencing products were used for hybrid identification and analyses. Once optimized, this non-lethal molecular method will allow for rapid species identification, as well as determining the relatedness of fish between and within ponds using a phylogenetic tree. Accurate fish identification, particularly differentiation of sunfish hybrids from bluegill (*Lepomis macrochirus*), is important for not only adaptive management and survey information, but also for ecological questions.

J. Zhu, O. Buschhaus, J. McGhee, A. Campbell and J. Campbell. Department of Natural Sciences, Northwest Missouri State University. **MITOCHONDRIAL DNA CHARACTERIZATION OF BULLFROG (*LITHOBATES CATESBEIANA*) POPULATIONS IN NODAWAY COUNTY, MO.** Bullfrogs (*Lithobates catesbeiana)* are the largest frog species native to Missouri, and they are important vectors of pathogenic chytrid fungi (*Batrachochytrium dendrobatidis*). Therefore, it is important to understand local migration patterns of this species. Our goal with this project was to develop lab and field protocols for frog collection and molecular characterization of their populations. Blood samples were extracted from bull frogs collected in Nodaway County, MO. Genomic DNA was purified and a fragment of the mitochondria genome was amplified using PCR. Sanger sequencing of amplicons is underway. Non-lethal blood collection has provided sufficient DNA for PCR amplification.

H. St. Dennis. Department of Biology, Missouri University of Science and Technology. **PHYLOGEOGRAPHY OF THE BIGMOUTH SHINER, *NOTROPIS DORSALIS*.** North American river systems exhibit diverse communities of freshwater fish, which are among the most diverse in the world. This diverse speciation is due in part to the extensive impact of Pleistocene era glaciation on river drainages. This glacial formation drove northerly distributed species to seek refuge in more southern habits during maximum glaciation. Once the glaciers retreated the species redistributed back to more northern habitats of their drainages. Some broadly distributed northern species such as Bigmouth Shiner, *Notropis dorsalis*, might in fact be comprised of multiple divergent and geographically separated lineages. *N. dorsalis* is a species of minnow native to small streams throughout central North America, occurring throughout tributaries of the Missouri River, upper Mississippi River, and tributaries of Lake Michigan and Lake Erie. All known populations of *N. dorsalis* exhibit homogenous morphology. However, we hypothesized that geographically separate populations would contain genetically distinct groups known as cryptic species. Using molecular genetics, it was possible to compare genetic variations in *N. dorsalis* samples through sequencing of the highly variable region of mitochondrial DNA cytochrome B gene. The variations in the cytochrome B gene have displayed distinct, and most likely cryptic, clades that align with the geographic isolation of the observed *N. dorsalis* lineages. This study has shown two distinct clades populating the Missouri and Mississippi River drainages, respectively, which are more closely related to each other than clade representatives observed in two different Great Lakes drainages. Additional sampling of populations in the eastern ranges of *N. dorsalis* is ongoing.

G. Dieringer and L. Cabrera R. Department of Natural Sciences, Northwest Missouri State University. **BEE DIVERSITY AND PATTERNS OF FLOWER VISITATION IN THE GENUS *AGALINIS* (OROBANCHACEAE).** *Agalinis* is a very diverse genus within the Orobanchaceae. Species may be either widespread in distribution or restricted in range. Natural populations tend to be small and isolated across natural grassland or open habitats frequently fragmented due to habitat loss. We conducted a literature review of the bee taxa visiting *Agalinis* flowers. To assess the impact of visiting bee diversity on flower size, distribution, and conservation status of 14 species, fifteen surveys were included plus our own field observations made over 30 years. From 160 floral records, we found 5 families, 17 genera, and 58 bee taxa have been documented visiting flowers of *Agalinis*. The Halictidae (43.1%) and Apidae (29.3%) constituted the greatest proportions of bees. The number of taxa recorded showed a significant relationship between visiting bee diversity and geographic distribution across the United States

and Canada (p=0.04). However, no differences in bee diversity based on flower size, regional distribution, or conservation status were noted. Bee diversity patterns recorded to date, suggest a generalized pollination system not associated with the limited distribution or small population sizes of *Agalinis* species. Nevertheless, previous studies indicate a level of specialization with respect to flower form and bee foraging behavior. The inflated flower form, combined with dimorphic stamens bearing filament trichomes seems to facilitate inverted bee foraging for pollen gathering. Support by Northwest.

C. Burandt, T. Wilson and A. Newton, Department of Biology, Missouri Western State University. **STUDYING FLY-HOST PLANT RELATIONSHIPS IN A CAMPUS RESEARCH PRAIRIE.** The 23-acre John Rushin Teaching and Research prairie began development in January 2020 through a collaboration between the Missouri Department of Conservation and faculty in the Department of Biology at Missouri Western State University. The multiuse prairie provides an excellent opportunity for applied higher learning. In our research, we study plant-arthropod relationships. Our aim is to determine if arthropods that are expected to inhabit a naturally formed prairie are found in the Rushin restored prairie. Native plant variation is important for maintaining arthropod biodiversity. Our focus was on *Paracantha* flies, which are known to inhabit thistle plants (*Cirsium* spp). From August through November of 2021, flower heads of tall and field thistle (*C. altissimum* and *C. discolor*, respectively*)* were monitored and collected in search of arthropod larvae and pupae. The location of each plant was also monitored via geographic positioning systems. Here we present the preliminary data from the pilot year of research.

C. Menne, A. Zahnd, J. Poush, M. Garza, K. Kyser, S. Buehre, A. Haddock, L. Tinoco and C. Barta. Department of Biology, Missouri Western State University, **FIRST YEAR VEGETATION SURVEY OF THE MISSOURI WESTERN STATE UNIVERSITY JOHN RUSHIN TEACHING AND RESEARCH PRAIRIE.** Prairies, populated by a vegetation blend of grasses, herbs, shrubs, and some tree species, historically covered over 400,000 square miles of North America. However, as a consequence of land use change, and agricultural repurposing, prairie coverage has substantially declined. In recent years, the scientific efforts focused on prairie restoration have largely increased, also establishing the basis of science-informed management practices. Missouri Western State University, in collaboration with the Missouri Department of Conservation and private land conservationists, has become one of the championing institutions of on-site prairie restoration in Missouri, with the restoration of a 26-acre campus plot to a conservation prairie. The John Rushin Teaching and Research Prairie today serves as model prairie ecosystem designed to facilitate scientific research and education in an applied learning, outdoors setting for students, faculty, and the community. The current work, as part of a long-term ecological and eco-physiological study framework, focused on an initial, first-year survey of the emerging prairie vegetation after the initial seeding in the beginning of 2020, and the relationship between emerging native species and invasive species. Based on our initial survey, we found that in its first year after seeding, only a proportion of the seeded prairie vegetation emerged successfully, while invasives and noxious weeds were still represented by a large number of species in distinct areas of the prairie. We found that about 60% of the emerging vegetation cover were native species and 40% non-native. About 50% of all identified species are weeds, 14% of which are noxious weeds. Of all identified species about 24% were grasses, and 27% belong to the Asteraceae (Daisy) family. Further prairie management and successful competition between

prairie species and invasives is expected to alter species composition in the following years, potentially shifting towards a higher success of native prairie species vs. invasives. Planned, differential-management practices, launching in 2022, on the surveyed plots are expected to reveal best-fit management practices to ensure native success and conservation in the following years.

H. Shoemaker, J. Potter, A. Kempf, S. Powell, B. Bashaw and M. Grantham. Department of Biology, Missouri Western State University. **METAGENOMIC ANALYIS OF DNA VIRUSES IN A SMALL URBAN POND.** Viruses are the most abundant biological entities in water bodies, and they are responsible for many biological and ecological effects in those bodies. However, most studies that have examined viral biodiversity focused on marine and large freshwater systems. A few studies have been performed in lakes, rivers, and reservoirs, but there are even fewer studies that have examined small freshwater bodies, such as ponds. This study focuses on the diversity of double-stranded DNA (dsDNA) viruses in the ponds on the Missouri Western State University campus. Virus particles were concentrated from pond water, and the DNA was isolated and used for metagenomic analysis using MinION sequencing. Initial data from one pond resulted in over 315,000 reads, and approximately 50% of those reads could be matched to existing viral, prokaryotic, archaeal, and eukaryotic sequences. Of the viruses we found, a majority of them were classified in the order *Caudovirales*, but there were also sequences of salmon gill poxvirus, a mimivirus, and a bacteriophage of *Bordetella* spp. These data indicate that we are able to isolate and sequence DNA from small freshwater systems using MinION sequencing, and future studies will compare these to data obtained from other urban ponds on the Missouri Western State University campus to gain a better understanding of the biotic and abiotic factors that affect viral biodiversity in these small freshwater systems.

J. Lewis. Department of Biology, Missouri Western State University. **SARS COV-2 OMICRON VARIANT EVOLUTION IN MIDWESTERN UNITED STATES.** SARS CoV-2 is a coronavirus which was first reported in Wuhan, China, in December 2019. SARS CoV-2 has spread across the planet multiple times, evolving into new variants as the pandemic continues. The current variant that has reached the US is known as the Omicron variant. This variant of SARS CoV-2 is more transmissible than other variants, while seeming to produce less intense symptoms, overall. We set out to compare the spread and evolution of the Omicron variant compared to the Delta variant, using previously collected Delta variant data to detect trends and differences between the variants. We utilized publicly available SARS CoV-2 genomes from GISAID, and analyzed data through software programs such as MrBayes to determine if evolution is occurring for the virus, and what evolutionary mechanisms are at play. We determined that the Omicron variant has spread throughout the Midwestern US, in a similar fashion to the Delta variant, but at a quicker rate due to the values associated in the phylogenetic tree. Population genetic analyses were also implemented to show what evolutionary pressures are on SARS CoV-2 as it spreads across the Midwestern United States.

M. Hoehns and A. Ślusarz. Department of Biology, Central Methodist University. **SOIL BACTERIA GROWTH WHEN INTRODUCED TO MARS REGOLITH SIMULANT.** Within the next 10 years, Elon Musk plans to send humans to Mars to start the colonization process (SpaceX). With this future mission, astronauts will need to prepare and learn how to survive on an extraterrestrial planet and learn how to grow their own crops to stay alive. The research process began by creating an ecosystem in Winogradsky columns, measuring the Mars

regolith simulant with a gradient, and measuring the bacteria in a bacterial growth curve. Based on my experiments, 1% Mars regolith simulant did not inhibit any of the six individual soil bacteria tested: *Rhodococcus rhodochrous*, *Bacillus megaterium*, *Rhodospirillum rubrum*, *Pseudomonas fluorescens*, *Micrococcus luteus*, and *Clostridium sporogenes*. The Winogradsky column ecosystems were not toxic to the Earth pond water, but the Mars regolith simulant could affect the profile of bacteria present.

C. Nwuba, J. Campbell and A. Campbell. Department of Natural Sciences, Northwest Missouri State University. **COMPARATIVE GENOMICS AND PHYLOGENETIC RELATIONSHIPS OF *SYNERGISTOTA* SPECIES FROM THE HUMAN MOUTH.** Bacteria within the phylum *Synergistota* are typically found in the human-oral cavity at the sites of periodontal disease but remain largely uncultivated and poorly studied. The purpose of this research is to analyze publicly-available genomes deposited in the Joint Genome Institute's (JGI) Integrated Microbial Genomes (IMG) database to analyze the metabolic capabilities of these organisms and elucidate genes potentially involved in pathogenesis. JGI's IMG/ER bioinformatics tools revealed that most oral-associated species within *Synergistota* contain genes encoding several proteins that can play a role in pathogenicity, such as glyceraldehyde 3-phosphate dehydrogenase, GTP binding protein LepA, phosphate transport system substrate binding protein, HSPA9 molecular chaperone DnaK and thioredoxin. These analyses shed some light on molecular mechanisms employed during pathogenesis by these bacteria.

P. Adams and J. Campbell. Department of Natural Sciences, Northwest Missouri State University. **ISOLATION OF ORAL MICROBIOTA USING BLOOD AGAR AND AEROBIC ENVIRONMENTS**. Many bacterial species in the human mouth have not been grown in a lab environment. Some of these species are suspected to contribute to the development of gingivitis, periodontitis and caries. Our goal is to isolate novel bacteria that have never been cultured in a lab. Samples were collected from healthy human saliva then enriched in aerobic R2A+blood and BHI+blood broth. After enrichment, bacteria were grown and isolated on solid forms of their respective media. Currently, we have approximately 30 samples awaiting 16S rRNA gene sequencing to identify these isolates. These results will inform future cultivation strategies for oral microbes.

K. Drzka and J. Campbell. Department of Natural Sciences, Northwest Missouri State University. **MICROAEROPHILIC ISOLATION OF MICROBIOTA FROM A HEALTHY HUMAN ORAL CAVITY.** Many bacterial species that can be found in the human mouth have not yet been grown in a lab environment. Some of these microbes are responsible for healthy conditions or inducing periodontitis, gingivitis and caries. We enriched and isolated bacteria from human periodontal samples under microaerophilic conditions on R2A and BHI supplemented with sheep's blood. Fifteen isolates were purified in total including 10 isolates grown on R2A with blood agar and five isolates on BHI. Pending Sanger sequences of 16S rRNA genes will be used to identify each isolate. These results will support future research of microbes responsible for oral diseases.

J. Unger and J. Campbell. Department of Natural Sciences, Northwest Missouri State University.
USE OF PLANCTOMYCETE-SPECIFIC MEDIA FOR FRESHWATER ENRICHMENT CULTURES. Bacteria that belong to the *Planctomycetota* phylum are part of the biological makeup of soil and aquatic environments but evade isolated cultivation in many laboratory settings. Water samples were obtained from Colden Pond and Mozingo Lake (Nodaway County, MO) and the Mississippi River (Saint Paul, MN). A freshwater medium (M1) was used and supplemented with various antibiotic concentrations in an effort to enrich novel planctomycetes. Approximately 14 pure cultures have been isolated, and 16S rRNA genes that were sequenced will be used for further identifications of the cultures. We plan to use similar media for additional aquatic and soil samples.

H. Wilcoxson, T. Roy, and K. Koy. Department of Biology, Missouri Western State University.
CREATING A SURVEY ABOUT THE EFFECT OF NATURAL HISTORY COLLECTION SPECIMENS ON STUDENT LEARNING OUTCOMES AND ATTITUDES TOWARDS SCIENCE. We are interested in how the integration of specimens from natural history collections can improve both student learning outcomes and attitudes towards science and a scientific career in undergraduate students. Well-preserved natural history specimens can lead students on a journey of discovery across time, enabling them to understand organismal form and function. The biology department at Missouri Western State University has several excellent biological and paleontological specimen collections. Different freshmen-level and upper-level undergraduate courses in biology utilize these specimens as part of various laboratory exercises. We predicted a strong correlation between hands-on laboratory experience involving specimens and improved student learning outcomes and attitudes towards science. We created a survey of student attitudes and self-evaluation to help better understand these connections. This consisted of pre- and post-assessments to compare subject satisfaction and understanding in relevant courses. It also included general questions based on previous biology laboratory knowledge and experiences. In the Fall of 2021, 3 post-assessments were given to an introductory biology lab and a pre-assessment was given to an upper-level biology course. The results of the surveys were analyzed to understand how and to what extent this benefits and improves student perspectives toward science through a variety of statistical methods. The results from our student surveys showed a positive correlation between students who worked with previous specimens and their overall perspective of the laboratory course and possible future work.

Chemistry Section

Oral Presentations:

B. Luo, A. Banik, E. W. Bohannan, J. A. Switzer, Department of Chemistry and Graduate Center for Materials Research, University of Science and Technology. **EPITAXIAL ELECTRODEPOSITION OF TRANSPARENT HOLE CONDUCTORS AND LIFT-OFF OF ORDERED FOILS FOR FLEXIBLE ELECTRONICS.** Epitaxial electrodeposition is a simple, low-cost technology to produce highly ordered materials on single-crystal surfaces. Epitaxial lift-off of films can produce free-standing ordered foils for flexible electronics. In this talk, we will discuss the epitaxial electrodeposition of materials and lift-off flexible foils. Firstly, an epitaxial Cu(111) film was electrodeposited on a self-assembled monolayer (SAM) of the amino acid L-cysteine on Au(111). Direct epitaxial lift-off of the Cu film without etching gives a single-crystal-like Cu(111) foil which could be utilized as flexible substrate for further growing other ordered materials. Secondly, epitaxial hole conductor CuSCN nanorods were electrodeposited onto Au(111). Highly-ordered CuSCN could provide a low density of defect sites and grain boundaries, suppressing charge recombination probabilities and facilitating efficient charge transport in opto-electronic devices such as perovskite solar cells. An ordered and transparent CuSCN foil was produced by epitaxial lift-off following a triiodide etch of the thin Au substrate. In addition, preliminary results will be presented on the low-mismatch CuCl(111)//Si(111) epitaxial system. This work is supported by the U.S. Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering, under grant no. DE-FG02-08ER46518.

E. Nordstrom, L. Gilbert-Saunders. Department of Chemistry, Missouri Southern State University. **TEA TREE OIL: AN INVESTIGATION OF EFFECTS OF LIGHT EXPOSURE ON AN ESSENTIAL OIL'S COMPOSITION AND STABILITY.** Essential oils are natural, volatile compounds which can possess medicinal properties such as antibacterial, antifungal, antiseptic, etc.; tea tree oil (TTO) is known to contain such properties, making it desirable as an alternative to conventional medicine. The effectiveness of these contained properties are unknown, and lack of FDA regulation on TTO allows for further variation of said properties to be marketed and sold globally. From previous research, it was found that TTO is susceptible to degradation reactions when exposed to light sources. Such reactions have potential to chemically alter the structure and stability of the oil, possibly affecting the safety, effectiveness, and proper intended usage. The purpose of this study is to assess the influence light exposure has on the composition of TTO. It was expected to find a relationship between increasing light exposure, in terms of energy, and degradation of the oil, which was measured through infrared and NMR spectroscopy. After exposing multiple samples of TTO to long-wave UV light for extended periods of time, new peaks appeared in the IR spectra at approximately 1680-1710 cm-1. Additionally, peaks in the NMR changed in both 1H and 13C spectra. These changes perhaps indicate the decomposition of TTO's original structure. Supported by Missouri Southern State University, Chemical and Physical Sciences Department.

R. Markley, L. Gilbert-Saunders. Chemical and Physical Sciences Department, Missouri Southern State University. **AN INVESTIGATION OF THE WATER QUALITY OF A RURAL FARM BY HACH AQUACULTURE TEST KIT.** Upon the acquisition of rural property, many landowners long for a tranquil quality of life, including recreational activities. For many rural areas the possibilities for fishing in ponds, streams, and rivers come to mind. The Kansas Department of Agriculture has recently pushed for landowners to test their water with a commercial testing kit to ensure this quality of life was within reach. Therefore, an investigation of the Hach Freshwater Aquaculture Test kit was utilized to ensure that the methods were reproducible within the field setting. Multiple water sources within the same water shed were sampled, in a one-mile radius. These testing sites included the Maris Des Cygene River, Middle Creek and a pond located on a farm outside of Ottawa, Kansas. It was found the test kit provided reproducible data and some inconclusive results. The main components of water tested with realistic data included acidity, alkalinity, carbon dioxide, chloride and total hardness, with the Maris Des Cygene River producing the highest parts per million of Cl^-. Other procedures examined but resulting in inconclusive data included dissolved oxygens, nitrate, and ammonia. Supported by the Missouri Southern State University Student Research Grant and the Chemical and Physical Sciences Department.

J. Long[1], P. Tompkins[1], and D.M. West[2], [1]Department of Physics, [2]Department of Chemistry, Southwest Baptist University. **CUSTOM CODED DATA ACQUISITION AND VOLTAGE SUPPLY SWITCH LABVIEW PROGRAMS.** A capillary electrophoresis (CE) instrument is being developed for course, laboratory, and research purposes at Southwest Baptist University. The instrument was assembled by an undergraduate research team. OceanView allowed for observation of instantaneous sample absorbance, but sample analysis required programs for the operation of the power supply and recording absorbance data for a given time. Both programs were designed using LabVIEW. The first program was coded to set the voltage and regulate the Acopian power supply. The power supply has provided adequate current to yield an electroosmotic flow through the silica capillary column for analyte separation. A second program designed to capture absorbance data can adjust the monitored wavelength and run-time parameters per sample injection. An Ocean Insight driver and NET wrapper program were imported into the LabVIEW code for the data acquisition program to communicate with the OceanHDX spectrometer. The direct communication between the spectrometer and the program has resulted in data acquisition for each sample analysis. The data acquisition program displays the recorded information in a real-time waveform graph. Curser markers are adjusted on the waveform graph for data quantification. Acquired data is directly exported to Microsoft Excel for complete data analysis. The project is ongoing with current improvements focused on including user interface navigation, reproducibility of sample injection, and functionality.

D. J. Echezona, D. L. Matthews, V. Alenicheva, C. A. Castelblanco Riveros, and M. J. Meziani, Department of Natural Sciences, Northwest Missouri State University. **RESIN INCORPORATING NANOPARTICLES FOR THE REMOVAL OF PHOSPHATE IONS FROM AQUEOUS SOLUTIONS**. A novel and facile route for the immobilization of magnetic nanoparticles in anion exchange resin beads with different loading is proposed. Morphology and structure of the resulting resin nanocomposites were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), energy dispersive spectroscopy (EDS), Fourier transform infra-red (FTIR), and thermogravimetry analysis (TGA). The results confirmed the presence of

smaller diameter Fe_3O_4 incorporated into the resin beads having an average diameter on the order of 10 nm with a few nanoclusters of 20-100 nm. The nanoparticles were homogeneously distributed throughout the resin. The magnetic-loaded resins will be tested for the removal efficiency of phosphate ions in lake water with different concentrations of phosphate solutions and pH levels. The resin form offers greater ease of handling, long term storage at room temperature, reusability in repeated reactions, and reduces the risk of environmental contamination.

D. L. Matthews,[a] V. Alenicheva,[a] C. A. Castelblanco Riveros,[a] M. J. Meziani,[a] Y.-P. Sun,[b] [a]Department of Natural Sciences, Northwest Missouri State University. [b]Department of Chemistry and Laboratory for Emerging Materials and Technology. **SYNTHESIS AND CHARACTERIZATION OF FLUORESCENT C-DOTS POLYMERIC COMPOSITE FILMS**. Carbon-based nanomaterials have emerged as the most promising due to their relatively high quantum yields, low cost, non-toxic nature, and excellent biocompatibility. Since the original report in 2006, carbon dots have been investigated by many research groups worldwide, with great advances made in their syntheses, mechanistic understandings, and evaluations for potential bio-applications. Development of inexpensive, and environmentally-friendly luminescent polymer films with these carbon-dots have drawn intense interest due to diverse applications in photonics, solar energy, antibacterial, and others. Here, we present a simple strategy for the fabrication of free standing flexible transparent films exhibiting tunable light emission by embedding carbon dots in polymer matrixes.

F. Burmeister[1], C. Jayasundera[2], C.N. Coon[3].[1]Department of Biology, Cottey College [2]Department of Chemistry, Missouri Valley College, [3] Department of Poultry Science, University of Arkansas. **NOVEL CHEMICAL MARKERS IDENTIFIED THROUGH SOLID PHASE MICROEXTRACTION GAS CHROMATOGRAPHY-MASS SPECTROSCOPY USED TO QUANTIFY POULTRY MEAL OXIDATION AND DEGRADATION.** Even the highest quality ingredients undergo oxidative stresses during manufacturing processes, increasing the nutrition delivery challenges facing large-scale feed manufacturing. In this preliminary study we investigate the impact of increasing peroxide values in rendered chicken meal and chicken by-product meal samples' chemical composition. The broad spectrum analysis utilized solid-phase micro-extraction (SPME) and gas chromatography-mass spectrometry (GC-MS) to identify 177 nonpolar compounds, 340 polar compounds, and 457 volatile compounds. The overall composition did not vary however individual compounds had strong linear correlations with peroxide value. In chicken by-product meal samples 38 compounds were linearly correlated and in chicken meals 27 compounds were identified ($r2>0.90$). This data introduces novel quality control markers for further research, and showcases the potential for greater accuracy by developing product specific markers. This research was funded by the Fats and Protein Research Foundation.

Poster Presentations:

O. Sharifi, B.Gunsaru, L. Gilbert, Department of Chemistry, Missouri Southern State University. **EXTRACTION, TOXICITY, AND CHEMICAL CHARACTERIZATION OF SELECT ANNONACEOUS ACETOGENINS.** Prior research has shown Annonaceous acetogenins to be effective in in-vitro studies by inhibiting the electron transport chain and angiogenic growth factors making it a potential candidate for oncological therapy. The exploration of variants of acetogenins and characterizing them are a critical step in further considering their use. Paw Paw twigs were collected in May of 2019 which was close to peak month for bioactivity. The plant material was shredded and dried in an oven at 40°C and ground. The dried plant materials were then repeatedly extracted with ethanol/methanol. Using this processed crude compound, the brine shrimp lethality bioassay (BST) was performed with aqueous methanol soluble fractions. The BST was used to assess the cytotoxicity of the extracts showing significantly greater toxicity to the shrimp compared to the methanol control and water hazard groups at 6, 12, and 24 hours. ($p<0.05$) indicating presence of the target compound. Further purification was achieved via HPLC chromatography. With the disparities shown via HPLC between previous studies and our samples, the samples are underway to being sent for LC/MS for further characterization. Work supported by MSSU Faculty and Equipment.

R. Markley, L. Gilbert-Saunders. Chemical and Physical Sciences Department, Missouri Southern State University. **AN INVESTIGATION OF THE METALS PRESENT IN THE MARIS DES CYGENE WATERSHED, RANTOUL KANSAS.** Upon the acquisition of rural property, many landowners utilize the water located on their farm for agriculture, livestock and human consumption. With this in mind, trace amounts of metals such as calcium, iron, lead, and zinc were analyzed by microwave plasma atomic emission spectroscopy (MP-AES- 4200, Agilent). Multiple water sources within the same water shed were sampled, in a one-mile radius. These testing sites included the Maris Des Cygene River, Middle Creek and a pond located on a farm in Rantoul, Kansas. Samples were collected over a range of dates for variability and frozen to maintain integrity. Standard calibration plots were created by using soluble inorganic nitrates, $Ca(NO_3)_2$, $Fe(NO_3)_3$, $Pb(NO_3)_2$, and $Zn(NO)_2$, over 2 orders of magnitude in parts per million. Data was collected in 5 replicates and averaged. Locations were compared for differences in metal distribution. Calcium concentrations were approximately 200 parts per million and were highest for the river and creek, however iron parts per million were approximately 0.20 and highest for the river and pond setting. Other metal ions will be discussed for location and concentration differences. Supported by the Missouri Southern State University Chemical and Physical Sciences Department.

G. Riddle[1], Z. Mayes[2], and K. Woelk[2], [1]Department of Physics, [2]Department of Chemistry, Missouri University of Science and Technology. **THE INFLUENCE OF DISSOLVED METAL IONS ON NUCLEAR MAGNETIC RELAXATION TIMES IN AQUEUS SOLUTIONS.** Relaxation of magnetization is frequently used in nuclear magnetic resonance (NMR) spectroscopy to gain information about materials properties such as Van der Waals interactions, molecular mobility, or porosity. Variations in relaxation times between biological tissues is exploited in relaxation-weighted magnetic resonance imaging (MRI) to generate image contrasts, such as between white and grey brain matter. In clinical MRI, cationic organometallic complexes such as gadolinium-based contrast agents (GBCAs) are often used to enhance the

clarity of images. A systematic investigation is conducted into the effects dissolved metal ions have on the ^{1}H NMR relaxation times of water molecules. The well-known and most studied effect paramagnetic Cu^{2+} ions have on water molecules is expanded, and compared quantitatively as a function of ion concentration, with other paramagnetic cations such as Co^{2+}, Fe^{3+}, or Cr^{3+}. The relaxation-time reduction caused by paramagnetic cations is compared with the effect diamagnetic cations have on the ^{1}H relaxation times of water molecules in solution. The diamagnetic ions used in this investigation are Na^{+}, K^{+}, or Mg^{2+} and are studied at the same concentrations of the paramagnetic cations. In further investigations, the effect of the anionic counterions such as Cl^{-} or SO_4^{2-} is evaluated and quantified. Results of this project provide critical baseline data for the search of new MRI contrast agents as well as for the evaluation of surface relaxivities. The knowledge of NMR surface relaxivities is useful for studying molecules adsorbing on paramagnetic surfaces or chemicals approaching catalysts with paramagnetic sites.

C. Murray[1], R. Herndon[2], Z. Mayes[1], M. Abdelrahman[2], and K. Woelk[1], [1]Department of Chemistry, [2]Department of Civil, Architectural and Environmental Engineering, Missouri University of Science and Technology. **CHARCTERIZATION OF PYROLYSIS OILS FOR ASPHALT FORTIFICATION.** The application of pyrolysis oil as a rejuvenator for aged asphalt is an attractive end-of-life use for hydrocarbon waste products such as used car tires or other rubber products. Pyrolysis oils are obtained through thermal processing of hydrocarbon or carbohydrate materials in an anaerobic environment at 300 – 1000 °C. Preliminary Nuclear Magnetic Resonance (NMR) studies of neat pyrolysis oil obtained from the thermal processing of car tires indicate the presence of both aromatic and aliphatic moieties, as well as smaller portions of amino groups. To characterize car-tire pyrolysis oils further, fractional distillations are used to separate volatile components from the desirable, less volatile compounds. Most of the volatile components are extracted at temperatures between 100 °C and 120 °C. Distillate samples are collected at different times during the fractional distillation, and their components identified by ^{1}H and ^{13}C NMR spectroscopy. The non-volatile oil components that remain after the fractional distillation are also investigated by NMR spectroscopy. The non-volatile fraction of the pyrolysis oil can be used to dope asphalt for an increased dispersion of load, which is expected to increase the pavement's lifespan. The use of the non-volatile oils from the car tires pyrolysis is envisioned to become an environmentally benign process for reducing the amounts of asphalt needed for road repairs and infrastructure maintenance and, at the same time, for repurposing large amounts of hydrocarbon waste materials.

A. Hermelink[1], H. Bahn[2], Z. Mayes[2], and K. Woelk[2], [1]Department of Chemical and Biochemical Engineering, [2]Department of Chemistry, Missouri University of Science and Technology. **INVESTIGATING INDUSTRIAL METHANOL PRODUCTION WITH NUCLEAR MAGNETIC RESONANCE RELAXOMETRY.** Methanol (CH_3OH) is an important bulk material and precursor chemical for many industrial and laboratory processes. It is used as organic solvent, antifreeze additive, or in liquid fuel production to facilitate the trans-esterification of natural lipids to biodiesel. Most commonly, methanol is produced industrially by the syngas route that converts natural gas (CH_4) through steam reforming into a mixture of carbon monoxide, hydrogen gas, and water vapor ($CO/H_2/H_2O$). The carbon monoxide/hydrogen/water vapor mixture is then converted to methanol, which is an exothermic reaction (-90.7 kJ/mol) but comes at the expense of a negative entropy balance. The syngas-methanol conversion is commonly facilitated at the active sites of a solid $Cu\text{-}ZnO/Al_2O_3$ catalyst

but at a yield of only about 7%. Nuclear Magnetic Resonance (NMR) relaxometry in a specialized toroid-cavity pressure probe is used to elucidate the reactivity of the catalyst's active sites. The toroid-cavity probe can record NMR relaxation data under the temperature and pressure conditions used in the industrial methanol production. A computational algorithm is used to analyze multiexponential decay data and extract their correlated relaxation coefficients. In the interpretation of the relaxation data, different coefficients are associated with different molecular environments, such as water molecules in the gas phase and water molecules bound to the catalytic sites. The relaxometry results will be used to identify yield-inhibiting processes in the methanol production, such as a suspected water-film deposition on the active sites of the catalyst, which could block the diffusion of gaseous molecules to the active sites of the catalyst.

R. Sait, Z. Ziauddin, C. Kaled, and N. Ulrich, Department of Chemistry, Maryville University. **WOULD YOU ADOPT A CHERNOBYL DOG? A GUIDED INQUIRY ACTIVITY FOR INTRODUCTORY CHEMISTRY STUDENTS.** Effectively engaging a diverse student population is a perennial challenge for chemistry educators. There is an ongoing need for guided-inquiry activities that feature real-life applications that will interest students. The Chernobyl disaster is considered the worst nuclear disaster in history and provides a fascinating framework for learning about radionuclides and their impact on the health of humans and animals. In the present study, we describe our efforts to create a guided-inquiry activity examining the relationship between radionuclides and their long-term impact on the large number of wild dogs (the "Chernobyl dogs") currently living within the Chernobyl Exclusion Zone. Using actual radionuclide data obtained from the Exclusion Zone, students will explore the chemistry and health effects of Sr-90, Cs-137, and Pu-239, thereby answering the question, "Would you adopt a Chernobyl dog?" Preliminary data assessing student achievement of our targeted learning outcomes will also be presented.

J. Alford, B. Jia, Department of Chemical and Physical Sciences, Missouri Southern State University. **ANALYSIS OF HYDROXYMETHYLFURFURAL IN HONEY USING A UV-VIS SPECTROPHOTOMETER**. Poor practices involving storage and transportation of honey cause the irreversible breakdown of fructose into hydroxymethylfurfural (HMF). While HMF is mutagenic, genotoxic, and organotoxic, its derivative (sulfoxymethylfurfural) is antioxidative, anti-allergenic, and anti-inflammatory, making the compound worthy of note. We adopted a method developed by J. W. White Jr. (as published in his 1979 paper to determine HMF levels in a variety of honey. A 5g (measured to the nearest 1 mg) sample of honey is treated with Carrez solutions for the clarification of the sample. After filtration, one test tube of filtrate is mixed with 0.1% sodium bisulfite to destroy the HMF chromophore, and another test tube of filtrate is mixed with deionized water. The filtrate with bisulfite serves as the reference, and the other as the sample. The HMF concentration is then determined by its absorbance at 284 nm measured by a UV-Vis spectrophotometer. While the United States has no legal limit for HMF concentration in honey, other nations have set their standard to 80 mg HMF per kg of sample, or 40 mg/kg for samples not originating in warm climates. Our determination of honeys from various suppliers has shown all falling below the 80 mg/kg. As HMF levels are used for the determination of purity of honey samples, these concentrations show how safe commercially available honey is, and shows room for potential improvement by manufacturers.

Computer Science & Mathematics Section

Oral Presentations:

K. Lai, K. Woelk, Department of Chemistry, Missouri University of Science and Technology. **REFINEMENT OF RELAXATION COEFFICIENTS IN NUCLEAR MAGENTIC RESONANCE.** Many natural decay and relaxation processes are described by rate equations of first-order kinetics leading to the determination of rate constants or relaxation-time constants. In Nuclear Magnetic Resonance (NMR) spectroscopy, spin-lattice and spin-spin relaxation-time constants (T_1 and T_2, respectively) are important parameters to evaluate the immediate environment around NMR-active nuclei and their molecules. Extracting these time constants from time-dependent nuclear-spin relaxation data can present a difficult task when nuclei of the same chemical shift relax with multiple time constants. The conversion of time-dependent NMR data into relaxation coefficients is a mathematical problem named Inverse Laplace Transformation. An iterative refinement algorithm is introduced as the solution for this transformation using a non-negative, least-squares optimization of the coefficient values. In every cycle of the refinement, the coefficients for two adjacent time constants are optimized, while all other coefficients are kept constant at their prior values. Once all coefficients are calculated, the process is repeated until no further improvement is achieved in fitting the experimental relaxation data. Compared to other existing methods for solving Inverse Laplace Transformation problems, the iterative solution produces relaxation curves that better fit the experimental NMR relaxation data. Using the sum of least-squares deviations as the maximum likelihood criterion, the improvement is typically about 0.5 - 1.5%. While this improvement may appear small, it can lead to substantial changes in the interpretation of NMR relaxation pathways.

J. Hayes, B. Link. Missouri Southern State University. **EXPERT AND NOVICE UNDERSTANDING OF INFINITY AT MATHEMATICS-PHYSICS INTERFACE.** The concept of infinity is applied widely in various contexts in physics, particularly while implementing the limits of large quantities, such as distance, time, and mass. We are investigating how experts and novices deal with this concept when they solve problems in mathematics and physics. We report results from individual semi-structured interviews with mathematics experts and physics students, where they are required to use the concept of infinity to solve the problems. We found that the ways experts and students interpret and implement the concept of infinity are not consistent. Students showed several difficulties with the concept of infinity which may either be due to their insufficient understanding of the concept, differences in how it is interpreted and implemented in mathematics and physics, or inappropriate implementation to physics. We also found that student difficulties stem from the fact that in mathematics infinity is used as an abstract upper bound, whereas in physics it is used to quantify scales of physical quantities.

Conservation Section

Oral Presentations:

J. Messick, Department of Biology and Environmental Health, Missouri Southern State University. **DRONES: NEW TOOLS FOR OLD TASKS.** Ecologic measurements made with an unmanned aircraft (UA or drone) were compared to traditional methods of collecting similar data. Qualitative thermal imaging to detect relative differences in temperatures were less dependent on protocol than were quantitative thermal imaging for radiometric measurements. The accuracy of temperature measurements made with a thermal drone is highly dependent on the ground sampling distance, flight altitude, emissivity, and related characteristics of the substrate. Population dispersion patterns determined using a drone were not significantly different ($p>0.05$) from the results of standard transect and plotless methods if flight altitude and camera angle were within the limits determined in this study. Results suggest that UA provide useful and sometime enhanced alternatives to standard methods for gathering ecologic data, but it is important to validate drone-based methodology against standard methods.

Poster Presentations:

J. Brooks[1,2], D.D. Duvernell[2], and L. Berkman[1], [1]Missouri Department of Conservation, [2]Biological Sciences Department, Missouri University of Science and Technology. **POPULATION GENETICS OF TOPEKA SHINERS.** The Topeka shiner (*Notropis topeka*) is a species of minnow that is endangered due to habitat destruction and sedimentation. Diminishing numbers reduced their range until only two refugial populations remained in Missouri, one in Moniteau Creek (Cooper County) and one in Sugar Creek (Daviess and Harrison County). Fish were taken from both locations to form two hatchery stocks for use in founding and maintaining new populations of Topeka shiner throughout their historic range. The Missouri Department of Conservation recently undertook a study investigating the effects of hatchery rearing to determine if there was a loss of genetic diversity within either of the captive populations or loss of distinctiveness between them compared to wild-caught samples. Preliminary results indicated that the two populations remained distinct and analyses currently in progress will allow researchers to quantify any loss of genetic diversity through the examination of diversity statistics.

O. R. Buschhaus and J. D. McGhee, Department of Natural Sciences, Northwest Missouri State University. **ESTIMATING SURVIVAL AND DETECTION PARAMETERS FOR AN AMERICAN BULLFROG POPULATION IN NORTHWEST MISSOURI.** The estimation of survival rates and the assessment of the probability of capture of adult bullfrogs aid in understanding species population dynamics. In this study, we obtained estimates of the weekly survival rates of American bullfrogs (*Lithobates catesbeianus*) using capture-mark-recapture (CMR) methods on a population in a single pond under field conditions in Northwest Missouri. We performed an analytical study on the survival rate of a local *L. catesbeianus* population using a live capture Cormack-Jolly-Seber (CJS) model in the MARK software. We compared five models regarding detection rate (p) and survival (phi) using AIC. The two best performing models selected assumed constant weekly survival and a constant detection probability. We

conclude this result is largely a function of low capture rates and that further studies should aim to capture and mark a larger proportion of the population to better assess these population parameters.

K. L. Kamke[1], S. L. Holcomb[2], B. Landwer[3], and W. R. Mabee[1], [1]Missouri Department of Conservation Central Region Office and Conservation Research Center, [2] Missouri Department of Conservation, Camdenton Office, [3]Missouri Department of Conservation, Agriculture Systems Field Station**. FAXONIUS PUNCTIMANUS (SPOTHANDED CRAYFISH) (DECAPODA: CAMBARIDAE) INVASION OF A WADABLE STREAM IN THE OSAGE RIVER BASIN IN MISSOURI.** An adult Form I male specimen of the crayfish *Faxonius punctimanus* (Spothanded crayfish) was found from Elm Springs Branch tributary to Tavern Creek in the Osage River drainage within the Ozark Highlands in Missouri during 2020. Sampling techniques and taxonomy used in collection and identification of the specimen are provided, and habitat characteristics of the reach where *F. punctimanus* was found to occur are presented. *Faxonius punctimanus* is regarded as an invasive species within the Osage River drainage basin in Missouri, and extensive sampling efforts combined with detailed studies of biotic communities, physical habitat, and water quality of sites invaded by *F. punctimanus* are warranted to assess status of this species regarding effects to other freshwater organisms and systems where it is invasive.

Geography Section

Poster Presentations:

C. Pallas. Department of Classics, Archaeology, and Religion, University of Missouri – Columbia. **ACCESSIBILITY AND ARCHAEOLOGY: A CASE STUDY OF RADIOCARBON DATED MATERIALS IN ITALY USING GIS.** Archaeology as a subject has made strides in terms of addressing and lessening the effects of colonialism, imperialism, and elitism, amongst other problematic foundations of the field, but still has a long way to go in terms of making the field an accessible and inclusive space. Due to my interests in archaeometry (the application of scientific analyses to studies in archaeology), I decided to examine accessibility in terms of place of origin of radiocarbon dated materials and surrounding resources, especially those concerning education. For my research, I used geographic information systems (GIS) to analyze the relationship between the location of materials dated via radiocarbon dating and that of education facilities in Italy. The radiocarbon dated materials dataset originated from the open access Archive of Italian Radiocarbon Dates (AIDA) and comes from 946 different archaeological sites across Italy, including the mainland, Sardinia, and Sicily. The remaining data used for analyses originated from the Humanitarian Data Exchange. The dated material and additional data provide information concerning the place of origin and the type of material for 4,040 radiocarbon dates. The resulting maps appear to show a relationship between the place of origin for radiocarbon dated material and education facilities in Italy, indicating that materials which are able to be radiocarbon dated are more likely to be dated if they are in close proximity to an education facility.

Geology & Geoscience Section

Oral Presentations:

D. DeHart and D. Gouzie, Department of Geography, Geology and Planning, Missouri State University. **BUILDING A RATING CURVE FOR STREAMS IN SPRINGFIELD MISSOURI.** In this study, we used the formula Discharge = Σ (Area x Velocity). A stream will be divided into subsections of 2 feet increments. For Area, we used the formula Area = (Depth x Width). For measuring Depth, we measured streams during many different conditions. These conditions include Low-Discharge, Medium-Discharge, and High-Discharge. To measure the Depth of the water, we have installed painted height guides in box culverts, and traced a ruler guide on a wading pole. In the stream channel, we moved in increments of two feet subsections for Width value. For Velocity, we calculated the speed of the water using a mounted pole system, with an impeller that counts revolutions. Overall, we have created discharge curve graphs with respective R^2 values. However, Springfield Missouri has been part of a drought for much of the project length. At first, much of the data was Low-Discharge, and as a result, the graphs had poor R^2 values. Once more rainstorms came, our R^2 values improved on our graphs with the broader range of discharge. A Rating Curve can help future projects by being a tool to quickly measure the discharge of the water and make it easier to record data on projects. A rating curve in this study can further simplify getting data for other studies on water quality and locating and monitoring drainage in Springfield Missouri.

R. Gomez and M. Gutierrez, Department of Geography Geology and Planning, Missouri State University. **WATER QUALITY MONITORING OF FIVE SPRINGS IN POLK COUNTY, MISSOURI, TO DETERMINE CONTAMINATION RISKS TO THE SPRINGFIELD AQUIFER.** The Springfield Plateau groundwater providence is an unconfined, karst aquifer that extends over southwestern Missouri and parts of Oklahoma and Arkansas. It overlies the Ozark confining unit and is mainly recharged by precipitation. Little research has been reported on this aquifer since it is not used for drinking supply nor irrigation. Being unconfined makes it vulnerable to waste contaminants from animals or other surface activities which reduce the quality of streams and may reach the Ozark aquifer, an important source of drinking water for the area. The objective of this ongoing study is to evaluate the ground water quality through analysis of the nitrate and selected major ions in five springs and one stream in Polk County, a county that holds the second largest number of cattle in Missouri. Samples were collected monthly for one year and analyzed for pH, alkalinity, turbidity, sulfate, chloride, calcium, magnesium, and nitrate. Springs having higher risk of contamination were identified and the amount of N export by the Little Sac River estimated. Overall, the results show a small contamination threat from cattle in the area, suggesting that the number of cattle and land management are operating sustainably and pose no threat to either streams or groundwater quality.

L. Rogers and M. Gutierrez, Department of Geography, Geology, & Planning, Missouri State University. **NITROGEN LOAD IN THREE STREAMS OF THE JAMES RIVER WATERSHED NEAR SPRINGFIELD, MISSOURI.** The increasing amounts of nitrates and phosphates from cities and farms that run off into river systems contribute to the formation of deadly algal blooms, or hypoxic bottom-waters in the ocean. Large streams are monitored but the

export of nutrients from small streams are mostly unknown. The contribution of the James River watershed of the Ozarks was the focus of this study. The methodology employed included to find locations near U.S. Geological Survey (USGS) stream flow gages, collect samples from the rivers, analysis and processing of the data. To ensure accuracy and to make sure no biotic processes skew the data, the samples were filtered and measured for pH, alkalinity, turbidity, $N0_3$-N, N-total and N-organic as soon as possible. The results of this research are expected to find an increase in the spring when farms and urban gardens add fertilizer. Besides, this will be background dataset for this watershed.

L.E. Speir[1], R. du Plessis[2], D. Oprean[2], and S.M. Jacquet[1], [1]Department of Geological Sciences, [2]School of Information Science and Learning Technologies, University of Missouri
VIRTUALLY THERE: PROGRESS TOWARDS A GEOLOGICAL VIRTUAL FIELD ENVIRONMENT OF ROCK BRIDGE MEMORIAL STATE PARK. Field education is an integral component of geology curricula, but inclement weather, global pandemics, and inaccessibility limit these opportunities. Virtual field environments (VFEs) offer an alternative means for students to digitally engage in field education. Herein, we document the development of a VFE intended to explore the karstic system within Rock Bridge Memorial State Park (RBMSP), which will serve as a supplement and/or replacement to the mandatory introductory geology field trip at the University of Missouri. We utilized a suite of pre-existing tools to develop the VFE. Initial scaffolding was completed on ThingLink (www.ThingLink.com, an online education platform specializing in interactive media) and features a series of 360° photos of key stops from the field trip. Students can freely navigate through the VFE, uncovering the geologic history of RBMSP via informational images, embedded web content, and 3D models of common rocks and fossils. A prototype was deployed in Fall 2021 wherein the ThingLink tour was embedded into a Canvas quiz followed by a summative assessment. While this met the immediate need for that semester, it highlighted the assessment limitations of the ThingLink platform. Current redesign efforts employ the e-learning platform Articulate Storyline to seamlessly incorporate formative and summative assessments into the VFE. Embedding content from ThingLink into Articulate Storyline takes advantage of the capabilities of both platforms, thus forming the basis of our VFE. Once completed, a version of the VFE will be published for broader audiences to discover the exemplar geology of the state of Missouri. Supported by a 2021 Paleontological Society Outreach and Education Grant.

D. Wormington, K. Mickus, and D. Gouzie, Department of Geography, Geology, and Planning.
INVESTIGATION INTO KARST OF SOUTHWEST MISSOURI USING ELECTRICAL RESISTIVITY. Nixa, Missouri is located on the southwestern edge of the Ozark Dome which consists of karst terrane. Near surface geophysical methods can be used in determining the location and nature of karst features such as caves and sinkholes, especially those that are not visible on the surface. There are a variety of geophysical methods that can be used to investigate karst features including electrical resistivity, gravity, seismic refraction, and very low frequency electromagnetic. While all these methods are useful in imaging karst features, electrical resistivity methods have been shown to be the most useful in deciphering sinkholes and caves. To investigate a known cave and related sinkholes and faults within Mississippian carbonates south of Nixa, Missouri, a series of two-dimensional electrical resistivity profiles will be collected using the Schlumberger array. Terrain data will be collected to include in modeling. The data were modeled using a robust two-dimensional inversion method where the inversion

parameters were varied to determine the statistically most reasonable model. Large areas of high resistivity have been detected using these methods. These areas represent undiscovered voids in the subsurface in the study area.

Physics & Engineering Section

Oral Presentations:

D. Washington. Department of Science, Technology, and Mathematics, Lincoln University. **FLEXIBLE OPTICAL FILTERS FOR HEALTH MONITORING DEVICES USING TECHNIQUES LIKE PULSE OXIMETRY AND FLUORESCENCE SPECTROSCOPY**. The main purpose of this research was to discover flexible optical filters for health monitoring devices using techniques like pulse oximetry and fluorescence spectroscopy. Research found various pulse oximetry and fluorescence spectroscopy techniques that excited and emitted at a variety of different LED wavelengths. The Data collected was from a spectrometer measuring how much light was absorbed through two different polymers. After conducting and analyzing data it was found that two polymer materials, P3HT and PBDTTTPD were well suited for absorption, exhibiting large absorption coefficients and spectrums. P3HT absorbed at a peak of 550nm for the pulse oximetry based optical technique. Whereas PBDTTTPD absorbed at a peak wavelength of 700nm for the fluorescence based optical technique. At the conclusion of the research, it was found that P3HT and PBDTTTPD are suitable for flexible optical filtering using pulse oximetry and fluorescence spectroscopy. The result from this research adds to data or current information that can be used to support the development of improved optical filtering techniques. Funded by the Department of Defense in partnership with the National Science Foundation.

P. Lewis, J. Numata, A. Stokes, J. Sundararajan, S. Burchett. Department of Chemical and Physical Sciences, Missouri Southern State University. **ELECTROLYSIS TANK RESEARCH PROJECT**. The production of hydrogen is of increasing importance as greener sources of energy are being sought out. Electrolysis, or the splitting of water molecules to produce oxygen and hydrogen gas using electricity, has the potential to produce hydrogen in a way that does not contribute to carbon dioxide emissions. In efforts to make hydrogen energy more familiar and accessible, there are tutorials on how to make hydrogen generators. If accessible tutorials and research were available on small-scale green production of hydrogen, it would further encourage public involvement and awareness in environment-friendly methods. The aim of our research is to create a small-scale electrolysis tank in which we can compare the most available yield improvements. The materials to be used are inexpensive in comparison to the industry materials available. This allows maximum accessibility to schools and independent researchers so that they can produce their own green hydrogen for energy use. Multiple improvement options will be compared in a common system to demonstrate cost-effective options. First, physical properties like the choice of the electrode will be compared. Surface area and shape will be adjusted to show effects on hydrogen yield. Next, chemical catalysts like the use of alkaline electrolyte solutions will be added and adjusted to observe the effects. Bath temperature will be adjusted from 30 to 80 degrees Celsius. Finally, the presence of a magnetic field will be applied. All adjustments will then be combined to observe total yield improvements for small-scale hydrogen production.

Poster Presentations:

M. Green and P. Hill, Department of Chemistry and Physics, Southeast Missouri State University. **THE USE OF POWDER X-RAY DIFFRACTION TO ANALYZE THE STRUCTURAL QUALITY OF NEW MAGNETOCALORIC MATERIALS**. Magnetocaloric materials are currently being investigated as an ecologically friendly and energy efficient alternative to commonly used vapor cycle refrigeration systems. Previous research on the $Mn_{5-x}Fe_xSi_3$ (x = 1, 2, 3, 4, 5) system has shown an enhanced magnetocaloric effect for the ferromagnetic compound $MnFe_4Si_3$. It has a Curie temperature of 302 K and shows the largest magnetic entropy change of the series. The maximum negative magnetic entropy change ($-\Delta S_m$) is about 4 J/kg•K for a field change of 5T around room temperature. To try and further improve the magnetocaloric properties of this material samples of $MnFe_4Si_{3-x}Sn_x$ (x = 0, 0.05, 0.10, and 0.15) were prepared using an arc melter. The samples' structure was examined using powder x-ray diffraction. X-ray diffraction of the materials reveals that the $MnFe_4Si_3$ sample is of single phase hexagonal structure and the substituted samples are primarily of the parent phase but show additional peaks of unknown origin. This presentation will discuss the full analysis of sample structure and outline our next steps for continuing the project.

E. DePriest[a], A. Brooks[b], [a]Department of Computer Science, Mathematics and Technology, Lincoln University; [b]Department of Aerospace and Engineer, Missouri University of Science and Technology. **GLASS AM RESEARCH PROJECT**. The main purpose of the project was to successfully 3D print glass. This project is important because we are making a breakthrough with the additive manufacturing of glass which is something very few groups in the world have achieved. My personal task was to make at translation program using MATLAB. The program is design to convert regular Marlin gcode that a FDM printer would use and it would convert it into a special gcode that our printer could read. Before I started my work, the printer would print without its full functions such as not utilizing the rotating turntable which limited the prints. After my work I have slowly added features that would make the gcode files shorter and more efficient and the turntable was then utilized. This will help the future of additive manufacturing and working with glass by learning the properties of it and by recording our findings.

Science Education Section

Oral Presentations:

M. Ghosh-Kumar. Department of Biology and Chemistry, Cottey College, **BIOCHEMISTRY LAB: QUALITATIVE AND QUANTITATIVE ANALYSIS OF CHICKEN LACTATE DEHYDROGENASE.** Understanding qualitative and quantitative assays are an integral part of biochemistry education. A comprehensive lab project was developed and implemented for undergraduate biochemistry at Cottey College, MO. Students were exposed to various hands-on experimental techniques including animal tissue homogenization, differential fractionation, salting out, protein extraction, chromatography, identification, enzyme assay, and quantification of protein yield. This one-semester biochemistry lab not only exposed students to many biochemical techniques but also helped them to design, execute, and analyze their research data, which were then communicated and presented through a final research paper. These research-based undergraduate labs also contributed to the development of analytical thinking and scientific data processing skills. Moreover, these rigorous science labs build confidence and inclusiveness among most of our underrepresented, first-generation student populations in a rural, Midwestern women's college.

M. Hill. Department of Chemistry and Physics, Southeast Missouri State University, **T-2 YEARS AND COUNTING: WHAT TO EXPECT FOR THE COMING 2024 TOTAL SOLAR ECLIPSE.** The 2017 total solar eclipse across America was an eyeopener for many. It had been almost 39 years since the shadow of the moon had entered the contiguous 48 states, where it went mostly unseen due to clouds and rain in the Pacific Northwest. When the path of totality crossed Missouri in 2017 individual communities were faced with decisions on what to do and how to prepare for the event. The next total eclipse will cross Missouri's bootheel in 2024, promising to be bigger and better than before. In addition, all of the United States will be able to witness at least a partial annular eclipse six months earlier. How will this affect our planning? With only two years to go, it is time to start talking. This presentation will cover the basic what, when, and where of the upcoming eclipse, provide information on what has already been done by national, state, and local planning committees to anticipate this event, and list where to find resources to help you and your community plan ahead. We will also review what we learned in planning for and celebrating the last event. Whether or not we plan for it, the eclipse will occur!

G. Bhattacharyya, Chemistry and Biochemistry Department, Missouri State University, **WHY DOES ROTE MEMORIZATION CONTINUE TO BE A DOMINANT STRATREGY FOR STUDENTS IN ORGANIC CHEMISTRY COURSES?** The publication of Morrison and Boyd's now legendary textbook was supposed to revolutionize teaching and learning in organic chemistry. Their book used electron-pushing mechanisms to teach reactions, so the prevailing belief of instructors was that the logic afforded by the mechanisms would, once-and-for-all, curtail students' rote memorization of reactions. This mechanistic approach continues to be the dominant method of teaching organic chemistry at the undergraduate and graduate levels. Though more than six decades have passed since the publication of Morrison and Boyd's first edition, the consensus from over forty research studies on how students learn and use electron-

pushing mechanisms to solve a variety of tasks is that rote memorization remains a prevalent method by which students internalize reactions and their mechanisms. In discussing research published by our group and many others worldwide, this talk will argue that rather than poor student attitude, the main reasons for rote memorization are a combination of the high, often implicit, cognitive demands of the mechanistic approach along with the students' stage of epistemic development and knowledge of the underlying concepts. Potential ways to overcome these obstacles are also proposed.

Poster Presentations:

J. Kessler, Department of Chemistry and Physics, Southeast Missouri State University, **COMPUTATION-BASED PROJECT FOR TEACHING UNCERTAINTY AND ERROR PROPAGATION IN A MODERN PHYSICS LABORATORY.** Uncertainty and error propagation are crucial skills for most STEM majors. However, where and when the topics are covered varies from simplified examples in early introductory physics courses to junior or senior level experimental methods courses. This presentation describes a novel method for teaching calculus-based uncertainty and error propagation skills where students perform two projects. Students worked in groups of two or three and were given two two-hour lab periods and time outside of class to complete each project. The projects were given during the first four weeks of a Modern Physics Laboratory course containing either sophomore or junior students majoring in either physics or engineering physics. The first project focused on understanding uncertainty and error propagation pertaining to experimental design for which students design laboratories to ascertain a measurement uncertainty below a threshold using a single measurement. The second project focused on interpreting uncertainty related to multiple measurement experiments using Monte Carlo simulations. Students needed to generate a large N (N>106) distribution of values to calculate finalized distributions, fit propagated distributions to a normal distribution to compute mean and standard deviation, and compare these values to their theoretical distributions. Students then applied these skills to a cellular phone triangulation example to determine the position and position uncertainty.

E. Sitkowski, and D. Morrone. Department of Basic Sciences, University of Health Sciences and Pharmacy in St. Louis, **AN EXPERIMENTAL BIOCHEMISTRY LAB COURSE USING COLORED MOLECULES TO IMPROVE UNDERSTANDING.** A biochemistry lab course may seem abstract to students who are unaccustomed to laboratory work. The purpose of this work is to build off previous results and introduce an additional intuitive, visual component to biochemistry lab education. As the volumes and concentrations of solutions are often small and colorless and spectroscopic work usually involves working with clear solutions, a biochemistry lab course often lacks a visual component that may assist in the learning process. To address this limitation, we developed an entirely visual biochemistry lab course wherein students purify and characterize a visually traceable fusion enzyme that also catalyzes a colorimetric assay. In its entirety, this lab course now involves a series of experiments that each makes use of visibly traceable components and experiments. Specifically, we developed a fluorescent protein fusion of mCherry-GUS. The fluorescent fusion partner allows students to visibly track their target protein from expression through purification as the mCherry protein is colored under ambient light. The GUS enzymatic fusion partner catalyzes a colorimetric assay that converts a colorless substrate into a yellow product. This visually traceable reaction allows students to monitor the

development of yellow color in a test tube in response to varying assay conditions. Kinetic characterization reveals the fusion to GUS does not alter kinetic parameters and expression analysis shows high production levels in *E. coli*. We report the development, characterization, and implementation of this entirely visual biochemistry lab course.

Social and Behavioral Sciences Section

Oral Presentations:

L. Hogan, Department of Psychology, College of the Ozarks. **PERCEPTIONS OF LEADERSHIP AND ORGANIZATIONAL CITIZENSHIP BEHAVIOR IN STUDENTS.** Many studies reveal the importance of trust in leadership and employee compliance. This study proposes to further investigate the relationship between the perceptions members of a large organization hold for high-ranking leaders and the members' subsequent motivation to obey those leaders. The subjects are members of an Introduction to Psychology class at College of the Ozarks (a private college in southwest Missouri), with ages ranging from 18-25. This study uses the APA definitions of "perception" and "motivation" as follows: "Motivation" is "the impetus that gives purpose or direction to behavior and operates in humans at a conscious or unconscious level," (APA 2020). "Perception" is "the process or result of becoming aware of objects, relationships, and events by means of the senses, which includes such activities as recognizing, observing and discriminating," (APA 2020).

Boston, C.E., Department of Social & Behavioral Sciences, Lincoln University-MO. **STUDENT BLOGGING TO INCREASE STUDENT ENGAGEMENT.** There has been a push in academia to incorporate digital technology into the classroom to capture students' attention and better achieve learning goals. However, not all educators are sure where to start or which tools are best to use. This presentation will focus on one particular technological tool that has been around for thirty years and has been incorporated into classroom settings for almost twenty years: blogging. Blogs are web journals that allow users to interact through posts and comments. Scholars have noted both benefits and challenges to implementing blogging in the classroom. I will reflect the experiences of posting students' work on an anthropology blog I have managed for almost a decade to offer potential solutions to many of the previously identified challenges.

B. Heckart, Department of Psychology, Missouri Southern State University. **A QUANTITATIVE STUDY OF RESTRAINT PRACTICES IN CLINICAL PSYCHIATRY.** Restraint practices are controversial in clinical psychiatry, as the use of force to restrict voluntary movement has been associated with both physiological and psychological consequences when staff exhibit incompetent restraint knowledge. The present study assessed the relationship between clinical psychiatric staff confidence and competence regarding technical knowledge of restraint practices; furthermore, the present study assessed relationships between staff years of field experience, time passed since receiving restraint education, and time passed since participating in a restraint episode. Participants (N = 93) responded to 15 competency questions based on the Code of Federal Regulations that establishes procedural guidelines for restraint practices in clinical settings. Each competency question was paired with a statement asking participants to rate their level of confidence in answering the respective question correctly on a scale from 0 (*not confident at all*) to 100 (*completely confident*). Results indicated significant group differences between the mean competency scores of all quartiles and between the mean confidence ratings of the first and third quartiles (M_1 = .87; M_3 = .92). Significant positive correlations were identified between competence and years of field experience and between time passed since receiving restraint education and time passed since participating in a restraint

episode. The results of the present study serve as an assessment of confidence and competence regarding restraint practices and advocate for continued efforts to increase clinical psychiatric staff restraint competency, staff retention, and frequency of restraint education.

R. Castellano, N. Lane, and A. Johnson, Department of Psychology & Sociology. Park University. **BODY BIAS IN TOP 100 BEAUTIFUL AND HANDSOME FACES.** Beauty is the eye of the beholder. However, there are a number of organizations that rate and rank beauty, e.g., Askmen, Esquire, Maxim, People magazine. The justifications for the rankings are elusive at best or privately guarded (Independent Critics). This presentation reports on a visual analysis of Independent Critics by TC Candler's Top 100 Most Beautiful and Top 100 Most Handsome Faces of 2020. Independent Critics boasts the highest viewership of any organization. According to their website, "Aesthetic perfection is only one of the criteria. Grace, elegance, originality, daring, passion, class, poise, joy, promise, hope… they are all embodied in a beautiful face." We wanted to examine the Independent Critics' Top Most Beautiful and Handsome faces for any insights into their rankings. We prepared the stimuli by taking still shots of each awardee from the TC Candler Facebook award video. We coded elements of each entry for name, rank number, country of origin, and age. Pixel count data were calculated for faces and bodies using GIMP 2.10. via the free-select tool. Google Trend data for January 2020 to January 2021 were collected for each awardee. The results indicate a significant Body Bias. The mean pixel ratio (face to body) was 18.74% (Females) and 20.04% (Males). Google Trend Totals were not correlated with Rankings. The mean age of the Females was 25.42-y-o and 31.46-y-o for Males. Male Age was not correlated with Rank; however, Female Age was significantly correlated with Rank providing evidence for a "younger is more beautiful" attitude.

V. Pascoe, Department of Psychological Science, William Jewell College. **AUTONOMIC ACTIVITY RELATED TO VISUAL AND INFORMATIONAL PROCESSING SPEED AND EFFICIENCY**. This study sought to expand the understanding of neuronal visual processes by researching the role of exercise on visual search efficiency in the population of undergraduate students at William Jewell College (N=19). The Symbol Digit Modality Test (SDMT) was presented as a pre- and post-test to participation in a High-Intensity Interval exercise program. The results of the comparison of these tests suggest participants requiring significantly more time to complete the second SDMT after participating in the exercise program: $t(18)= -2.835$, $p<0.011$, $d=-0.650$. Of note, however, was a secondary measure of accuracy comparison between tests revealed no significant difference in accuracy of participants compared across SDMT trials, $t(18)=-0.265$, $d=-0.061$, $p<0.794$, with correctness in responses remaining generally consistent. These findings suggest exercise and its by-product of increased heart rate variability produce an overall deficit in efficiency on such visual search tasks while having no significant impact on accuracy.

Poster Presentations:

A. Johnson, C. Young, and N. Legan, Department of Psychology, College of the Ozarks. **PHYSICAL ACTIVITY'S IMPACT ON COLLEGE STUDENTS ABILITY TO MANAGE EXTERNAL STRESSORS.** The purpose of this study was to analyze physical activity's impact on stress. We predict that there will be a positive relationship between physical activity and stress management among college students. We predict that high levels of physical activity will be associated with high levels of positive stress management. An online 12-question survey was sent out to college students in an introductory psychology course at a liberal arts college. These students participated in the questionnaire voluntarily and received extra credit. The results of our study showed a significant mean difference in how often an individual feels stressed (Independent Variable) being measured across their belief of whether exercise is beneficial for them or not (Dependent Variable). Secondly, there was not a linear correlation between the days a week you exercise (Independent Variable) and an individual's ability to manage stress (Dependent Variable). Finally, there was no significant relationship between class rank (Independent Variable) and the negative influences of stress (Dependent Variable).

R. Castellano, N. Lane, and A. Johnson, Department of Psychology & Sociology. Park University. **DISTORTED PERCEPTIONS OF DC AND MARVEL SUPERHEROES AND VILLAINS.** This study reports on the accuracy of DC/Marvel characters' Universe, Status, and Height and Weight estimations. We collected data via an online survey for: Sex; Age; Familiarity with superheroes/ villains; and Engagement Activities. Participants were presented with 30 DC/ Marvel characters and asked to identify Universe (DC or Marvel), Status (Superhero or Villain), and to estimate Height and Weight (SAE or Metric). A total of 362 participants completed the survey (55% Males & 44% Females, mean age of 36.88). Seventy-seven percent indicated being Extremely or Very familiar with characters while 86% watch movies and 54% watch animated programs. The accuracy for Universe was 71.4% SAE (min 45% - Green Goblin – max 83% Captain Marvel) and 74.37% Metric (min 29% – Green Goblin – max 85% Poison Ivy & Ironman). The accuracy for Status was 78.5% SAE (min 55% – Scarlet Witch – 92% Ironman) and 78.7% Metric (min 45% Catwoman – max 85% Captain America & Spiderman). For Height and Weight estimations combined, the overall accuracy was 10.7% (male characters) and 19.4% (females). In contrast, the Extremely Familiar respondents were higher, 15.8% (males) and 25% (females). For Height, only 1 mean estimate (SAE) and 12 (Metric) fell within 95% CI. For Weight, 11 mean estimates (SAE) and 5 (Metric) fell within 95% CI. Character heights were underestimated. Female weights were underestimated; male weights were overestimated. Perhaps, estimations were influenced by racial/ ethnicity. Future studies would benefit by collecting these data and investigating whether identifying with superheroes or other personal factors are influencing perceptions.

A. Hays, C. Sanford, J. Shirk, and E. Thomas-Dietz, Department of Psychology, Westminster College. **THE EFFECTS OF NOTIFICATIONS ON MEMORY AND RECOGNITION.** Previous research has been conducted that shows notifications and the mere presence of one's mobile device does impact their ability to perform tasks. We tested how notifications impact people's memory and recognition for our research by testing two different groups. We planned to investigate if notifications distract them and their ability to perform well on a recall survey. We had both a control group and an experimental group that watched the same video to do this. Both

groups followed the same procedures from watching the short 10-minute video to completing a short 10-minute survey afterward that contained video questions and questions about their emotional state. Though the experimental group received a text notification during the experiment to measure if that notification distracted them and affected their ability to recall points in the video. It is hoped that the results of this experiment will give us a look inside at how much notifications distract us and how they impact our memory and recognition to support our hypotheses. Results of this study identify that there are risk factors on memory and recognition abilities because of mobile devices notifications. This study also has implications for targeting ways to reduce notifications and the distractions that they cause when performing everyday tasks.

A. Hays, V. Gentzsch, and K. Moore, Department of Psychology, Westminster College. **THE ROLE OF VALUES IN COLLEGE WOMEN'S DRUNKOREXIA AND DISORDERED EATING BEHAVIORS.** Disordered eating is on the rise among college women today. We are looking at the role of values in college women's drunkorexia and disordered eating behaviors. Drunkorexia is the act of limiting food intake before consuming alcohol. To do this we investigated the correlations between values of women in sorority life and those not in sorority life. Our participants took a 15-minute survey dealing with different scales looking at eating attitudes, drunkorexia motives, and behaviors as well as some demographic questions that placed them into the sorority and non-sorority groups. Only women of Westminster were counted as participants and only their data was used. It is hoped that the results of this study of comparing women at Westminster in Greek life and those not in Greek life will be significant and support our hypothesis that women in sororities with certain values will be more susceptible to higher levels of drunkorexia and disordered eating compared to women not in Greek life. Results of this study identify risk factors of drunkorexia and disordered eating among women on Westminster's campus. The results of this study also have implications for targeted interventions to improve healthy eating and drinking habits.

C. Arnold, C. Collins, M. Unnvik, and L. Elder, Department of Psychology, Central Methodist University. **INDIVIDUAL DIFFERENCES IN RESPONSE TO ARTICLE HEADLINES.** The present study examined the relation between ideology, belief in science, and reaction to headlines. Tal and Wansink (2016) showed that the general public finds articles containing scientific wording or graphs as more believable than articles without them, leading us to hypothesize that scientific sounding headlines will be found more believable. Furthermore, we expected that belief in science would buffer against belief in pseudo-scientific headlines. Finally, based on the theory of motivated reasoning (e.g. Washburn & Skitka, 2018) we expected that participants would be more likely to share article headlines that align with their political beliefs. To explore this, 400 participants were recruited using Amazon Mechanical Turk. Each participant was shown headlines that were manipulated to sound scientific or non-scientific on four different topics – vaccines, sex differences, running, and Gaia. Participants then indicated on a five-point scale how likely they were to share the article and how believable they found it. Consistent with our hypothesis, scientific headlines were found to be more believable ($M = 3.94$) than non-scientific headlines ($M = 3.81$; $p < .05$). However, contrary to our hypothesis, belief in science was positively correlated with belief in all articles, including pseudo-scientific Gaia articles ($r = .355$). Also inconsistent with out hypothesis, more conservative participants reported

higher likelihood of sharing all articles, including liberal-sounding articles. These results indicate underlying individual differences in response to article headlines.

E. Nelson, M. Richardson, and M. Westphal, Department of Psychology, Westminster College.
THE RELATIONSHIP BETWEEN STRESS, COVID-19 AND ALCOHOL USE. This project is based around coping strategies in college students and the use of alcohol during the unprecedented times of COVID-19. Alcohol has been found to be used to relieve stress, and for college students, along with the already stressful academic environment, COVID-19 has exacerbated mental health issues. The study comprised of 45 students from Westminster College. Westminster College has relatively high drinking rates compared to other colleges of similar size. This study seeks to establish the relationships between how COVID-19 has impacted our lives, the academic environment, and perceived stress with the use of an Educational Stress Scale for Adolescents (ESSA), Drinking Motives Questionnaire Revised (DMQ-R), and Corona Pandemic Anxiety Scale (CPAS-11). This study was done completely online at a small liberal arts college. The first hypothesis connecting high fear of COVID-19 with increased drinking habits was not supported ($p = 0.707, 0.329, 0.353, 0.563$). Sub scales of DMQ-R for enhancement and conformity were positively correlated ($p < 0.001$). Results have implications for changing drinking habits on campuses. Results can also be used to teach students better coping mechanisms on college campuses. Our presentation will include background research on the topic, the methodology of our study, and a discussion of our results.