

13th ANNUAL UNDERGRADUATE RESEARCH DAY



THURSDAY, MAY 5, 2022

1:00 PM – 3:00 PM

PLASTER STUDENT UNION

STUDENT POSTERS DISPLAY

1:00 PM to 2:00 PM

PSU Ballroom West

CNAS RESEARCH IN:

SCIENCE

TECHNOLOGY

ENGINEERING

MATHEMATICS

SPEAKER & AWARDS:

2:00 – 3:00 PM

PSU Ballroom East

SPEAKER:

Dr. Razib Iqbal,
Department of
Computer Science

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Tamera Jahnke, Dean

Jorge Rebaza, Associate Dean

Alicia Mathis, Biology Department Head

Adam Wanekaya, Chemistry & Biochemistry Department Head

Ajay Katangur, Computer Science Department Head

Doug Carroll, Cooperative Engineering Program Director

Toby Dogwiler, Geography, Geology & Planning Department Head

Stephanie Hein, Hospitality Leadership Department Head

William Bray, Mathematics Department Head

Robert Mayanovic, Physics, Astronomy & Materials Science Department Head

Guest Speaker Dr. Razib Iqbal is the 2021 recipient of the Atwood Research and Teaching Award and an Associate Professor in the Department of Computer Science

Title: Making Smart Homes Smarter using Human-as-a-sensor

Abstract: A smart home refers to a dwelling equipped with sensors and actuators that automate tasks normally handled by humans. One newer aspect is the inclusion of multimedia data, such as audio and video, captured via microphones and cameras. With the proliferation of smart home devices like Amazon Alexa and Google Home and low-cost video cameras, it is an evolving field from both research and commercial aspects due to the need to improve human capabilities in various scenarios, such as assisted living, safety, security, and entertainment. Motivated by the idea of improving human-computer interaction, we are investigating how to efficiently analyze live video data for fall detection to notify caregivers of a potential fall situation and analyzing voice interactions with smart devices for emotion detection to offer an intuitive smart home experience that will react based on the current emotional state of the user. This research exploration might also establish a foundation for future research on context-sensitive operational policy generation for smart indoor environments.



About Dr. Razib Iqbal: Dr. Razib Iqbal joined the Computer Science Department at Missouri State University in the Fall of 2015 as an Assistant Professor. His academic background is in Computer Science. He received a B.Sc. degree from North South University, Bangladesh, in 2004, and the M.Sc. and Ph.D. degrees from the University of Ottawa, Canada, in 2006 and 2011, respectively. Professor Iqbal started his academic career at Valley City State University, USA, as an Assistant Professor of Software Engineering in 2014. From 2011 to 2014, he was a Development Expert with the Bridgewater Systems Division of Amdocs in Ottawa, Canada. Dr. Iqbal has authored over 40 peer-reviewed articles in leading journals, conferences, and workshops. He reviewed numerous grant applications, journal and conference articles, and served on various international conferences and journals' technical program committees or editorial boards

About the Atwood Research and Teaching Award: The Atwood Research and Teaching Award was endowed by Dr. Jerry Atwood, a 1964 graduate of Missouri State University and now an internationally known chemist. He started his career at University of Alabama in 1967 but has been the department head at University of Missouri-Columbia since 1994. In addition he was appointed a Curators Professor starting in 1999. The award winner receives a certificate and \$2,500 to be spent over the next year on students, research supplies, summer salary or travel.

SUBMISSIONS 2022

BIOLOGY	
	--BIO: Ecology, Conservation and Wildlife--
1	CARBARYL SENSITIVITY IN GRAPEVINE Courtney Duncan. Biology. Faculty Advisor: Laszlo Kovacs
2	DISCREPANCIES IN CLASSIFYING A NOVEL SONG VARIANT IN WHITE-THROATED SPARROWS Rachel Lange. Biology. Faculty Advisor: Jay McEntee
3	IS WATER WILLOW (<i>JUSTICIA AMERICANA</i>) A DRIVER OR PASSENGER IN ITS OZARK STREAM ECOSYSTEM? Alexis Reifsteck. Biology. Faculty Advisor: Deb Finn
4	METAL CONTAMINATION DECREASES MACROINVERTEBRATE ABUNDANCE IN BIG RIVER OF SOUTHEAST MISSOURI Malachai Frisby. Biology. Faculty Advisor: La Toya Kissoon-Charles
5	A STORY OF A BROKEN DAM: AQUATIC VEGETATION COVER DECREASES WHILE ALGAE BLOOMS Daphne Miles. Biology. Faculty Advisor: La Toya Kissoon-Charles
6	LIFE-HISTORY OF A GRAZING CADDISFLY IN AN INTERMITTENT OZARK STREAM Hannah Robinson. Biology. Faculty Advisor: Deb Finn
7	STOCKTON LAKE CRAPPIE POPULATION DEMOGRAPHICS: EVALUATION OF A 10” MINIMUM LENGTH LIMIT Chase Forck. Biology. Faculty Advisor: Quinton Phelps
8	ASSESSMENT OF PADDLEFISH SNAG FISHERY AT FORT GIBSON DAM Cameron Haeffner. Biology. Faculty Advisor: Quinton Phelps
9	FOOD OR FLIGHT: FISH AFFECT MAYFLY EMERGENCE AND COMMUNITY COMPOSITION IN INTERMITTENT OZARK STREAMS Grace Minge. Biology. Faculty Advisor: Deb Finn
	--BIO: Cellular, Microbiology and Genetics--

10	<p>EFFECTS OF ZnO AND CuO NPS ON HUMAN THYROID CANCER CELLS (ML-1) VS RAT MEDULLARY THYROID CARCINOMA (CA77) Alyse Peters, Nakaja Weaver, Kayti Monahan, Biology. Faculty Advisor: Kyoungtae Kim</p>
11	<p>AN INVESTIGATION OF THE IMPACT OF CADMIUM SELENIDE ZINC SULFIDE QUANTUM DOTS ON SACCHAROMYCES Nhi Le, Jonathan Routh. Biology. Faculty Advisor: Kyoungtae Kim</p>
12	<p>ML-1 THYROID CANCER CELLS ARE MORE RESISTANT TO PLATINUM-BASED CHEMOTHERAPEUTIC AGENTS Seth Harris. Biology. Faculty Advisor: Kyoungtae Kim</p>
13	<p>PRENATAL AND POSTNATAL DIETARY EXPOSURE TO TIN DIOXIDE AND COPPER OXIDE NANOPARTICLES CAUSES AN INCREASE IN Iba1 POSITIVE MACROPHAGES AND NF-kB EXPRESSION IN PUBESCENT RAT COLON Daniela Silva, Camron Satterfield. Biology. Faculty Advisor: Paul Durham</p>
14	<p>THE EFFECTS OF HYPOCHLOROUS ACID AGAINST INFECTIOUS MICROBES Tarkesia Blakley. Biology. Faculty Advisor: Chris Lupfer</p>
15	<p>DETECTING TUMOR-CAUSING BACTERIUM <i>ALLORHIZOBIUM VITIS</i> IN SOIL BY PCR ANALYSIS Jacquelyn Wray. Biology. Faculty Advisor: Wenping Qiu</p>
16	<p>EFFECTS OF PRENATAL AND POSTNATAL DIETARY EXPOSURE TO SILVER OR PALLADIUM NANOPARTICLES ON CEREBRUM NF-KB AND GFAP EXPRESSION IN PUBESCENT RAT PUPS Daniel Garten. Biology. Faculty Advisor: Paul Durham</p>
CHEMISTRY AND BIOCHEMISTRY	
17	<p>FIRST STEPS TOWARD SOLVING THE CRYSTAL STRUCTURE OF YELLOW THERMOSTABLE PROTEIN Keerti Vittalam. Chemistry and Biochemistry. Faculty Advisor: Natasha DeVore</p>
18	<p>THE QUANTUM YIELD OF FLUORESCENT PROTEINS Caitlin Padgett, Chemistry and Biochemistry. Faculty Advisor: Natasha DeVore</p>
19	<p>WILD-TYPE CANINE-KRAS PURIFICATION AND CRYSTAL DEVELOPMENT Grace Kirsch, Chemistry and Biochemistry. Faculty Advisor: Natasha DeVore</p>

20	BIOPHYSICAL STUDIES OF DNA BACKBONE INTERCONVERSION AND DYNAMIC PROPERTIES VIA NMR Krusha Bhakta, Chemistry and Biochemistry. Faculty Advisor: Gary Meints	
21	IDENTIFICATION OF SUGAR-BASE PROTON INTERACTIONS USING NOSEY 2D NMR IN DICKERSON DEW DODECAMER, T9 AND 8mer T4 GpG Samia Mahmud. Chemistry and Biochemistry. Faculty Advisor: Gary Meints	
22	ICP-MS ANALYSIS OF CHANGES IN ELEMENTAL CONCENTRATION OF WHEAT GENERATIONALLY-EXPOSED TO CERIUM OXIDE NANOPARTICLES AND PERFLUOROCTANESULFONIC ACID Andrew Coulliette. Chemistry and Biochemistry. Faculty Advisor: Cyren Rico	
23	GENERATIONAL EXPOSURE TO CERIUM OXIDE NANOPARTICLES ALTERS PERFORMANCE OF WHEAT EXPOSED TO PERFLUOROCTANESULFONIC ACID Preston Clubb. Chemistry and Biochemistry. Faculty Advisor: Cyren Rico	
24	STRESS AND ANTIOXIDANT ACTIVITY ASSAYS OF WHEAT SUCCESSIVELY EXPOSED TO CERIUM OXIDE NANOPARTICLES AND PERFLUOROCTANESULFONIC ACID Maximo Reyes. Chemistry and Biochemistry. Faculty Advisor: Cyren Rico	
25	INVESTIGATIONS OF ONE-DIMENSIONAL “MOLECULAR SLINKY” FLUORESCENT PLATINUM CYANOXIMATES Marck Dragoi. Chemistry and Biochemistry. Faculty Advisor: Nikolay Gerasimchuk	
26	THE INHIBITORY POTENTIAL OF GOLD NANOPARTICLES ON THE AMYLOID FIBRILLATION OF HUMAN INSULIN Zachary Flint, Haylee Grannemann, Emma Taylor. Chemistry and Biochemistry. Faculty Advisor: Tuhina Banerjee	
27	SENSITIVE DETECTION OF EBOLA VIRUS USING FUNCTIONAL NANOSENSOR Cassidy Soard. Chemistry and Biochemistry. Faculty Advisor: Tuhina Banerjee	

COMPUTER SCIENCE	
28	<p>INTELLIGENT TRAFFIC INTERSECTION MONITORING VIA LIVE CAMERA Tyler Songer, John Meents, Guvanch Garryyev, Robert Safford, Cameron Briggs. Computer Science, Faculty Advisor: Mohammed Y. Belkhouche</p>
29	<p>AUTOMATED EYE TRACKING TECHNOLOGY AS AN ANALYSIS TOOL TO DETECT HUMAN WAKEFULNESS AND ENGAGEMENT Andrew Cole, Danielle Kelly, Daniel Snegur, Vitor Freitas, Jack Bauer. Computer Science. Faculty Advisor: Mohammed Y. Belkhouche</p>
30	<p>EYE PAUSE - FACIAL TRACKING MEDIA CONTROLLER Breven Hinckley, Nathan Kadlec, Rhett Proctor, Joshua Lewenczuk, David Harper. Computer Science. Faculty Advisor: Mohammed Y. Belkhouche</p>
31	<p>DETECTION OF MALICIOUS CONTENT IN COMPRESSED FILES USING DEEP CONVOLUTIONAL NEURAL NETWORKS Selma Bouraoui. Computer Science. Faculty Advisor: Mohammed Y. Belkhouche</p>
32	<p>AUTONOMOUS CONTROL OF FIXED-WING AIRCRAFT USING DEEP REINFORCEMENT LEARNING Hung Nguyen. Computer Science. Faculty Advisor: Siming Liu</p>
COOPERATIVE ENGINEERING	
33	<p>AUTOMATED SOLAR TRACKING SYSTEM Matt Bowie, Jeremy Long, Bronson Tavenner, Aaron Ivie. Cooperative Engineering. Faculty Advisor: Tayo-Obafemi-Ajayi</p>
34	<p>FREQUENCY MODULATED - CONTINUOUS WAVE DOPPLER RADAR Justin Sherman, Jesse Young, Seth Koscheski, Joseph Perry. Cooperative Engineering. Faculty Advisor: Rohit Dua</p>
35	<p>DESIGN AND DEVELOPMENT OF A CAPACITIVE DEIONIZATION UNIT FOR EVALUATING ELECTRODE STORAGE LIMITS Joshua Cox, Ana Torres. Cooperative Engineering. Faculty Advisors: Daniel Moreno and Tayo Obafemi-Ajayi</p>
36	<p>PID FLUID TEMPERATURE CONTROLLER Grant Shaver, Austin Atkins, Isaac Hargrave, Samuel Whittington. Cooperative Engineering. Faculty Advisor: Tayo Obafemi-Ajayi</p>

		GEOGRAPHY, GEOLOGY AND PLANNING
		--GGP: Geology--
37		A NEW SPECIES OF NOSTOCERATIDAE AMMONITE Todd Robitsch. Geography, Geology and Planning. Faculty Advisor: Damon Bassett
38		CULTURAL GEOLOGY OF THE LOWER MISSISSIPPIAN NORTHVIEW FORMATION "WORM ROCK", SOUTHWESTERN MISSOURI, USA Jaren Schuette. Geography, Geology and Planning. Faculty Advisor: Kevin Evans
39		BUILDING A RATING CURVE FOR STREAM IN SPRINGFIELD, MISSOURI Dorian DeHart. Geography, Geology and Planning. Faculty Advisor: Doug Gouzie
40		U-PB GEOCHRONOLOGY OF TITANITE AND ZIRCON TO DATE METAMORPHIC RESET OF 1.6 GA METAMORPHIC PLUTONIC ROCKS NEAR BUENA VISTA, COLORADO Sarah Sommer. Geography, Geology and Planning. Faculty Advisor: Gary Michelfelder
41		NITROGEN LOAD IN THREE STREAMS OF THE JAMES RIVER WATERSHED NEAR SPRINGFIELD, MISSOURI Logan Rogers. Geography, Geology and Planning. Faculty Advisor: Melida Gutierrez
42		HEAVY METAL ENRICHMENT AND TRANSLOCATION FACTORS IN ROOT, STEM, LEAVES, AND GRAIN OF EACH OATS (<i>Avena sativa</i>) AND BARLEY (<i>Hordeum vulgare</i>) IRRIGATED WITH TREATED WASTEWATER: A FIELD EXPERIMENT Jesus Manuel Ochoa-Rivero. Geography, Geology and Planning. Faculty Advisor: Melida Gutierrez
43		WATER QUALITY MONITORING OF FIVE SPRINGS IN POLK COUNTY, MISSOURI, TO DETERMINE CONTAMINATION RISKS TO THE SPRINGFIELD AQUIFER Ramona Gomez. Geography, Geology and Planning. Faculty Advisor: Melida Gutierrez

	--GGP: Geography, Geospatial and Planning--
44	DATA COLLECTION INFRASTRUCTURE FOR FEATURE SIMILARITY ANALYSIS IN SATELLITE IMAGES OF ARTIC SEA ICE CJ Moore, Gavin Moore, Dylan Berndt. Geography, Geology and Planning. Faculty Advisor: Xin Miao
45	WATER QUALITY ANALYSIS IN BLUEFIELDS BAY, JAMAICA DURING MARCH 2022 Hannah Lowery, Allison Gargus. Geography, Geology and Planning. Faculty Advisor: Bob Pavlowsky
	PHYSICS, ASTRONOMY AND MATERIALS SCIENCE
46	THE ORBITAL DRIFT OF CRYOVOLCANIC MATERIAL FROM ENCELADUS WITHIN SATURN'S E RING Amira Bezone. Physics, Astronomy and Materials Science. Faculty Advisor: Sarah Morrison
47	FABRICATION OF 2D HETEROSTRUCTURE OF GRAPHENE AND TRANSITION METAL OXIDES Jessica Fink. Physics, Astronomy and Materials Science. Faculty Advisor: Kartik Ghosh
48	DECONVOLUTION OF 2D MATERIAL RAMAN SPECTRA FOR MICROFABRICATING HETEROSTRUCTURES OF GRAPHENE AND MOLYBDENUM OXIDES Gabriel Fedynich. Physics, Astronomy and Materials Science. Faculty Advisor: Kartik Ghosh
49	ESTIMATING THE DEGREE OF ATMOSPHERIC JEANS ESCAPE FROM TERRESTRIAL EXOMOONS Cory Padgett. Physics, Astronomy and Materials Science. Faculty Advisor: Sarah Morrison

#1 - CARBARYL SENSITIVITY IN GRAPEVINE

Courtney Duncan. Biology. Faculty Advisor: Laszlo Kovacs

Insecticides are developed to kill insects without harming the plant. Our results suggest that the insecticide carbaryl may adversely affect grapevine (*Vitis* species). Necrosis in leaves of an F1 hybrid progeny of grapes has been observed in the field following the application of a carbaryl-containing insecticide. We were able to map the genetic determinant of this phenotype to a locus on chromosome 16 in the female parent's genome. However, field observations cannot be considered as evidence that necrosis is caused by carbaryl. We developed a leaf disk-based bioassay for testing the effects of carbaryl *in vitro* where we could ensure only two independent variables, the grape genotype and exposure to carbaryl. We used this bioassay to phenotype the entire F1 progeny, then performed QTL mapping using our observations. We mapped a QTL for sensitivity in our bioassay that corresponded exactly with the position of the QTL peaks from three independent field assays, confirming our hypothesis: necrosis observed in the field is caused by carbaryl. We continued our research by running an RNAseq on RNA extracted from the leaf tissue of sensitive and insensitive samples. We are currently working to enforce our bioassay results by identifying the portions of the genome responsible for carbaryl sensitivity.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45689>

#2 – DISCREPANCIES IN CLASSIFYING A NOVEL SONG VARIANT IN WHITE-THROATED SPARROWS

Rachel Lange. Biology. Faculty Advisor: Jay McEntee

White-throated sparrows have historically been known from their whistled song that ends in repeated triplets of notes. However, a new doublet-ending song variant appeared in the latter half of the 20th century in western Canada. This variant has spread eastward across North America in the decades since its first appearance and, according to Otter et al. (2020), completely replaced the original triplet in some western populations. To test the validity of this claim, this study conducted a blind scoring of a random sample of recordings used by Otter et al. in their study and recordings made by MSU students. The results of this scoring were compared with Otter et al.'s findings, which showed that some atypical sparrow songs are scored differently by different people. This highlights the need for an objective, automated scoring system of white-throated sparrow songs in order to make reliable conclusions about the spread of the double variant.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45718>

#3 – IS WATER WILLOW (*JUSTICIA AMERICANA*) A DRIVER OR PASSENGER IN ITS OZARK STREAM ECOSYSTEM?

Alexis Reifsteck. Biology. Faculty Advisor: Deb Finn

Missouri native plant, water willow, grows in Ozark streams and is typically the first macrophyte to recover following bed-moving flash floods. In other ecoregions, water willow has been proposed as an ecosystem engineer that increases streambed stability and embeddedness and reduces local water velocity. The ecosystem impact of water willow is not understood in the Ozark Highlands, nor is its sensitivity to nutrient status. We are surveying water willow in six streams, along an agricultural gradient, to assess both 1) its role as a local-scale ecosystem engineer ("driver"); and 2) Its potential response to nutrient concentrations at the watershed scale ("passenger"). Thus far, we have collected water willow rhizomes from three of the six streams and water samples from all six to measure major nutrients (phosphorous and nitrogen). We measured biomass allocation among root, shoot, and rhizome tissue for every 20cm of rhizome with a meristem and oven-dried at 60°C for 72 hours. We will assess its role as a local-scale ecosystem engineer later in the growing season. The results will allow us to better understand water willow's ecological role in Ozark streams.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45704>

#4 – METAL CONTAMINATION DECREASES MACROINVERTEBRATE ABUNDANCE IN BIG RIVER OF SOUTHEAST MISSOURI

Malachai Frisby. Biology. Faculty Advisor: La Toya Kissoon-Charles

Missouri's long history of mining, and centuries of contamination resulted in high metal concentrations in streams. In the Old Lead Belt (southeast Missouri), streams such as Big River contain sediments, vegetation, and detritus (decomposing plant material) with high concentrations of Pb and Zn. This metal contamination alters macroinvertebrate community composition as macroinvertebrates are sediment-dwelling organisms and their main food source is detritus. We carried out leaf pack experiments in Big River upstream (reference reach) and downstream (mining reach) of mine tailings to determine the impacts of mining contamination on macroinvertebrate colonization of detritus. Leaf packs (mesh hole size *Platanus occidentalis*) on contaminated and non-contaminated gravel bars in Big River. We hypothesized that more macroinvertebrates would colonize leaf packs in the reference reach compared to the mining reach. We also expected that more macroinvertebrates would colonize non-contaminated leaf packs compared to contaminated leaf packs. Contaminated leaf packs had 22% fewer macroinvertebrates compared to non-contaminated packs in the mining reach. There was a 20% difference between contaminated and non-contaminated leaf packs in the reference reach.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45733>

#5 - A STORY OF A BROKEN DAM: AQUATIC VEGETATION COVER DECREASES WHILE ALGAE BLOOMS

Daphne Miles. Biology. Faculty Advisor: La Toya Kissoon-Charles

Fluctuating water levels, depending on size and frequency, can affect aquatic plant growth, promote nuisance vegetation (e.g., filamentous algae), and result in shifts in dominant growth forms (i.e., submerged to emergent dominated system). Many impoundments in the Ozarks are spring-fed and experience fluctuating water levels. It is unknown whether seasonality or changes in water depth have a greater impact on submerged aquatic plant communities. William's pond, a spring-fed pond in the Ozarks, experienced lower than average water levels for about 22 months (almost 2 years) due to a malfunctioning dam. We completed seasonal vegetation surveys and measured water depth to determine how aquatic vegetation responded to changes in water levels. We hypothesized that decreasing water levels will subsequently lead to decreased submerged aquatic vegetation (SAV) cover and increased filamentous algae cover. SAV cover decreased by 63% and filamentous algae cover increased by 46% when the water depth was below average. This indicated an inverse relationship between SAV and filamentous algae. Decreasing water volume resulted in increased competition for nutrients, sunlight, and habitat for submerged vegetation. These findings imply that abnormal changing water depth had a greater impact on plant communities compared to seasonal changes in water depth.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45774>

#6 – LIFE-HISTORY OF A GRAZING CADDISFLY IN AN INTERMITTENT OZARK STREAM

Hannah Robinson. Biology. Faculty Advisor: Deb Finn

Intermittent streams are a harsh environment of flash flooding and long seasonal dry periods. Nonetheless, there is massive annual production of aquatic insects. One seasonally abundant caddisfly is *Agapetus illini* (Trichoptera: Glossosomatidae) which we collected from October 2020 to September 2021 in an Ozark intermittent stream to characterize their life history. We studied four reaches – two bedrock and two gravel, with one of each drying up completely for multiple months. Then we measured body length of every individual to get size distributions through time. Larvae first appeared in December, two months following the return of surface flow. All larval sizes were present by January, but the distribution differed among the four reaches suggesting asynchronous development. Gravel reaches are likely source populations based on the abundance of tiny larvae present during the extent of the growth season. A bed-moving flood in early May demolished the population aside from those at the upstream-most reach, which likely serves as a refuge during high-flow disturbance. The abundance and rapid generation time of *A. illini* suggest that, while underappreciated, intermittent streams contribute substantially to local ecosystems.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45751>

#7 – STOCKTON LAKE CRAPPIE POPULATION DEMOGRAPHICS: EVALUATION OF A 10” MINIMUM LENGTH LIMIT

Chase Forek. Biology. Faculty Advisor: Quinton Phelps

Recreational fishing is very popular in the United States and has the potential to greatly benefit local economies. White Crappie *Pomoxis annularis* and Black Crappie *P. nigromaculatus* represent commonly targeted and harvested fish species in Missouri. Currently, statewide crappie regulations allow anglers to harvest 30/person/day with no minimum length restrictions. However, certain systems are managed under varying minimum length limits and daily bag limits. Stockton Lake, located in southeastern Cedar County, northeastern Dade County, and southwestern Polk County, Missouri is formed by the Big Sac and Little Sac rivers. Crappie are currently managed under a 10” (250mm) minimum length limit of 15/person/day. However, little to no information regarding population demographics exists for the Stockton Lake crappie population. Using standardized fall trap-net sampling in conjunction with the Missouri Department of Conservation, we assessed population demographics (i.e., recruitment, growth, and mortality) using age data collected from the sagittal otoliths. Further, we used this demographic information to evaluate population level responses to harvest under current regulations. Understanding population demographics and responses to exploitation can provide managers insights into effective and proper regulations and management strategies.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45763>

#8 – ASSESSMENT OF PADDLEFISH SNAG FISHERY AT FORT GIBSON DAM

Cameron Haeffner. Biology. Faculty Advisor: Quinton Phelps

The Paddlefish snag fishery at Fort Gibson Dam (FGD) tailwater is the only high dam tailwater where snagging is permitted by statute. While most Paddlefish fisheries within the state are effectively constrained to winter and spring seasons due to fish density or timing of migratory movements, hydropower and flood releases at FGD provide a year-round attractant for Paddlefish. This extended snagging season makes FGD an important fishery by creating snagging opportunities for anglers that may not otherwise have access to Paddlefish. However, this could result in overall increased angling pressure, which, combined with high summer water temperatures, may have harmful impacts on the Paddlefish stock below the dam such as reduced abundance, reduced average individual size, and delayed or immediate release mortality. This study aims to quantify several variables impacting Paddlefish release conditions.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45898>

#9 - FOOD OR FLIGHT: FISH AFFECT MAYFLY EMERGENCE AND COMMUNITY COMPOSITION IN INTERMITTENT OZARK STREAMS

Grace Minge. Biology. Faculty Advisor: Deb Finn

In streams everywhere, fish eat mayflies. Mayflies in Western Mountain streams have been documented to chemically detect the presence of predatory fish and to respond by developing faster and emerging as smaller-sized adults. It is unknown if this pattern holds in other regions or in streams that lose surface flow, therefore, we asked whether similar responses occur in Ozark intermittent streams. Using emergence traps, we collected samples monthly for one year in two streams, one with fish and one without. The two streams are tributaries of Bull Creek in southwest Missouri and are similar in size and flow patterns. The fishless stream has a barrier between it and the mainstem, and the fish stream connects to the mainstem during floods. We measured adult mayfly mesonotum lengths to the nearest 0.1 mm using an ocular micrometer. Across all taxa, mean size was greater in the fishless stream. We also observed different communities, with greater diversity in the fishless stream and different dominant species between the two. Because flood timing and magnitude influence fish accessibility, it will be interesting to continue monitoring to assess whether our documented mayfly patterns change in years with different flood patterns.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45789>

#10 – EFFECTS OF PRENATAL AND POSTNATAL DIETARY EXPOSURE TO SILVER OR PALLADIUM NANOPARTICLES ON CEREBRUM NF-KB AND GFAP EXPRESSION IN PUBESCENT RAT PUPS

Daniel Garten. Biology. Faculty Advisor: Paul Durham

Metal nanoparticles have increased in utilization in industry resulting in increased water contamination. It is known that prolonged exposure to certain heavy metals through drinking water can cause neurological toxicity and damage. Previous studies have looked at damage to brain tissue as a result of direct contact with metals, but little is known about the effects of exposure to heavy metals on the brains of offspring. The goal of this study was to investigate the effect of silver and palladium nanoparticle exposure via drinking water of rat dams on the hippocampus of offspring. Nanoparticles were administered at 0.1 mg/L (Ag, 20 nm) or 2 mg/L (Pd, 15 nm) via drinking water of rat dams during pregnancy, and to offspring via the dam's milk. Pups were nursed for 21 days at which time they were sacrificed, brains were removed and frozen in liquid nitrogen. Brains were sectioned and stained for the presence of nuclear factor kappa B (NF-kB), and glial fibrillary acidic protein (GFAP). Tissues were also stained with nuclear dye, DAPI to identify morphological changes. Results showed an increase in NF-kB in hippocampal tissues of rat pups exposed to silver or palladium. No significant change was seen in GFAP expression.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45791>

#11 - AN INVESTIGATION OF THE IMPACT OF CADMIUM SELENIDE ZINC SULFIDE QUANTUM DOTS ON SACCHAROMYCES

Nhi Le, Jonathan Routh. Biology. Faculty Advisor: Kyoungtae Kim

Quantum dots (QDs) are nano-semiconductor crystals that are highly utilized for research and medical applications. Recent findings have indicated the toxicity of QDs, however, its impact on yeast remains unclear. The primary goal of our research was to investigate the interaction between QDs and *Saccharomyces cerevisiae* as well as the induced changes resulting from this interaction. We treated red cadmium selenide zinc sulfide quantum dots (CdSe/ZnS QDs) to yeast strains expressing different organelle reference markers, then we used these reference markers to track QDs' subcellular localization. We found that QDs initially interacted with the outer components of yeast cells with a preference for the mother site. Around 6 hours after treatment, QDs were found at the plasma membrane, the endocytosis vesicle, and the late Golgi/trans Golgi network. QDs were not observed in the late endosome. Additionally, we found that 6 hours of QDs exposure caused various abnormalities, including the prolonged turnover rate of endocytosis associated protein, Abp1-GFP; depolarization of GFP-Snc1; and fragmentation of the actin cable. Interestingly, results from the recovery assay showed that actin cable fragmentation resulted from QDs exposure is reversible. Overall, this study provided insight into yeast-QDs interactions.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45670>

#12 - ML-1 THYROID CANCER CELLS ARE MORE RESISTANT TO PLATINUM-BASED CHEMOTHERAPEUTIC AGENTS

Seth Harris. Biology. Faculty Advisor: Kyoungtae Kim

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 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 IC50 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 20uM of these chemicals, which is directly comparable in effect to the 100uM of chemicals in ML-1 cells. Upon comparing the expression levels of pro-apoptotic enzymes with 40uM of these chemicals, expression was 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.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45706>

#13 - PRENATAL AND POSTNATAL DIETARY EXPOSURE TO TIN DIOXIDE AND COPPER OXIDE NANOPARTICLES CAUSES AN INCREASE IN Iba1 POSITIVE MACROPHAGES AND NF-κB EXPRESSION IN PUBESCENT RAT COLON

Daniela Silva, Camron Satterfield. Biology. Faculty Advisor: Paul Durham

Heavy metal nanoparticles are being increasingly used in many different applications, which increases the risk of environmental contamination in drinking water during the manufacturing, use, and disposal of these products. Studies on the effects of nanoparticle exposure have focused on adult organs and tissues, but little is known about the impact of exposure during development. To study the effect of early-life exposure on the colon in Sprague-Dawley rats, tin dioxide and copper oxide nanoparticles were administered during mating, pregnancy, and after birth. After 21 days of nursing, the pups were sacrificed and colons were removed, frozen, sectioned, and stained to determine changes in the expression of Iba1, a marker of activated macrophages, and in the expression of NF-κB, a proinflammatory signaling protein. An increase in Iba1 and NF-κB staining was found in the mucosa of colon tissues of offspring exposed to nanoparticles when compared to the control group. These results provide evidence that exposure to copper and tin nanoparticles caused an increase in the number of macrophages in the colon tissues. Higher numbers of macrophages, which are associated with inflammation, may increase the risk of developing chronic colon diseases later in life.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45773>

#14 - THE EFFECTS OF HYPOCHLOROUS ACID AGAINST INFECTIOUS MICROBES

Tarkesia Blakley. Biology. Faculty Advisor: Chris Lupfer

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 and 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 quickly, 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.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45790>

#15 - DETECTING TUMOR-CAUSING BACTERIUM *ALLORHIZOBIUM VITIS* IN SOIL BY PCR ANALYSIS

Jacquelyn Wray. Biology. Faculty Advisor: Wenping Qiu

The bacterium, *Allorhizobium vitis*, lives freely in soil and can cause crown gall disease, potentially killing grapevines. However, not all *All. vitis* strains cause crown gall, only those containing a tumor-inducing (Ti) plasmid. When Ti plasmid is transferred from the bacterium to plant cells, it transforms and reprograms those plant cells to form a tumor that produces nitrogenous nutrients for *All. vitis*. This restricts the plant's nutrient flow and ultimately terminates the vine. To protect their vineyards from economic loss, grape growers need to know if their planting sites have the *All. vitis* bacteria containing the Ti-plasmid. Detecting Ti plasmid in soil by polymerase chain reaction (PCR) is challenging, as soil contains humic acids that interfere with PCR. This project is to develop a method to acquire good-quality DNA from soil and protocols of detecting *All. vitis* chromosomal DNA and the Ti plasmid. The optimum concentration of soil DNA for detecting both chromosome and Ti plasmid DNA was determined. Tumor-causing *All. vitis* were detected in the soils sampled. This method will be used to conduct a comprehensive survey of *All. vitis* in Missouri vineyard soils.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45777>

16 - EFFECTS OF ZnO AND CuO NPS ON HUMAN THYROID CANCER CELLS (ML-1) VS RAT MEDULLARY THYROID CARCINOMA (CA77)

Alyse Peters, Nakaja Weaver, Kayti Monahan. Biology Faculty Advisor: Kyoungtae Kim
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, an ROS 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 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. <https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45467>

#17 – FIRST STEPS TOWARD SOLVING THE CRYSTAL STRUCTURE OF YELLOW THERMOSTABLE PROTEIN

Keerti Vittalam. Chemistry and Biochemistry. Faculty Advisor: Natasha DeVore
The purpose of this research is to determine the crystal structure of yellow thermostable protein (YTP). We expressed the gene in *E. Coli* BL21 cells using the pETCK3 plasmid to initiate transformation. The expression of YTP protein in the cells (following the initial introduction of the plasmid) was initiated via the addition of Isopropyl-beta-D-thiogalactoside (IPTG). The cells were then grown for 2 days at 26°C. The cells were lysed with sonication followed by centrifugation. After centrifugation the lysate was purified with a nickel column followed by an ion exchange column. The purified protein was characterized by fluorescence and UV-vis absorption spectroscopy. We identified protein crystals with commercial screens and then optimized the crystals for X-ray diffraction. The X-ray diffraction data was collected at the Stanford Linear Accelerator. <https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45686>

#18 – THE QUANTUM YIELD OF FLUORESCENT PROTEINS

Caitlin Padgett, Chemistry and Biochemistry. Faculty Advisor: Natasha DeVore
The purpose of this research is to calculate the quantum yield of different fluorescence proteins. Quantum yield is a measure of the efficiency of photon emission represented through fluorescence. In this research, the quantum yield was calculated for yellow, blue, green, and a mutated green fluorescent protein. To find the quantum yield values, the sample needs to be compared to a standard. Fluorescein was used as the standard between all the fluorescent protein samples. The UV-vis absorption spectroscopy was used to collect the absorbance of the increasing sample concentration. The Fluorescent Spectrometer was used to determine the total area of the fluorescence of each sample concentration. The area of fluorescence versus absorbance was plotted to find the slope of the line which was used in further calculations to determine the quantum yield. The quantum yield was determined to understand and compare how much all the fluorescent proteins emitted fluorescent light. <https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45737>

#19 - WILD-TYPE CANINE-KRAS PURIFICATION AND CRYSTAL DEVELOPMENT

Grace Kirsch, Chemistry and Biochemistry. Faculty Advisor: Natasha DeVore

The purpose of this research is to express wild-type canine-KRAS in *E. coli* cells and isolate the expressed protein. Our goal is to determine the three-dimensional structure of the canine KRAS with X-ray crystallography. We are expressing the gene in *E. coli* BL21(DE3) competent cells using the pET28a plasmid. The expression of KRAS protein in the cells (following the initial introduction of the plasmid) was induced via the addition of Isopropyl-beta-D-thiogalactoside (IPTG), the cells were then grown for one day overnight. The cells were lysed with sonication. After centrifugation, the lysate was purified with a Nickel affinity column. The eluent was then further purified by ion exchange chromatography. The purified protein was characterized by UV-vis absorption spectroscopy. The protein is currently in the crystal screening process to further characterize the protein. <https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45781>

#20 - BIOPHYSICAL STUDIES OF DNA BACKBONE INTERCONVERSION AND DYNAMIC PROPERTIES VIA NMR

Krusha Bhakta, Chemistry and Biochemistry. Faculty Advisor: Gary Meints

Two palindromic DNA sequences – [5'-CGCGAATTCGCG-3'] (DDD) and [5'-GATAGCGCTATC-3'] (GCGC) – were analyzed via the 2D NMR techniques of ¹H-¹H NOESY and ¹H-³¹P HSQC. The Drew-Dickerson Dodecamer or DDD sequence is a well-studied DNA sequence. Through the correct proton assignments of the DDD NMR spectrum, similar principles of analysis were applied to evaluate the GCGC sequence. Proton interactions between nucleotides and their neighboring sugars were assigned using the NOESY walk. These assignments were then used to identify interactions between the sugar and phosphorus backbone through ¹H-³¹P HSQC. Assignments will later be confirmed through evaluation of the GCGC sequence at varying temperatures. Data gathered from analysis of the phosphorus backbone such as %BII will provide insight on base excision repair mechanism and the biomolecular recognition of lesions present in damaged DNA.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45746>

#21 – IDENTIFICATION OF SUGAR-BASE PROTON INTERACTIONS USING NOESY 2D NMR IN DICKERSON DEW DODECAMER, T9 AND 8mer T4 GpG

Samia Mahmud. Chemistry and Biochemistry. Faculty Advisor: Gary Meints

The Dickerson Dew Dodecamer (DDD) is a well-known DNA sequence, used as a control in experiments with similar DNA Sequences. In this project, NOESY 2D NMR was used to investigate proton interactions in the DDD sequence, which was further used to compare and investigate the T9 sequence, which is an alternative version of the DDD sequence. Along with T9 and DDD, an 8mer T4 GpG sequence was also investigated. The T9 sequence was damaged at the 9th position, where the normal C was replaced by a T to include T: G mismatch. The 8mer T4 GpG was a non-palindromic sequence of DNA, as compared to T9 and DDD, where a normal C: G base pair was replaced with a mismatched T: G base pair, now in a non-self-complementary sequence. NOESY 2D NMR of these DNA sequences showed significant chemical shifts along with the mismatched and damaged bases. These chemical shifts can be explained by conformational changes, which potentially changed bonds and proton-proton interactions between mismatched bases and surrounding bases. These data are crucial for understanding the recognition of damaged sites during DNA repair.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45762>

#22 - ICP-MS ANALYSIS OF CHANGES IN ELEMENTAL CONCENTRATION OF WHEAT GENERATIONALLY-EXPOSED TO CERIUM OXIDE NANOPARTICLES AND PERFLUOROOCETANESULFONIC ACID

Andrew Coulliette. Chemistry and Biochemistry. Faculty Advisor: Cyren Rico

This study was performed to determine the impact of successive exposure to emerging contaminants cerium oxide nanoparticles (CeO₂-NPs) and perfluorooctanesulfonic acid (PFOS) on wheat. Wheat was exposed to CeO₂-NPs in soil (500 mg/kg) and seeds harvested from these plants were grown again in soil amended with PFOS (50 mg/kg) until full maturity. The plants grown in PFOS are called daughter plants. The roots and shoots were harvested from daughter plants and processed for elemental analysis. Results showed that successive exposure to the contaminants can lead to changes in elemental uptake in plants. Further studies are required in order to understand the full impact of generational exposure these emerging contaminants.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45767>

#23 - GENERATIONAL EXPOSURE TO CERIUM OXIDE NANOPARTICLES ALTERS PERFORMANCE OF WHEAT EXPOSED TO PERFLUOROOCETANESULFONIC ACID

Preston Clubb. Chemistry and Biochemistry. Faculty Advisor: Cyren Rico

This study investigated the effects of generational treatments of wheat with cerium oxide nanoparticles (CeO₂-NPs) followed by exposure to perfluorooctanesulfonic acid (PFOS). Wheat was grown for 21 days (short-term exposure) or 90 days (long-term exposure) in soil with PFOS (50 ppm). Biomass production, chlorophyll content, enzyme activity, and membrane damage were measured at short-term exposure, while elemental concentration of grains harvested from long-term study was analyzed. Results showed that generational exposure to CeO₂-NPs improved chlorophyll content but reduced concentrations of important macro- and micro-elements in the grains. The data seems to suggest that continuous exposures to contaminants could negatively affect the nutritional quality and grain elemental composition in succeeding generations.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45786>

#24 – STRESS AND ANTIOXIDANT ACTIVITY ASSAYS OF WHEAT SUCCESSIVELY EXPOSED TO CERIUM OXIDE NANOPARTICLES AND PERFLUOROOCETANESULFONIC ACID

Maximo Reyes. Chemistry and Biochemistry. Faculty Advisor: Cyren Rico

This Course-Based Undergraduate Research (CURE) study investigated the effects cerium oxide nanoparticles (CeO₂-NPs) and perfluorooctanesulfonic acid (PFOS) in successive generation exposure of wheat plants. Seeds from wheat plants exposed to cerium oxide nanoparticles in previous generation were germinated and grown in soil contaminated with PFOS (50 mg/kg). After 21-day exposure, leaves were harvested and analyzed for different stress parameters (i.e., chlorophyll content, lipid peroxidation, catalase and ascorbate peroxidase activity). Results showed that the parent generation exposure to CeO₂-NPs could have effects on daughter plants' performance. In the future, grains from long-term exposure study will be analyzed to measure treatment effects on elemental and fatty acid compositions of grains.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45796>

#25- INVESTIGATIONS OF ONE-DIMENSIONAL “MOLECULAR SLINKY” FLUORESCENT PLATINUM CYANOXIMATES

Marck Dragoi. Chemistry and Biochemistry. Faculty Advisor: Nikolay Gerasimchuk

In recent years in our research group were discovered new molecular compounds based on platinum that exhibit ability for self-assembly in solutions with the formation of 1D-solids [1,2]. Those appear as flexible “poker-chip” stacks (or molecular slinky) both in solid state and in solutions and also demonstrate photoluminescence in the near-infrared region of electromagnetic spectrum beyond 1000 nm. There were total 6 compounds of PtL₂ composition (L = small organic molecules – cyanoximes – abbreviated further as DECO, PipCO, MCO, 2PCO, BCO and PyrCO shown below) of that type identified and characterized with their photophysical properties patented [3]. In this presentation we report results of studies pure solid dark-green powders of these six platinum compounds and also their micelles in aqueous solutions with two different detergents such as Na-decanoate and Na-dodecylsulfate. Solid state studies involved recording fluorescence spectra in the presence of several gases of industrial importance and at applied external pressure, while solutions studies were carried out in wide temperature range from +5 to +95°C. Conducted work lays foundation for the next step in this large project: photothermal cancer therapy based on micelles of PtL₂.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45771>

#26 –THE INHIBITORY POTENTIAL OF GOLD NANOPARTICLES ON THE AMYLOID FIBRILLATION OF HUMAN INSULIN

Zachary Flint, Haylee Grannemann, Emma Taylor. Chemistry and Biochemistry. Faculty Advisor: Tuhina Banerjee

The mechanism of amyloid fibrillation persists as one of the more difficult problems within the realm of biochemistry. The etiological nature of this reaction has provoked numerous studies, though the thermodynamic stability of the fibrils combined with the neuro-specific mediums in which they form remain insurmountable obstacles. Therefore, compounds that could kinetically impede this reaction are of particular interest. In this experiment, we assessed the inhibitory potential of gold-nanoparticles using human insulin. Insulin serves as a readily available analogue to many of the amyloid-forming proteins found in the brain, undergoing the same conformational change from a primarily α -helical structure to β -sheets. We synthesized the gold nanoparticles via the Turkevich method with polyethylene glycol (PEG) as the reducing agent. The particles were injected into an incubation solution of insulin hexamers and allowed to undergo fibrillation in parallel with control solutions. Thioflavin T (ThT) fluorescence was then used to track the respective rates of aggregation. Our preliminary findings show a potential link between the presence of gold nano-particles and slower rates of insulin aggregation.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45794>

#27 - SENSITIVE DETECTION OF EBOLA VIRUS USING FUNCTIONAL NANOSENSOR

Cassidy Soard. Chemistry and Biochemistry. Faculty Advisor: Tuhina Banerjee

Ebola virus hemorrhagic fever outbreaks have high fatality rate in resource-limited settings due to the lack of adequate infrastructure. The virus is spread via direct contact with body fluids from an infected individual or contact with infected bats and primates. To increase survival rate against the virus, a rapid detection method must be available. Though there are few point-of-care methods available for Ebola detection, they are not ultrasensitive and economical. They require more sophisticated instruments and resources for identification of the virus. Herein, we present a novel antibody-conjugating magneto-plasmonic nanosensor (MPnS, gold/iron oxide nanocomposite) for the multiparametric detection of Ebola virus within minutes. Multimodal detection strategies including SPR and spin-spin MR (T₂ msec) techniques enabled for the ultrasensitive finding of Ebola-glycoprotein (GP), one of the disease biomarker seen in the blood following Ebola virus (EBOV) infection, in low picomolar concentrations. Additionally, the visual detection of the target protein through colorimetric read-out (SPR) makes it ideal to be used in PoC settings. This new MPnS approach also allows for one-step rapid detection and differentiation between EBOV subtypes. Furthermore, the MPnS platform was able to detect Ebola-GP spiked in complex biological samples and exhibited high analytical performance in each case.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45691>

#28 - INTELLIGENT TRAFFIC INTERSECTION MONITORING VIA LIVE CAMERA

Tyler Songer, John Meents, Guvanch Garryyev, Robert Safford, Cameron Briggs.

Computer Science, Faculty Advisor: Mohammed Y. Belkhouche

This project aims to accurately track and monitor a city traffic intersection via a live camera feed. We used the publicly accessible Springfield city traffic intersection cameras as our main sample source, provided by Ozark Traffic. We track the position of all cars within view of the camera using a machine learning algorithm to detect them. We log statistics such as the number of cars and data specific to the cars. Expanding on the information gathered, we can accurately log different forms of traffic.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45673>

#29 - AUTOMATED EYE TRACKING TECHNOLOGY AS AN ANALYSIS TOOL TO DETECT HUMAN WAKEFULNESS AND ENGAGEMENT

Andrew Cole, Danielle Kelly, Daniel Snegur, Vitor Freitas, Jack Bauer. Computer Science. Faculty Advisor: Mohammed Y. Belkhouche

Human wakefulness is a recurring brain state and state of consciousness in which an individual is conscious and engages in coherent cognitive and behavioral responses to the external world. Eye-blinking and eye-blink rate have risen to be a promising means of measuring an individual's engagement with their visual content. Generally, the more important information is to an individual and the more wakeful and engaged they are, the more they will inhibit blinking. Statistical analysis indicates average blink rate ranges with calculation of 95% confidence interval values considering that average eye-blink rates vary among healthy adults depending on their environment and activity they are engaged in. Utilizing computer vision using the libraries OpenCV with the 68-point facial detection algorithm from Mediapipe, our system receives camera feed from a user's machine, detects their eyes, calculates their average eye-blink rate, analyzes their values against either a predetermined or user-defined wakefulness threshold, and provides user feedback relating to their current level of wakefulness and engagement. Additionally, our system provides optional activities to reengage the user if they fall below their wakefulness threshold and utilizes machine learning to refine the user baseline over time. The application possibilities for our system are promising and numerous.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45671>

#30 – EYE PAUSE - FACIAL TRACKING MEDIA CONTROLLER

Breven Hinckley, Nathan Kadlec, Rhett Proctor, Joshua Lewenczuk, David Harper.

Computer Science. Faculty Advisor: Mohammed Y. Belkhouche

By leveraging a field of Artificial Intelligence to derive data from images and videos, otherwise known as computer vision, the “Eye Pause” software can detect a user's attention to their media. The module includes the open-source library OpenCV to implement Haar Cascade Classifiers for facial detection and eye tracking. The Haar Cascade is a machine learning algorithm for object detection by using edge or line detection to frame a user's face and eyes. The software uses the classifiers to detect whether or not a user is looking at their screen. If a user stops viewing their screen, the playing media will halt until the user's gaze returns. Embedded in the module are configurable options that also include items like low-light modes or modifiable delay until pausing media when attention diverts. Intended as a convenience feature for consumers but has many applicable uses. Prominent applications are accessibility and also commercial training. The media controller allows a user that has difficulty utilizing conventional methods to be able to control media. Additionally, this controller could also be modified to ensure videos are watched by an employee for compliance or training purposes, only allowing the video to play when the user is viewing.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45680>

#31 - DETECTION OF MALICIOUS CONTENT IN COMPRESSED FILES USING DEEP CONVOLUTIONAL NEURAL NETWORKS

Selma Bouraoui. Computer Science. Faculty Advisor: Mohammed Y. Belkhouche

Cybercriminals are using vulnerabilities in compressed file formats such as .zip, .7zip, and .rar to deliver malware to computers without being detected by network filters and antivirus software. In cybersecurity, deep learning algorithms showed good results when applied to threat detection and malware classification. The main objective of this research is to establish methods to detect malicious content in compressed files without opening or extracting the contents of these files, and thus without harming the system. A deep convolutional neural network (CNN/ConvNet) was designed, implemented, and trained to detect potential malicious contents in compressed files. A labeled dataset consisting of malicious and benign compressed files was used in this research. Byte histogram features were extracted from each file and used to train the CNN model. The testing results exceeded 95% accuracy, and demonstrated the effectiveness of the proposed method.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45765>

#32 - AUTONOMOUS CONTROL OF FIXED-WING AIRCRAFT USING DEEP REINFORCEMENT LEARNING

Hung Nguyen. Computer Science. Faculty Advisor: Siming Liu

The design of autonomous control of fixed-wing aircraft has been a challenging high-dimensional continuous control problem for many years due to its excessive requirement for highly precise control while operating on the extreme edges of the flight envelope. This study extends the state-of-the-art Deep Reinforcement Learning algorithms to the realm of building autonomous flight controller. Specifically, we apply Deep Deterministic Policy Gradient algorithm and Actor Critic deep model architecture for the problem of automating aircraft control in Gym-JSBSim flight simulator. Through extensive trial-and-error simulated experiences, our controller is able to explore the full range of the nonlinear flight envelope and learn effective control policies for maintaining a target altitude and heading by directly adjusting control surface in multiple controlling tasks. To address the overfitted aircraft multidimensional oscillation issues, we extended the existing reward shaping function and introduced a new dimension on pitch level control for stabilizing the aircraft maneuvering in all wing level, side slip, and pitch level control. The results demonstrate that the pitch level oscillating issue was significantly improved by the extended reward shaping function. We further adopted transfer learning approach by training the controller on a simple task to gain the capability of basic flight control and further re-train the controller on more complicated tasks and achieved higher performance with a much shorter learning process.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45739>

#33 - AUTOMATED SOLAR TRACKING SYSTEM

Matt Bowie, Jeremy Long, Bronson Tavenner, Aaron Ivie. Cooperative Engineering. Faculty Advisor: Tayo-Obafemi-Ajayi

Due to the increasing world population and the depletion of many natural resources, there is a larger need for renewable energy than ever before. Solar energy is a popular alternative to the burning of fossil fuels due to its near infinitely renewable nature. As better technology develops, solar energy can become the best source of renewable energy. The goal of this project was to design an automated solar tracking system that follows the sun as it moves through the sky, increasing the efficiency of energy production when compared to a stationary solar panel. A Raspberry Pi Zero is being used as the system controller. It handles the calculations for the sun's location via a mathematical model, driving of the two axis motors, and processing of the data collected by the power sensor. To start the program the user will need to insert a flash drive with the coordinates of their current location and flip three switches on the front panel. Once that has been done, the system will run itself with no need for human interface. The system consists of two motors that allow the solar panel to twist and tilt to track the sun based on the mathematical model of the sun. The declination angle, latitude, longitude, and hour angle are all factors that play a role into the mathematical model of the sun. The efficiency of a tracking system could greatly impact the future of renewable energy sources.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45583>

#34 - FREQUENCY MODULATED - CONTINUOUS WAVE DOPPLER RADAR

Justin Sherman, Jesse Young, Seth Koscheski, Joseph Perry. Cooperative Engineering.
Faculty Advisor: Rohit Dua

Doppler radars utilize electromagnetic radiation to gather information on objects at a distance. This is accomplished by transmitting EM waves at a precise frequency, and analyzing how the distant object alters the frequency of the return signal. Our system accomplishes this by using a ramp generator IC chip that is connected to a voltage controlled oscillator. The chosen propagation frequencies were in the industrial, scientific, and medical spectrum, at 2.4GHz to 2.47GHz. The oscillator sends the transmit wave through a custom designed patch antenna, and is received by a second patch antenna, to be passed through a 15 kHz active low pass filter for offline computer processing via MATLAB. For electrical stability, and for size reduction, the radar was designed on a custom 2 layer printed circuit board with dimensions that are smaller than a standard breadboard. This project was designed to give educators and enthusiasts a way to easily introduce radar theory. Our group plans to make public the custom printed circuit board design files, our bill of materials, and safety instructions, to ensure people of any skill level could successfully build the system.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45726>

#35 - DESIGN AND DEVELOPMENT OF A CAPACITIVE DEIONIZATION UNIT FOR EVALUATING ELECTRODE STORAGE LIMITS

Joshua Cox, Ana Torres. Cooperative Engineering. Faculty Advisors: Daniel Moreno and Tayo Obafemi-Ajayi

To meet increasing demands for clean water, it is important to understand the thermodynamic performances of such processes. Reverse osmosis is most effective for removal of salt at high concentrations (e.g. seawater), but at lower concentrations, electrochemical techniques such as capacitive deionization (CDI) can be made more thermodynamically efficient. Due to CDI cells operating on lower cost and less energy than alternative desalination processes, they could lead to more accessible fresh water sources globally without the need for upkeep of high-pressure systems. CDI cells operate on lower voltage compared to electrolysis and exhibit higher energy efficiency. Here, the fabrication of a basic CDI cell is reported, including the design and construction of a CDI stack, fabrication of carbon electrodes using several chemical processes, and the construction of electrode processing equipment. Preliminary experiments are conducted which examine the salt removal and current decay for a given applied cell voltage. Presently, the cell can remove 10-20% of the initial salt solution, with this removal limited by the maximum storage capacity of the electrode. In the future, this salt removal will be compared with predicted theoretical values for a range of operating conditions.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45750>

#36 - PID FLUID TEMPERATURE CONTROLLER

Grant Shaver, Austin Atkins, Isaac Hargrave, Samuel Whittington. Cooperative Engineering.
Faculty Advisor: Tayo Obafemi-Ajayi

In today's day and age, it seems that automation and smart devices are found everywhere in the average home. The PFTC aims to fulfill this demand when it comes to automating shower temperature control, while also bringing an affordable option to the normal consumer. This is done by designing a system that incorporates its usage on the normal shower valve, being able to be installed without replacing the entire system. This proposition utilizes computer code (PID control that rotates a motor that in turn rotates the valve) in order to meet the set point given by a user, delivering the correct water temperature to the system within a matter of 45 seconds to a minute. With this system, a user can set a desired water temperature, walk away, and return to the shower with the water temperature set at exactly what they want. The product's affordability and versatility will eventually offer a device that can be adopted by many homes and families.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45782>

#37 - A NEW SPECIES OF NOSTOCERATIDAE AMMONITE

Todd Robitsch. Geography, Geology and Planning. Faculty Advisor: Damon Bassett

A new species of ammonite has been collected from the Upper Cretaceous Frontier Formation in Natrona County Wyoming. Ammonites are extinct cephalopods with external shells, related more closely to cuttlefish, squid and octopus, than to the extant shelled cephalopod species, the nautiloids. This specimen was originally identified as being a relative of the Nostroceratid *Eubostrychoceras matsumotoi*, and this research is an endeavor to further identify the specimen through the ammonitic sutures. Ammonoid sutures occur at the junction of the inner wall of the shell and the septum and may be utilized as a species identifying characteristic. Three methods were used in the attempt to locate sutures. The first involved meticulous scrutiny of the original fossil under a stereoscope. Attempts two and three used a type of three-dimensional photography in which minute details were visible with the aid of computer software. The specimen was photographed under different lighting conditions, with and without a coating of ammonium chloride. Ammonium chloride was added to enhance the visibility of any suture structures. These methods proved inconclusive, as no visible sutures were identified. Further investigation is warranted.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45625>

#38 – CULTURAL GEOLOGY OF THE LOWER MISSISSIPPIAN NORTHVIEW FORMATION "WORM ROCK", SOUTHWESTERN MISSOURI, USA

Jaren Schuette. Geography, Geology and Planning. Faculty Advisor: Kevin Evans

Burrows and other trace fossils are abundant in fine sandstones of the lower Mississippian (Kinderhookian Series) Northview Formation of southwestern Missouri. Blocks of this material especially are common in vernacular architectural applications in and around Springfield. Locally, this material is referred to as "worm rock" or "worm-eaten rock." A class project was undertaken to examine the ichnofauna of blocks used in construction of Phelps Grove Park amphitheater. Ichnospecies include *Scalarituba missouriensis* Weller 1899, *Nereites* sp., and *Zoophycos* sp.; previous investigators have shown that other fauna include bivalves and foraminifera. Over its depositional area, the Northview Formation ranges from approximately 1.5–25 m thick. In the area of thickest deposition, the Northview is composed of a cyclic succession of a lower light gray-green shale, and the upper part consists of interbedded very fine sandstone, siltstone, and shale. Two stratigraphic sections were measured and described north of Springfield at Noble Hill and Dunnegan to compare with the allochthonous blocks, and short cores were drilled for μ CT scans to examine burrows in three dimensions. An attempt was made to estimate burrow density, but μ CT scans indicate the rock was much more thoroughly bioturbated than what the surface texture would indicate. We collected hundreds of images of top and side views of blocks used as facing stone in the amphitheater. The structure was built in 1936 by the Works Progress Administration of the New Deal. Ed Elkins, stonemason and foreman on the project, oversaw a crew of more than 40 men in building the amphitheater and several public vernacular construction projects around the city. Four columns of the amphitheater are composed of middle Mississippian (Osagean series) Burlington-Keokuk limestones; these were moved to Phelps Grove from the old Colonial Hotel. The Northview Formation is an important stratigraphic unit regionally because it separates the lower Ozark aquifer from the upper Springfield aquifer over the northern part of the Springfield plateau. While the burrowed sandstone is aesthetically pleasing material for facing stone, it remains undetermined if burrow porosity poses a risk for water infiltration in buildings or as conduits for groundwater in the subsurface.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45690>

#39 – BUILDING A RATING CURVE FOR STREAM IN SPRINGFIELD, MISSOURI

Dorian DeHart. Geography, Geology and Planning. Faculty Advisor: Doug Gouzie
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.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45713>

#40 - U-PB GEOCHRONOLOGY OF TITANITE AND ZIRCON TO DATE METAMORPHIC RESET OF 1.6 GA METAMORPHIC PLUTONIC ROCKS NEAR BUENA VISTA, COLORADO

Sarah Sommer. Geography, Geology and Planning. Faculty Advisor: Gary Michelfelder
The Sawatch Mountain Range in central Colorado contain metamorphic rocks uplifted during the Laramide Orogeny related to the Paleoproterozoic Colorado province. These rocks are broadly interpreted to be part of the Gunnison-Salida arc terrane of central Colorado which is composed of the Dubois and Cochetopa successions of upper green schist to lower amphibolite facies rocks and later intruded metagranite/ granitic gneisses. Here we seek to determine the age range of these rocks near the contact of the 35 Ma Mt. Princeton batholith. Our intent is to determine if these rocks underwent substantial contact metamorphism and determine if partial melting of country changes the magma composition near the contact. Fifteen samples of the metamorphic rocks were dated U-Pb zircon and U-Pb titanite geochronology by laser ablation ICPMS to determine if zircon and titanites along the interface with the batholith were entrained during partial melting and if these ages are resetting the metamorphic ages of some metamorphic rocks. Additionally, fourteen samples from the Mt. Princeton Batholith were analyzed along two transects with varying distance from the interface. Separating partially reset titanite from new titanite will show the difference in timing between the initial rock formation and the timing of the most recent metamorphic event. We compare these ages with U-Pb ages of titanite and zircon in the plutonic rocks to determine the influence of partial melting of the metamorphic rocks on magma chemistry. These data suggest that the metagranites nearest to the batholith interface were partially reset by intrusion with intercept ages of 35 Ma and ~1400 Ma, but cores from these zircons retain the crystallization age of the granite at ~1400 Ma. Titanite is absent from the metamorphic rocks along the interface suggesting it was preferentially melted/ recrystallized during intrusion.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45730>

#41 - NITROGEN LOAD IN THREE STREAMS OF THE JAMES RIVER WATERSHED NEAR SPRINGFIELD, MISSOURI

Logan Rogers. Geography, Geology and Planning. Faculty Advisor: Melida Gutierrez

The increasing amounts of nitrates and phosphates from cities and farms that run off into river systems contribute to eutrophication (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 three rivers in 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, NO₃-N, N-total and N-organic as soon as possible. The results of this research show the end N-load varies between .008-2.23 Mg/d. The lowest values were observed in Wilsons creek and the highest in both Finley creek and James River after a heavy rain in early April, as we expected. In the spring farms and gardens apply fertilizers. Besides, this serves as a background dataset for this watershed.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45744>

#42 - HEAVY METAL ENRICHMENT AND TRANSLOCATION FACTORS IN ROOT, STEM, LEAVES, AND GRAIN OF EACH OATS (*Avena sativa*) AND BARLEY (*Hordeum vulgare*) IRRIGATED WITH TREATED WASTEWATER: A FIELD EXPERIMENT

Jesus Manuel Ochoa-Rivero. Geography, Geology and Planning. Faculty Advisor: Melida Gutierrez

Globally, freshwater resources in semi-arid areas are heavily strained. In many of these areas, domestic wastewater is used to irrigate crops. A concern associated with this practice is the potential accumulation of toxic heavy metal(loid)s (HMs) in plants. A border experiment was conducted to determine the accumulation of HMs in barley and oats irrigated with either treated domestic wastewater (TWW) and compared to those irrigated with groundwater (GW). The plant content of As, Cd, Fe, Mn, Ni, Pb and Zn in each of root, stem, leaves and grain were determined and compared between TWW and GW. As accumulated in the roots of the both crop crops; other metals showed higher accumulation in plants irrigated with GW and in oats more than barley. Bioconcentration factor and translocation factors showed a small tendency of these plants to accumulate metals in leaves and grain. With a reported increase in grain yield of about >50%, no significant difference in HMs accumulation and less soil salinization using TWW with respect to GW, the benefits of irrigating barley and oats with TWW stem out. However, monitoring of soil salinity and potential accumulation of HMs or other toxic contaminants for the duration of TWW irrigation is recommended.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45754>

#43 - WATER QUALITY MONITORING OF FIVE SPRINGS IN POLK COUNTY, MISSOURI, TO DETERMINE CONTAMINATION RISKS TO THE SPRINGFIELD AQUIFER

Ramona Gomez. Geography, Geology and Planning. Faculty Advisor: Melida Gutierrez

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.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45892>

#44 - DATA COLLECTION INFRASTRUCTURE FOR FEATURE SIMILARITY ANALYSIS IN SATELLITE IMAGES OF ARTIC SEA ICE

CJ Moore, Gavin Moore, Dylan Berndt. Geography, Geology and Planning. Faculty Advisor: Xin Miao

Remote detection of sea ice features present in Arctic regions can be highly informative to design and verify global climate models. Satellite imagery can provide instrumental data in uncovering spatial patterns of sea ice by way of novel deep learning (DL) models that are trained to perceive feature similarities from labeled images. Training a DL model to classify previously unencountered sea-ice images requires a comprehensive dataset of labeled sea-ice samples. Creating an effective and accurate dataset requires a high degree of domain knowledge and carries major time costs even for multiple parties. To solve this problem, we develop a suite of open-source data collection tools to allow researchers to efficiently create a specialized training dataset. Using common Python libraries including Matplotlib and Tkinter we develop a platform that employs an automated segmentation algorithm alongside segmentation labeling, image navigation, and data management functionalities to streamline the process of training data collection. We find that moderate degrees of accuracy can be achieved by segmentation-based DL classification models trained on small amounts of data created, and we provide an easily adaptable framework to develop, analyze, augment, and consolidate similar datasets for other computer-vision tasks within and beyond geospatial sciences.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45768>

#45 - WATER QUALITY ANALYSIS IN BLUEFIELDS BAY, JAMAICA DURING MARCH 2022

Hannah Lowery, Allison Gargus. Geography, Geology and Planning. Faculty Advisor: Bob Pavlowsky

Bluefields Bay, Jamaica uses local stream and spring systems for secondary drinking water sources, clothes washing, bathing, and recreation. Water quality in this area is vulnerable due to poor economic development, pollution from human activities, and karst geology where groundwater can be affected by surface pollution. The objectives of this study were to assess water temperature, salinity, specific conductance, and bacteria at 12 sites along four stream and spring systems, including outflow from a Mangrove forest. Using prevailing water conditions and observed land-use characteristics, sampling sites were evaluated for water pollution risk. Good water quality conditions were found in more secluded areas away from the public, where streams flow through healthy wetlands, and at spring heads where ground water is discharged below mountain bluffs. Poor water quality conditions were found at sites near populated areas with greater densities of crude septic systems used for domestic waste treatment. The qualitative colorimetric bacteria test used in Jamaica was calibrated with a standard method (IDEXX) using samples from five Springfield, Missouri sites. Future work to improve water quality in Bluefields Bay includes informing the community about water resources management practices and developing a system for community program for water quality monitoring.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45784>

#46 - THE ORBITAL DRIFT OF CRYOVOLCANIC MATERIAL FROM ENCELADUS WITHIN SATURN'S E RING

Amira Bezzine. Physics, Astronomy and Materials Science. Faculty Advisor: Sarah Morrison

During NASA's Cassini mission, it was observed that one of Saturn's moons, Enceladus, undergoes cryovolcanic eruptions at its south pole and that this material supplies Saturn's E ring. This study examined the dynamical evolution of this erupted cryovolcanic material once in the E ring and how it. Using both analytic estimates and numerical simulations, this study estimated the relative contributions of non-gravitational forces such as plasma drag and radiation pressure to the orbit evolution of ring particles as a function of particle size. While surface morphology and photometric constraints from Cassini indicated that the E ring "paints" other moons embedded in the ring such as Tethys, Telesto, Calypso, Dione, Helene, and Polydeuces, the dynamics of this process and its possible connection to Enceladus' eruptive behavior is understudied. Icy particles less than a few microns in size drift outward past Enceladus primarily due to plasma drag. This study will place limits on the likelihood that particles from a single eruptive event on Enceladus can paint the subsequent outer moons, and discuss dynamical constraints on Enceladus' eruptive behavior from the outward drift of E ring material.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45757>

#47- FABRICATION OF 2D HETEROSTRUCTURE OF GRAPHENE AND TRANSITION METAL OXIDES

Jessica Fink. Physics, Astronomy and Materials Science. Faculty Advisor: Kartik Ghosh
Recently, 2-dimensional materials such as graphene, MoS₂, and molybdenum oxide have gained much attention due to wide range of applications in electronic industry. Molybdenum oxide has the potential use for energy conversion, gas sensing, and many others. The purpose of this study is to explore the intrinsic properties of a monolayer or a few layers of molybdenum oxide as it has promising applications. Synthesis of samples used Pulse Laser Deposition, a powerful technique that allows fine-tuning of the growth of the oxide thin films. Raman Spectroscopy, X-Ray Diffraction, SEM EDS, and electrical measurements are used to analyze the structural and physical properties of the films. Early samples have shown a combination of molybdenum dioxide and molybdenum trioxide that may be of future interest.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45792>

#48 – DECONVOLUTION OF 2D MATERIAL RAMAN SPECTRA FOR MICROFABRICATING HETEROSTRUCTURES OF GRAPHENE AND MOLYBDENUM OXIDES

Gabriel Fedynich. Physics, Astronomy and Material Sciences. Faculty Advisor: Kartik Ghosh

Two dimensional materials with transition metal oxide heterostructures show growing potential for a wide amount of uses in electronics. Due to this rising interest, the need to further understand the material properties has become a fundamental priority. However, the fabrication process of a heterostructure device is laborious. The goal of this study is to provide Raman Spectroscopy analysis for the experimental production methods used to produce graphene and transition metal oxides. This will both confirm successful fabrication and allow further structural data to be analyzed briefly when the two are interfaced. To produce molybdenum oxides, a Pulse Laser Deposition method was used. Then Graphite was used with variations of a widely known micromechanical exfoliation technique to extract layers of Graphene. Both methods had the material deposited on a substrate of silicon. Finally, the samples were analyzed using Raman Spectroscopy, a method that graphs out a “structural fingerprint”. This “fingerprint” gives a profile of the molecules present, which indicates what to look for after fabricating a material.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45779>

#49 - ESTIMATING THE DEGREE OF ATMOSPHERIC JEANS ESCAPE FROM TERRESTRIAL EXOMOONS

Cory Padgett. Physics, Astronomy and Materials Science. Faculty Advisor: Sarah Morrison
This study investigates the degree of Jeans escape from an Earth-like exomoon around a Jupiter-like exoplanet compared to an Earth-like stand-alone planet for similar thermal conditions. Jeans escape, otherwise known as thermal escape, is the mechanism for which thermally energetic molecules in the exobase can escape an atmosphere due to having higher thermal speeds than the threshold escape speed. Cases that have been studied of this system are of varying temperature and orbit regimes. The varying temperatures regimes range from the standard Exobase temperature at 1,000 Kelvin with additional cases in steps of 100 Kelvin above and below this value. The studied orbit regimes cases are varied from the inner to outer possible stable orbit regimes for this exomoon-exoplanet pairing. At 500 km altitude, an Earth-like exomoon would experience an 8.31-264.34% (outer-inner orbit cases) difference at 800 K temperature and an 5.18-125.63% difference at 1,200 K temperature in Jeans Escape rates due to differences in effective escape and thermal speeds.

<https://symposium.foragerone.com/cnas-undergraduate-research-symposium-spring-2022/presentations/45939>

BIOLOGY

Study in biology opens the doors to a variety of rewarding careers. Career areas for biology majors include the health-care field; industry research, development, and testing (including biomedical and biotechnology fields); conservation, ecology, and wildlife biology; and science education. A degree in biology is excellent preparation for entry into the health professions because the study of biology gives clear insights into the nature of health and disease. Training provided in our bachelor's degree programs can lead to entrance to professional schools in medicine, optometry, dentistry, veterinary medicine, pharmacy, and many other health-related professions. Biology graduates also find a wealth of opportunities in rapidly growing biotechnology, food technology and pharmaceutical industries. Our program emphasizes laboratory experiences, and many positions in these industries place a premium on laboratory skills that can be gained through undergraduate coursework. Another important field for our majors is environmental biology, including conservation, wildlife and resource management, aquatic biology and environmental assessment. Employers in these fields include many federal, state and local government agencies, as well as environmental consulting firms, toxicology laboratories, research-oriented museums, zoological parks and aquariums and public-service environmental organizations.

CURRENT RESEARCH

- **Paul Durham** – Cell Biology, Neurobiology
- **Debra Finn** – Stream Ecology
- **Brian Greene** – Herpetology, Ecology
- **Kyoungtae Kim** – Cell Biology, Molecular Genetics
- **La Toya Kissoon-Charles** – Wetland Ecology, Wetland Plants
- **Laszlo Kovacs** – Genetics, Grapevine Biology
- **Day Ligon** – Physiology, Herpetology
- **Christopher Lupfer** - Microbiology, Immunology
- **Sean Maher** - Mammalogy, Ecology
- **Alicia Mathis** – Behavioral Ecology, Herpetology
- **Jay McEntee** – Evolution of Bird song
- **Babur Mirza** - Environmental Metagenomics, Microbial Ecology, Bioremediation
- **Quinton Phelps** – Applied Fisheries management
- **Avery Russell** – Plant-insect interactions
- **Georgianna Saunders** – Biology Education
- **Charles Stephen** - Cave insects
- **Alexander Wait** – Plant Ecology, Conservation

CHEMISTRY & BIOCHEMISTRY

The Department of Chemistry & Biochemistry at Missouri State University has 16 tenured/tenure-track faculty, 2 instructors, 3 staff members, 20 graduate students, and 200 majors. The Department has maintained programs approved by the American Chemical Society Committee on Professional Training since 1974 and offers tracks designed to help students achieve successes in a variety of career directions, including graduate school, industrial applications, medical school, biotechnology, materials development, and environmental engineering. The primary goal of the department is to produce graduates with a sound background in the fundamental areas of chemistry and a working knowledge of modern instrumentation. Toward this end, all chemistry majors have the opportunity to experience hands-on training with a broad range of instruments in their course work, and all majors participate in undergraduate research, which offers opportunity for real-world application of coursework knowledge and helps to develop critical thinking skills.

CURRENT RESEARCH

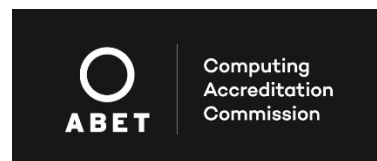
- **Tuhina Banerjee** - Biochemical, Biophysical and Nanotechnology
- **Gautam Bhattacharyya** - Chemical Education Research
- **Richard N. Biagioni** - Analytical and Environmental
- **Eric Bosch** - Organic Chemistry, Crystal Engineering and Coordination Chemistry
- **Bryan E. Breyfogle** - Electrochemistry of Materials; Chemical Education
- **Natasha DeVore** – Biochemistry and Structural Biology
- **Nikolay Gerasimchuk** - Inorganic/Bioinorganic Chemistry - Oxime-Bearing Ligands and Their Metal Complexes; physical methods of investigations of chemical compounds; x-ray crystallography
- **Gary A. J. Meints** - Physical/Biophysical Chemistry, NMR Spectroscopy of Damaged DNA
- **Mark M. Richter** - Analytical - Photoluminescence and Electrogenerated Chemiluminescence (ECL)
- **Cyren Rico** – Analytical, Environmental, Nanomaterials-Plant Interactions, Ecological Effects of Nanomaterials
- **Alan Schick** - Physical/Materials Chemistry - Colloid and Surface Chemistry; Organic films and emulsions
- **Reza Sedaghat-Herati** - Organic and Polymer Chemistry
- **Matthew Siebert** – Theoretical organic and organometallic chemistry
- **Erich D. Steinle** – Analytical, Developing Sensors Based on Nanotechnology and Electrochemistry
- **Adam K. Wanekaya** - Analytical Chemistry, Nanomaterials in Sensing, Biological and environmental applications
- **Fei Wang** – Inorganic/Physical Chemistry; high-temperature solid state syntheses, X-ray crystallography, intermetallic compounds, thermoelectric materials, first-principle band structure computation
- **Keiichi Yoshimatsu** - Biosensing, Fluorescent Sensing, Paper-based Analytical Device, Protein and Peptide Science, Polymer Chemistry

COMPUTER SCIENCE

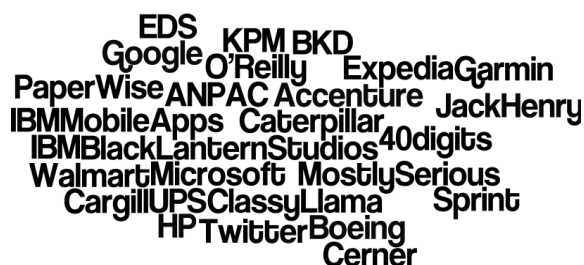
Computer science is a technology-oriented discipline whose fundamental principles combine theory, abstraction, and design. A solid foundation in the fundamental principles is critical to continued learning and adaptation to the technological changes which occur so rapidly in this discipline. The department prepares its graduates for professional employment and graduate education by emphasizing these principles and their application to solution of specific problems, while also addressing the ethical and social issues associated with computing.

All tenure-track faculty members have Ph.D.'s in the field of computer science, which leads to opportunities for Bachelor's degree students to participate in research projects. Faculty lead a variety of research agendas (see below), including neural networks, algorithm design for DNA sequencing, high-level language design, and computer architecture projects on FPGA circuit boards.

MSU's Computer Science program has for many years been accredited by the Computing Accreditation Commission of ABET, www.abet.org. ABET accreditation demonstrates a program's commitment to continuous improvement and to providing its students with a quality education.



As examples of continuous changes in the curriculum and the field of CS, our department has recently added a second option, "Software Development," to the CS degree. In that degree option, students will choose a minor to complement the CS coursework. Our Advisory Board, made up of MSU CSC grads in industry leadership, have told us that a Software Development option will be attractive to their companies.



The salary expectations for computer science majors are nearly the highest of any field. Initial salary offers to MSU CS graduates are outstanding (see Annual Report, careercenter.missouristate.edu), and average starting salaries for 2016 CS grads are projected at \$61,321. (See www.nacweb.org). As examples, graduates of the past five years or so work at these recognizable companies, and many have started their own software businesses.

CURRENT RESEARCH

- **Yassine Belkhouche** – Deep learning and Its Application; Machine Learning and Pattern Recognition; Secure Machine Learning; Information Fusion, Computer Vision
- **Mukulika Ghosh** – Robotics, Computation Geometry, Solid and Physis based Modeling, Algorithms
- **Razib Iqbal** – Multimedia Systems and Communications, Digital Content Adaptation, Software Engineering, Software Quality Assurance, Automated Software Verification and Validation, Internet of Things, Computer Security.
- **Ajay Katangur** - Cyber Security, Information Assurance, Cloud Computing, Wireless Networks, Computer Networks, Optical Networks, Mobile Computing
- **Anita Liu** – Wireless Ad-hoc, Sensor Networks, Mobile Computing, Parallel and Distributed Computing, and Bioinformatics
- **Siming Liu** - Search, Optimization, Machine Learning, Evolutionary Computation, Artificial Intelligence, Parallel and Distributed Computing, Games and Simulations
- **Jamil Saquer** – Data Mining, Formal Concept Analysis, Machine Learning, Computer Science Education, Graph Theory and Graph Algorithms
- **Lloyd Smith** – Multimedia Digital Libraries, Speech-driven and Multimodal User Interfaces, Music Information Retrieval, Computer-aided Music Education, Pattern Recognition
- **Yang Wang** – Digital Image Processing and Analysis, Pattern Recognition, Computer Vision, Graphics, Algorithm Designs and Analysis, Multimedia Computing, Document Analysis

COOPERATIVE ENGINEERING PROGRAM

Missouri State University and the Missouri University of Science & Technology are proud to offer degrees in Civil Engineering, Electrical Engineering and Mechanical Engineering on the Missouri State University campus. The three engineering degrees are granted by the Missouri University of Science and Technology, in cooperation with Missouri State University. Students are able to complete all four years of the degrees on the Missouri State University campus. The curriculum for the degrees is the same as the curriculum at the Missouri University of Science and Technology. The engineering degrees are accredited by ABET. Missouri State University also has a strong pre-engineering program for students who wish major in other fields of engineering.

Engineers assist in the design and development of all sorts of products. The role of the engineer is to ensure that products are safe, durable, reliable, and cost effective. Engineers develop and follow the codes and standards that are put in place to protect the public safety. Engineering is an honorable profession. Civil Engineers assist in the design of buildings, bridges, dams, levees, water treatment facilities, drinking water facilities, transportation systems, and many other projects. Electrical Engineers assist in the development of power plants, robots, computer systems, electronic control systems, telecommunication systems, and many other projects. Mechanical Engineers assist in the development of internal combustion engines, steam turbines, gas turbines, refrigeration and air conditioning, robots, machine tools, production facilities and many other products. Engineers assist with the design and/or manufacturing of almost every product that we use.

CURRENT FACULTY

- **Dr. Douglas Carroll** – PhD, Missouri University of Science and Technology
- **Dr. Rohit Dua** – PhD, Missouri University of Science and Technology
- **Dr. Ryan Hutcheson** – PhD, Texas A&M University
- **Dr. Daniel Moreno** – PhD, Georgia Institute of Technology
- **Dr. Tayo Obafemi-Ajayi** – PhD, Illinois Institute of Technology
- **Dr. Theresa Odun-Ayo** – PhD, Missouri University of Science and Technology
- **Dr. Matthew Pierson** – PhD, University of Kansas
- **Dr. Sanjay Tewari** – PhD, Texas A&M University
- **Dr. Jeffrey Thomas** – PhD, Missouri University of Science and Technology
- **Mrs. Stephanie Thomas** – MS, University of Arkansas

GEOLOGY, GEOGRAPHY & PLANNING

The Department of Geography, Geology and Planning is staffed by 19 full-time faculty members. All majors and minors are focused on student involvement in intellectual studies and practical hands-on work in the field and the laboratory. The Center for Resource Planning and Management (CRPM) is an applied research and academic support unit of the Department. Another center within the Department is The Ozarks Environmental and Water Resources Institute (OEWRI). This institute supports efforts to protect and restore water quality and supply in the Ozarks Region. OEWRI initiates and supports research programs aimed at solving environmental problems by working in partnership and cooperation with university researchers, environmental groups, and governmental agencies.

CURRENT RESEARCH

- **Damon Bassett** - Stable isotope geochemistry and paleontology
- **Melanie Carden-Jessen** – Earth Science Education and Assessment
- **Debbie Corcoran** - Medical & World Regional Geography
- **Toby Dogwiler** – UAV-based Remote Sensing, UAV operations, Structure-from-Motion Photogrammetry, Geospatial Analysis
- **Kevin Evans** - Paleozoic Carbonate Stratigraphy, Impact Geology
- **Krista Evans** - The Tiny House Movement, Rural Geography, Vernacular Architecture
- **Douglas Gouzie** - Cave and Karst Systems; Geologic Carbon Sequestration
- **Melida Gutierrez** – Environmental Geochemistry
- **Tasnuba Jerin** – Fluvial geomorphology, Biomorphology, Watershed Hydromorphology, anthropogenic and climate change impacts on fluvial systems and watersheds
- **Jun Luo** - Geographic Information Science
- **Ronald Malega** - Human geography, urban planning, quantitative methods in geography and planning
- **Matthew McKay** – Structural Geology and Tectonics
- **Xin Miao** – Remote Sensing, Invasive Species
- **Gary Michelfelder** - Volcanology, Igneous Trace Element and Isotope Geochemistry, Mineral Chemistry
- **Kevin Mickus** - Geophysics, Tectonics, Remote Sensing
- **Robert Pavlowsky** – Geomorphology, Hydrology, Water Quality; Ozark rivers and Urban Watersheds
- **David Perkins** - Weather, Climate & Society; Sustainable Tourism; Tourism Geographies
- **Xiaomin Qiu** – Graphical Representation of Spatial Data
- **Charles Rovey** - Hydrogeology, Sedimentology, Glacial Stratigraphy; Geologic Carbon Sequestration

HOSPITALITY LEADERSHIP

The Department of Hospitality Leadership prepares students for managerial positions in hotels, restaurants, resorts, casinos, institutional foodservice, special events, catering, and many other areas. Students in the major choose to pursue one or more of the following options: Lodging, Food and Beverage, Senior Living, Club Management, Tourism, and General Operations.

The department boasts two active student organizations, opportunities for experiential learning, access to many industry professionals, and an active advisory board. A dedicated Hospitality Career Fair is held every March and October, enabling students to obtain positions with leading regional and national hospitality firms.

The HL faculty is comprised of a group of individuals with numerous publications and presentations who hold leadership posts in various international, regional, and local associations and organizations. They have won many teaching and service awards, and are highly regarded for their dedication and commitment to hospitality education.

The Hospitality Leadership department is accredited by the Accreditation Commission for Programs in Hospitality Administration (ACPHA). It has been continuously accredited since 1992.

Mission of the Hospitality Leadership Department

The Department of Hospitality Leadership at Missouri State University is committed to creating an environment of academic excellence. We prepare our students to be ethical leaders in the hospitality and tourism industries by providing an environment where meaningful learning and development is a priority. We serve our constituencies through quality teaching, community engagement, and relevant focused research.

CURRENT FULL-TIME FACULTY

- **Albert Barreda**, PhD – University of Central Florida
- **Liza Cobos**, PhD - University of Central Florida
- **Renata Fernandes Guzzo**, PhD – University of Houston
- **Matt Bekebrede**, BS – Missouri State University
- **Stephanie Hein**, EdD – University of Missouri, Columbia
- **Yoshimasa ‘Nancy’ Kageyama**, PhD – University of Central Florida
- **Wajeana White**, MPS – Missouri State University

MATHEMATICS

Mathematics has been called the Queen of the Sciences and also, the Science of Patterns. The essence of mathematics is about discovering and observing patterns, exploring possibilities and consequences, developing quantitative and qualitative sense, and, analyzing and construction solutions to problems, both real world and abstract. The Department of Mathematics offers degree programs which lead to a multitude of career possibilities including teaching, industrial work, government service, and graduate school. Our mathematics education program is the largest in Missouri. Many graduates have pursued graduate studies leading to advanced degrees (we have a Master's program), and professional careers such as college teaching. We also have an excellent pre-engineering program.

CURRENT RESEARCH

Richard Belshoff - Commutative Rings and Algebras and Associative Rings and Algebras

William O. Bray - Harmonic Analysis

Yue Cui – Statistics, Nonparametric models

Ngoc Do – Inverse problems, Spectral theory

Kanghui Guo – Harmonic Analysis, Differential Equations

Adam Harbaugh - Mathematics Education

Shouchuan Hu - Nonlinear Functional Analysis and Multivalued Analysis, Differential Equations

Paula Kemp – Algebra and Analysis, Number Theory, Foundation of Mathematics, and Lattice Theory

Kurt Killion - Curriculum Development for Preservice Elementary and Middle School Mathematics Teachers

Shelby Kilmer – Topology, Abstract Harmonic Analysis, Approximation Theory

Gay Ragan – Mathematics Education

Jorge Rebaza – Applied Mathematics, Dynamical Systems, Numerical Analysis

Les Reid - Commutative Algebra, Algebraic Geometry, Combinatorics, and Algebraic K-theory

Mark Rogers – Commutative Ring Theory

Steven Senger - Geometric Combinatorics

Kishor Shah – Commutative Algebra

Yingcai Su – Microarray Data Analysis; Regression with Correlated Errors; Spatial Statistics; Statistical Inference for Stochastic Processes and Random Fields; Monte Carlo and Quasi-Monte Carlo Method

Patrick Sullivan - Mathematics Education

Xingping Sun – Applied Mathematics, Approximation Theory, Computational Analysis, Numerical Analysis

Cameron Wickham - Commutative Algebra, Finite Rings, Homological Algebra.

Matthew Wright – Harmonic Analysis and Partial Differential Equations

Songfeng Zheng – Pattern Recognition and Machine Learning, Statistics Applications, Image Analysis and Statistical Learning Theory

In addition to our professors, the department also has the following dedicated Instructors providing instruction to general education mathematics courses:

Joann Barnett

Patti Blanton

Roger Bunn

Sylvia Carr

Oana Nelson

Carolyn Shand-Hawkins

Donna Sherrill

Gary Stafford

Linda Sun

Kimberly Van Ornum

Fan Zhou

PHYSICS, ASTRONOMY & MATERIALS SCIENCE

The Physics, Astronomy, and Materials Science Department is committed to excellence in teaching, research, and service in each of our disciplines, which allows us to provide the best possible learning environment for our undergraduate and graduate students. We offer a wide range of courses, from introductory level to advanced. Our faculty members are deeply involved in research activities that include neural networks, the scholarship of teaching, the astrophysics of pulsating stars, energy, and the fabrication and development of nanotechnology devices. Department members provide community service at the local, regional, and national levels.

CURRENT RESEARCH

- **Tiglet Besara** - Design, Synthesis, and Characterization of Novel Inorganic Materials
- **David Cornelison** – Laboratory Astrophysics
- **Evan Frodermann** – Physics Pedagogical
- **Kartik Ghosh** - Growth and Characterization of Nanostructured Spintronic Materials
- **Shyang Huang** - Growth of Spintronic Materials using MBE, Scanning Tunneling Microscope
- **Robert Mayanovic** - Studies of Materials and Nanomaterials under Extreme Conditions
- **Bradley Mills** – Theoretical Astrophysics
- **Saibal Mitra** – Nanoscale Materials and Devices like Nanosensors, Nanobatteries, Photovoltaic Materials
- **Sarah Morrison** - Orbital Dynamics and Evolution of Extrasolar Planetary Systems
- **Emmett Redd** – Optical Neural Networks
- **Michael Reed** - Asteroseismology of late evolution compact pulsating stars
- **Ridwan Sakidja** – Computational Materials Science, High Temperature Materials, Protective Coatings, Materials Genome

2021 CNAS Virtual Undergraduate Research Symposium Winners

Biology: Ecology, Wildlife and Conservation

1st Place: *Abigail Giering*

DO OZARK NATIVE DUCKWEED SPECIES STAND A CHANCE AGAINST NON-NATIVE LANDOLTIA PUNCTATA IN AMMONIA POLLUTED WATERS?

Faculty Advisor: Dr. La Toya Kissoon-Charles

2nd Place: *Madoch Jamroch, Allison Scott*

ANATOXIN-A DETECTION IN SPRINGFIELD WATER SYSTEMS

Faculty Advisor: Dr. Babur Mirza

Biology: Cellular, Microbiology and Genetics

1st Place: *Nhi Le, Cameron Kirk*

KINETIC ANALYSIS OF CADMIUM QUANTUM DOT'S TRAFFIC

Faculty Advisor: Dr. Kyoungtae Kim

2nd Place: *Dailyn Jones*

IDENTIFICATION OF THE TERATOGENIC AND TOXIC EFFECTS OF THE HERBICIDES HEXAZINONE, MECOPROP, AND THIFENSULFURON-METHYL ON ZEBRAFISH EMBRYONIC DEVELOPMENT AND SURVIVAL

Faculty Advisor: Dr. Ryan Udan

Chemistry

1st Place: *Autumn Pilarski*

¹H SOLUTION NMR ANALYSIS OF AN 8MER NON-PALINDROMIC DNA SEQUENCE CONTAINING A U:G MISMATCH

Faculty Advisor: Dr. Gary Meints

2nd Place: *Giselle Campos, Samuel Nack*

COMPUTATIONAL STUDY ON STRUCTURE OF IR SPECTRAL LIBRARY USING CLUSTER ANALYSIS

Faculty Advisors: Dr. Razib Iqbal and Dr. Keiichi Yoshimatsu

Cooperative Engineering

1st Place: *Dominic Zucchini, Tyler Tracy, Cassidy Johnson, Whitney Vermillion*

CONTACTLESS LEVEL ACQUISITION AND MONITORING SYSTEM (CLAMS)

Faculty advisors: Dr. Doug Carroll and Dr. Matt Pierson

2nd Place: *Curtis Brumfield, Kyle Doran, Logan Reed, Benjamin Hynes*
UNDERSTANDING THE BASICS OF POWER FACTOR CORRECTION
Faculty Advisors: Dr. Tayo Obafemi-Ajayi

Geology

1st Place *Dorian DeHart*
TEMPERATURE AND DISCHARGE MONITORING OF SPRINGS AND STREAMS TO
APPROXIMATE WATER DRAINAGE BASINS IN THE SPRINGFIELD PLATEAU,
MISSOURI
Faculty advisor: Dr. Doug Gouzie

2nd Place: *Brianna Williams*
PLAGIOCLASE ZONING AS AN INDICATOR OF MAGMA PROCESSES AT SAN
PEDRO VOLCANO, CENTRAL VOLCANIC ZONE, CHILE
Faculty Advisors: Dr. Gary Michelfelder

Geography, Geospatial and Planning

1st Place: *Ramona Gomez*
WATER QUALITY ANALYSIS OF THE SPRINGFIELD PLATEAU AQUIFER
Faculty advisor: Dr. Melida Gutierrez

2nd Place: *Kara Smith*
YOUR PERSONAL TOUR THROUGH DUBLIN, IRELAND
Faculty Advisors: Dr. Krista Evans

Hospitality Leadership

1st Place: *Courtney Roberts, Elijah Sellers, Mara Presot, Bethany Osheim*
TOURISTS' PERCEPTIONS OF DESTINATION AND ITS PRODUCTS: THE CASE OF
ITALY
Faculty Advisor: Dr. Yoshimasa "Nancy" Kageyama.

Mathematics

1st Place: *Fiona Wu, Slade Gunther*
MIXED ERDOS TYPE POINT CONFIGURATION ESTIMATES
Faculty Advisor: Dr. Steven Senger

2nd Place: *Rachel Heili*

USING MATHEMATICAL ARGUMENTS AS A TOOL TO DEVELOP CONCEPTUAL UNDERSTANDING IN A DEVELOPMENTAL MATHEMATICS CLASS

Faculty Advisor: Dr. Patrick Sullivan

Physics, Astronomy and Materials Science

1st Place: *Daniel Amuedo*

FREE-STANDING LIQUID MEMBRANES AS A NON-FOULING FILTER FOR THE REMOVAL OF MICRO-PLASTICS FROM WATER

Faculty Advisor: Dr. Tiglet Besara

2nd Place: *Tyler McGilvry-James*

ARTIFICIAL INTELLIGENCE FOR DEFECT EXAMINATION (AIDE)

Faculty Advisor: Dr. Ridwan Sakidja

CNAS SCHOLARSHIPS	SCHOLARSHIP DESCRIPTION
1st Lieutenant Gary Finley Engineering Scholarship	The Recipient of this award will be an undergraduate student properly enrolled full time at Missouri State University pursuing a career in engineering. When awarded to an incoming freshman, consideration will be given to high school performance, college potential, and leadership qualities. When awarded to a student enrolled at the sophomore level or higher the student must have maintained an overall grade point average of at least 3.2. Preference shall be given to a student enrolled in and/or participating in the Military Science/ROTC program. The student will hold the scholarship for one academic year. The scholarship may be renewed but students must reapply and be considered with all other applicants
Amelia Counts Scholarship	The recipient of this scholarship will be an incoming or current undergraduate student enrolled full time at Missouri State University pursuing a degree within the College of Natural and Applied Sciences. The recipient must have a cumulative GPA no less than 3.1. Preference will be given to students in the following order: 1. involved in a minimum of one (1) university student organization or athletic program or involved in two high school student organizations if an incoming freshman. 2. be a first-generation higher education student 3. resides in campus housing if a freshman or sophomore. The student can continue to hold the scholarship so long as they continue to meet the main criteria and the first preference. The student may hold the scholarship up to 4 academic years.
Andereck Family Scholarship	Awarded to incoming freshmen or undergraduate students properly enrolled at MSU and majoring (or with an interest in majoring) in Physics, Physics Education, Engineering Physics or Astronomy. This scholarship is renewable, but the student must reapply.
Banks Family Scholarship	Awarded annually to a full-time undergraduate majoring in the Department of Physics, Astronomy, and Materials Sciences. For incoming freshmen consideration will be given to high school academic performance and leadership. For sophomores or greater student must have overall GPA of 3.0 and a departmental GPA of 3.0. This scholarship is renewable, but the student must reapply.
Barbara J. Lucks Scholarship for a Sustainable Future	The Recipient of this award will be a First Generation junior, senior or graduate student in Geology, Geography and Planning (GGP) with a declared major of Geography and Sustainability, with a cumulative GPA of 2.5. Preference will be given to a student from a rural area. Applicant to complete an essay explaining your commitment to environmental sustainability, including how you plan to include environmental sustainability within your career objectives and personal life. This scholarship will be renewed automatically as long as the student continues to meet all criteria.
Bears CNAS Endowed Scholarship	The recipient of these awards will be an undergraduate or graduate student properly enrolled full-time at Missouri State University. Recipients will be a junior, senior or graduate student pursuing a degree in the College of Natural and Applied Sciences. Students must have a cumulative GPA of 2.8 or higher to qualify. Preference shall be given to a student demonstrating financial need. The student(s) will hold the scholarship for one academic year. This scholarship may be renewed, but student(s) must reapply.
Bill and Maret Cheek Scholarship	Awarded annually to a full-time undergraduate sophomore or greater majoring in Geography or Planning, with preference going to Planning students. Student must have an overall GPA of 3.0 and a departmental GPA of 3.25. Preference also given to students involved in professional organizations. All else equal, financial need may be considered. This scholarship is renewable, but the student must reapply.

Biology Alumni Scholarship	Awarded to a Biology major that has completed 60 hours toward a BA or BS degree in Biology and at least 15 hours of Biology (including BIO 235) with a minimum 3.0 GPA in Biology and must enroll for at least 12 hours. This scholarship is renewable, but the student must reapply for consideration with all other applicants.
Biology Board of Advisors Summer Research Fellowship	Awarded annually to a rising junior, senior or graduate student seeking a degree in the Department of Biology. The student must demonstrate an interest in pursuing graduate studies. Student will receive award in the summer semester, so they must be enrolled in at least 1 summer credit hour. This award may be renewed, but the student must reapply.
Biology Education Scholarship	Student must have completed 60 hours, with at least 15 hours of Biology (including BIO 235) with a minimum 3.0 GPA in Biology. The student must have been admitted into Teacher Education program with the intention to teach and be enrolled full-time. This scholarship is renewable, but the student must reapply.
Bob and Amy Schellhorn Geoscience Scholarship	The Recipient of this award will be an undergraduate student properly enrolled at Missouri State University. Recipients will be sophomore, junior or senior pursuing a degree in Geology. The student must have successfully completed GLG 332 (Mineralogy). Students must have a cumulative GPA of 2.5 or higher and a minimum of 2.8 GPA in Geology coursework. The recipient will hold the scholarship for one academic year. The scholarship is eligible for renewal but the recipient must reapply and continue to meet the eligibility requirements.
Boeing Software Engineering Scholarship	Awarded annually to a full-time student majoring in Computer Science. Sophomores or greater must have an overall and departmental GPA of 3.2. Must be member of Missouri State University Chapter of Association of Computing Machinery. Preference given to United States Citizens. This scholarship is not renewable.
Bonnalie Oetting Campbell Biology Scholarship	The recipient will be an undergraduate student properly enrolled at Missouri State University and majoring in Biology. The recipient will have a minimum overall GPA of 3.5. Preference will be given to those with financial need. The recipient must have completed or be currently enrolled in cellular biology or physiology. The award is automatically renewable as long as the recipient continues to meet the requirements of the award.
Bonnalie Oetting Campbell Summer Research Award	The recipient will be an undergraduate or graduate student properly enrolled at Missouri State University, majoring in Biology, and enrolled to perform summer field study work at the Bull Shoals Field Station. Students must be enrolled in at least one hour over the summer to receive aid in the summer semester. The award is renewable, but the student must reapply each year.
C. Louis and Thelma Ferrell Van Buren Scholarship	Awarded annually to a full-time junior or greater enrolled in College of Natural and Applied Sciences with an overall GPA of 3.0. Awards will be made with regard to financial need and consideration given to students involved in extracurricular activities. Students may be considered for renewal of the scholarship, but they must reapply with other candidates and continue to meet all criteria.
Carla Hinton Memorial Biology Scholarship	Awarded annually to a full-time student majoring in Biology. Sophomores or greater must have a 3.0 GPA in coursework in Biology. Awards will be made with regard for financial need. This scholarship may be renewed, but the student must reapply.
Carol L. (Harless) Stephens Scholarship for Math Teachers	Awarded annually to a full-time junior or greater working towards a BSED in Mathematics with a cumulative and departmental GPA of 3.0. Preference will go to students from Southwest Missouri. Awards will be made with regard for financial need. Scholarship will be automatically renewed as long as the student maintains satisfactory academic progress and continues to meet all scholarship requirements.

Charles and Cindy Rodgers Scholarship	The Recipient of this award will be a current undergraduate student or incoming freshman properly enrolled full-time at Missouri State University and is a resident of the state of Missouri. The Recipient must show financial need and have declared a major within the College of Natural and Applied Sciences. The Recipient must have a cumulative GPA of 3.2 if an existing undergraduate student or a high school cumulative GPA of 3.5 if an incoming freshman. The student will hold the scholarship for one academic year. The scholarship may be renewed, but the student may reapply and be considered with all other applicants.
Chemistry Department Scholarship Fund	Awarded annually to Chemistry major. Must be full-time with 75 or more credit hours earned as of the end of the academic year in which applying; Must have minimum GPA of 3.0 in chemistry and overall, including transfer work, and a minimum of 19 hours completed in chemistry as of the end of semester in which applying; must be active in student organizations. This is a one-time award. Recipients may be considered for renewal with all other applicants.
Chemistry Department-Graduate Scholarships	Awarded annually to a student in their second, third, or fourth semester in the Chemistry graduate program with a GPA of 3.0. Must have made significant research progress towards thesis confirmed by Research Advisor. This is a one-time award.
Clyde and Judy Paul Mathematics Education Award	The Award will be given annually to a graduating senior pursuing a degree in a Mathematics program that will result in an initial Missouri certificate to teach mathematics at the high school level. The student must have completed all requirements for admission to and completion of the Teacher Education Program. Selection will be based on observed (by mathematics faculty) performance in the college classroom; field experiences as documented by mathematics faculty and other properly certified instructors; documented service activities; and personal characteristics favorable for teacher success that have demonstrated the recipient's potential to become an outstanding teacher. The recipient(s) must be a senior graduating at the end of the spring and/or summer semester that has completed a minimum of 60 hours, including a minimum of 15 hours of mathematics courses while enrolled at the Missouri State University Springfield campus. The recipient(s) must have completed at least one of the following courses: MTH 409 or MTH 410. This is a one-time award to be paid out the semester they are selected.
CNAS Scholarship for STEM Secondary Education Students	The recipient of this award will be a junior, senior, or graduate Science and/or Mathematics Secondary Education student within the College of Natural and Applied Sciences. Recipients must have a GPA that will lead toward certification in the State of Missouri. The scholarship shall be automatically renewable as long as criteria is still met. Those who receive the scholarship as juniors are eligible to reapply as a senior and those who receive as a senior are eligible to reapply as a graduate student.
College of Natural and Applied Sciences Scholarship	Awarded annually to a full-time undergraduate majoring in a program in College of Natural and Applied Sciences with an overall GPA of 3.0 and a departmental GPA of 3.5. Scholarship recipients may be considered for renewal of the scholarship, but must reapply with all other applicants.
Computer Science Department Scholarships	There are currently no requirements for this scholarship other than being a student seeking a degree in the Computer Science Department. This scholarship is not renewable.

ConocoPhillips Scholarship for Computer Science	The Recipient of this award will be a full-time undergraduate student properly enrolled at Missouri State University seeking a degree within the Department of Computer Science and maintain a cumulative GPA of 3.0 or higher. This scholarship is intended to enhance diversity by encouraging students from diverse backgrounds to apply. Accordingly, recipients must have a demonstrated interest in and commitment to promoting an educational environment that is diverse and inclusive of individuals irrespective of their gender, race/ethnicity, veteran's status, disability, sexual orientation, and/or gender identity. Serious consideration will be given to all ways in which potential recipients might contribute to a diverse educational environment. Preference shall be given to a student who demonstrates financial need. This scholarship may be renewed, but the recipient must reapply for consideration with all other applicants.
D. Kent Smith Memorial Scholarship	Awarded annually to full-time junior or senior majoring in Geology with a minimum of 25 hours completed of required courses for Geology degree. Must have a GPA of 3.0 in these degree courses and overall. Preference given to students with no other scholarships. This scholarship is renewable, but the student must reapply.
Department of Chemistry Board of Advisors Summer Research	Awarded annually to a rising junior, senior, or graduate student properly enrolled at Missouri State University within the Department of Chemistry participating in summer research. In addition, the student must possess a demonstrated interest in pursuing graduate studies in chemistry, be enrolled in at least one hour during the summer term, and have a declared chemistry major. The student will hold the scholarship for one summer term. The award may be renewed, but student must reapply for consideration with all other applicants.
Doris C Lorz Scholarship Award	Awarded annually to a full-time junior or senior enrolled as a major in the Department of Chemistry that has completed 20 hours in Chemistry and has a departmental GPA of 3.8 and an overall GPA of 3.5. Preference will be given to those involved in extracurricular activities. The scholarship recipient may be considered for renewal, but must reapply with all other applicants.
Dr. and Mrs. Thielmann Chemistry Education - Undergraduate	The Recipient(s) of this award will be an undergraduate student properly enrolled at Missouri State University. Up to two scholarships will be awarded to the top undergraduates pursuing a degree in chemistry education. Students must have completed at least 9 hours of chemistry coursework and have at least a 3.0 Cumulative GPA. The student will hold the scholarship for one academic year. The scholarship may be renewed but students must reapply and be considered with all other applicants.
Dr. Carl Fronabarger Family Memorial Scholarship	Awarded annually to a full-time student majoring in Mathematics and have a desire to pursue a career as a Math Teacher. Juniors or greater must have an overall GPA of 3.0 and a departmental GPA of 3.5. Students must have financial need. Scholarship will be automatically renewed as long as the student maintains satisfactory academic progress.
Dr. Carl Riegel Memorial Scholarship	Awarded annually to a full-time undergraduate student seeking a degree in the Hospitality Leadership Department. Preference should be given to a veteran or the child of a veteran. This scholarship may be renewed, but the student must reapply.

Dr. Eric Shade Memorial Scholarship	The recipient of this award will be an undergraduate student properly enrolled as a Computer Science major at Missouri State University. Recipient must have an overall GPA great than or equal to 3.5. Recipient must have a membership in the Association for Computing Machinery. Preference should be given to a lower classman. Recipient must have been a member of the Association for Computing Machinery team the previous November. Should a team from Missouri State not have competed in the Association for Computing Machinery competition the previous November than scholarship selection committee may select a recipient meeting all other requirements who has shown interest in programming languages. The student will hold the scholarship for one academic year. The scholarship may be renewed and preference is given to the student receiving the scholarship the previous year, but the student must reapply and continue to meet all criteria.
Dr. John B. Prater Scholarship	Awarded annually to full-time undergraduate students majoring in Mathematics or Computer Science that have completed or enrolled in the first calculus course. For freshmen consideration should be given to high school academic performance and leadership. Sophomores or greater must have maintained a high enough GPA to allow progress toward a degree. Awards will be made with a preference for financial need. Scholarship recipients may be considered for renewal of the scholarship, but must reapply with all other applicants.
Dr. John H. Keiser Endowed Scholarship in Public Affairs and	Awarded annually to a full-time student majoring in the College of Natural and Applied Sciences with an overall GPA of 3.25 and a GPA of 3.5 in their field of study. Student must be seeking a career related to the natural environment. Awarded based on financial need. Scholarship recipients may be considered for renewal of the scholarship, but must reapply with all other applicants.
Dr. Lonnie and Billie Scott Science and Mathematics Educati	\$1,000 scholarship(s) will be awarded annually to an undergraduate student seeking a Bachelor of Science in Education (mathematics) or a pathway toward secondary education licensure for science education (BS + MAT) in the College of Natural and Applied Sciences. The recipient of the award should demonstrate excellence in academics while also being an active member of the community. Preference should be given to students graduating from Forsyth High School in Forsyth, MO. The student will hold the scholarship for one academic year. The scholarship may be renewed but students must reapply for full consideration with all other applicants.
Dr. Robert W. Martin Research Fellowship	Awarded annually to a full-time junior or senior majoring in the Chemistry Department with plans to pursue a graduate degree at Missouri State. Consideration given to academic performance and research interest. The recipient may be considered for renewal, but must reapply with all other applicants.
Dr. Roland Kimball Memorial Scholarship	Awarded annually to a full-time junior or higher who is active in the Pre-Dental program. Student must demonstrate potential in the field of Dentistry as demonstrated through a letter of recommendation from a faculty member in CNAS. Student must have an overall GPA of 2.8 and demonstrate financial need. Scholarship recipients may be considered for renewal of the scholarship, but must reapply with all other applicants.
Dr. Tom Tomasi Biology Summer Research Award	The Recipient of this award will be a senior student enrolled in the Accelerated Master of Biology tract or a graduate student in the Master of Biology program properly enrolled at Missouri State University. Preference will be given to students with financial need. Students receiving a faculty member's grant and/or holding a summer graduate assistantship within the Biology department at Missouri State University are not eligible. Students must provide a research plan and one letter of recommendation from their research mentor for consideration.

Dr. Woodrow Sun Scholarship	Awarded annually to a full-time undergraduate student majoring in Mathematics. For freshmen, consideration should be given to high school academic performance and leadership. Sophomores or greater must have an overall GPA of 3.0 and a departmental GPA of 3.0. Scholarship recipients may be considered for renewal, but they must reapply with all other applicants.
E. Howard and Thelma F. Matthews Scholarship	Awarded annually to a full-time sophomore or greater pursuing a B.S.ED. in Mathematics with an overall GPA of 2.5. Awarded with regard for financial need. Scholarship recipients may be considered for renewal of the scholarship, but they must reapply with all other applicants.
Earl Moulder Hotel Administration Endowed Scholarship Fund	Awarded annually to a junior majoring in Hotel Administration with an overall GPA of 3.0. Scholarship automatically renewed for one additional year as long as the student maintains satisfactory academic progress.
Ed Huffman Mathematics Scholarship	Awarded annually to a full-time undergraduate sophomore or greater, majoring in Mathematics (including Pre-Engineering) or Mathematics Education that has a departmental GPA of 2.5 and has completed the first Calculus course required by the major. Priority given to students that do not receive other scholarships covering tuition. Scholarship recipients may be considered for renewal of the scholarship, but must reapply with all other applicants.
Emil Lorz Memorial Scholarship	Awarded annually to juniors or seniors majoring within the Chemistry Department with at least 20 hours in Chemistry and a departmental GPA of 3.8 and an overall GPA of 3.5. Must be enrolled full-time. Recipients may be considered for renewals, but must reapply with all other applicants.
Engineering Program Scholarships	There are currently no requirements for this scholarship other than being a student seeking a degree in Engineering through the Cooperative Engineering Program. This scholarship is not renewable.
Esther H. Scarlett Memorial Ecology Scholarship	Awarded annually to a full-time graduate student in the College of Natural and Applied Science with a program of study emphasizing ecological concerns. Must have an undergraduate GPA of 3.0 and GPA of 3.5 in field of graduate study. Awards made with regard for financial need. Preference given to students that are married with children. Scholarship recipients may be considered for renewal, but must reapply with all other applicants.
Eugene H. Henderson Memorial Scholarship	The Recipient of this award will be made to a junior, senior or graduate students with a declared major in Physics, Astronomy and Materials Science. First preference shall be given to a First-Generation student with financial need. Second preference shall go to a first-generation student. Third preference shall go to a student demonstrating financial need. This scholarship will be renewed automatically as long as the student continues to meet all criteria.
Eugene T. Scafe Memorial Scholarship	Awarded annually to a student majoring within the Chemistry Department with an overall and departmental GPA of 3.0. Must have 18 hours in Chemistry completed and an overall minimum of 60 hours completed. The scholarship will be automatically renewed for a maximum of two years as long as the student maintains a cumulative 3.0 GPA.
Evelyn Maxwell Endowed Scholarship Fund	Awarded annually to a full-time freshman or transfer student majoring in Mathematics Education. Incoming freshman should be in the top 33% of their class and submit a letter of recommendation from a high school mathematics teacher. Transfer students should have an overall GPA of 2.5. Preference given to students with financial need. This scholarship is not renewable.

Evelyn Ruark Leonard STEM Scholarship	The recipient of this award will be a sophomore, junior, or senior enrolled in one of the following science based majors: Math, Engineering, Physics, Chemistry, or Biology. The student must be active within a student professional organization related to STEM. The student must have started an internship or undergraduate research (unless an Engineering major). The student must have a minimum GPA of 3.0 or higher. The student will hold the scholarship for one academic year. It may be renewed through graduate school, should the student reapply for consideration with all other applicants.
Fagerlin-Johnson-Moeglin Field Studies Scholarship	At least two scholarships awarded annually - One to Geography or Planning major enrolled in GRY 470 or its equivalent during the Summer session and One to Geology or Earth Science Education major enrolled in GLG 412 or 413 or its equivalent during the Summer session. Preference given based on academic performance with previous three semesters being more heavily weighted. Students must have a cumulative and departmental GPA of 3.0. This scholarship is renewable, but the student must reapply. Student must be enrolled in at least one hour over the summer to receive aid. This scholarship is awarded in full in the summer.
Foundation for Immunotoxicology Award	Two awards presented annually two full-time students - one to Biology major and one to a Chemistry major. Both must have completed 12 hours in their major and have an overall GPA of 3.5. Applicants must be nominated by faculty within the Department of Biology and the Department of Chemistry. Student must provide a personal statement discussing merits and future goals. This scholarship is renewable, but the student must reapply.
Fred and Diane May Planning Scholarship	The recipient of this award will be an undergraduate degree-seeking student majoring in Community and Regional Planning and properly enrolled at Missouri State University. Recipients must have at time of application, and maintain, at least a 3.0 cumulative GPA. Preference will be given to students who are members of the Missouri Association of Planning Students or the American Planning Association, and who have demonstrated financial need. The scholarship may be renewed, but the student must reapply annually.
Gerald Perry Memorial Scholarship	Awarded annually to a full-time undergraduate Biology major. Incoming freshman considered based on high school academic performance and leadership, All current students must have an overall GPA of 3.0. Scholarship will be automatically renewed as long as the student maintains satisfactory academic progress.
Hanover Scholarships for Mathematics	Awarded annually to a graduate or undergraduate student seeking a degree in Mathematics or Mathematics Education. The recipient may be considered for renewal, but they must reapply with all other applicants.
Harriett H. Ford Memorial Scholarship in Chemistry	Awarded annually to a full-time incoming freshman who has completed an AP or IB Chemistry course or has won a science fair competition with a Chemistry related project. Must have overall high school GPA of 3.2. Must submit letter from high school chemistry teacher attesting to students interest and commitment to Chemistry and confirming they meet the requirements. Serious consideration will be given to all ways in which potential recipients might contribute to a diverse educational environment. This scholarship is not renewable.

<p>Harthcock Chemistry Research Fellowship</p>	<p>The Recipients(s) of this award will be a graduate student(s) properly enrolled at Missouri State University with an overall undergraduate GPA minimum of 3.2 and a GPA minimum of 3.5 in Chemistry course work. Recipient(s) must conduct applied research in pursuit of their Masters of Science in Chemistry. Applied research is defined (and determined by the Chemistry Department Head) as that research that would be of interest by a for-profit company engaged in similar research that the student is conducting or that a company would have interest in such research to the point they could consider funding such research. Recipient(s) must have received their undergraduate degree in Chemistry from a college or University within the United States. The student(s) will hold the Fellowship for one academic year. The Fellowship can be renewed for one additional year (two years maximum) if the Chemistry Department Head views this is the best use of the Fellowship versus awarding this to a first year student. If this is a renewal for a second year, to be eligible the student must be in good standing with the university and their GPA for their graduate work at MSU the first year must be a minimum of 3.5. The Fellowship can be given to one or several graduate students pursuing a Master of Science degree in Chemistry at Missouri State University based on available funds. This fellowship will be selected and tracked through Scholarship Manager and selections will be verified by the Foundation/Financial Aid, but the students will be awarded the money through a stipend instead of on their student account.</p>
<p>Hein Family Scholarship in Hospitality Leadership</p>	<p>The scholarship shall be awarded to up to three students per year. The first award shall be made with preference given to an incoming freshman with satisfactory academic performance in high school. If there are no qualifying applicants the scholarship shall be awarded to a student currently enrolled in Hospitality Leadership with a 2.5 GPA or higher. The second award shall be given to one or two students with preference given to a student enrolled in Hospitality Leadership employed by Chartwells Higher Education. If there are no qualifying applicants the scholarship shall be awarded to a student(s) enrolled in Hospitality Leadership with a 2.5 GPA or higher. The students will hold the scholarships for one academic year. Scholarship may be renewed but will need to reapply each year.</p>
<p>Hospitality Leadership Board of Advisors Scholarship</p>	<p>Awarded annually to an undergraduate student seeking a degree in the Hospitality Leadership Department. Student must have completed 30 hours. Preference should be given to those students that have at least 1 year experience working in the hospitality industry. This scholarship may be renewed, but the student must reapply.</p>
<p>Hospitality Leadership-Scholarships</p>	<p>There are currently no requirements for this scholarship other than being a student seeking a degree in Hospitality Leadership. This scholarship is renewable, but the student must reapply.</p>

	<p>Awarded annually to full-time juniors or seniors seeking degrees in the Hospitality and Restaurant Administration Department. Rather than applying, candidates for consideration will be nominated by the HRA Faculty. Those nominations will be based on students most likely to succeed if they were to seek careers at the Hotel Nikko - San Francisco. Preference should be given to students graduating in December each year and ready to work at Hotel Nikko the following January/February. Second preference would be for students graduating in May, but able to finish up their course work via online courses in order to start at Hotel Nikko immediately in May or June (Still allowing for students to start in January/February while continuing studies remotely.) Third would be students graduating in May and having the ability to start the first week of June. Students selected to receive this scholarship are not required, but will be incited and receive first preference to participate in a Manager-In-Training (MIT) Program with the Hotel Nikko - San Francisco following graduation. Students will interview with members of the Hotel Nikko - San Francisco Management Team to ensure a successful placement. Through successful completion of the Hotel Nikko - San Francisco MIT, students will be offered an interview opportunity for management positions at Hotel Nikko properties, including the San Francisco location, and could be offered an additional signing bonus by the Hotel Nikko if a management of MIT position is available and offered. The award may be renewed, but the student must reapply or be re-nominated for full consideration. This scholarship will be paid in full in the fall.</p>
Hotel Nikko San Francisco Hospitality Leaders Scholarship	
Howard Petefish Award	<p>Awarded annually full-time student majoring in Physics. Award given at end of students junior year. Must have overall GPA of 3.0 and a departmental GPA of 3.5. This scholarship is not renewable.</p>
Hurtado Family Scholarship	<p>Awarded annually to a student seeking a major in the College of Natural and Applied Sciences with an overall GPA of 2.0. First preference will go to students involved in ROTC and applicants who would not qualify for other scholarships based on GPA or standardized tests alone. Consideration will be given to academic performance, future potential, and leadership skills. Scholarship is for one year, but the student may be considered for renewal if they reapply for consideration with all other applicants.</p>
James K. Bass Scholarship for Geology Field Studies	<p>At least two scholarships will be awarded annually with a value of at least \$2,000 each. Awards will be given to undergraduate students majoring in Geology that will be enrolled in a required Field Studies Course. Students must submit a Personal Statement explaining their motivation and interest in the field of Geology. Preference will be given to need. Students must be enrolled in at least one summer credit to receive this award. This scholarship is not renewable and will be paid in full in the summer.</p>
Jim Downing Mathematics Scholarship	<p>Student must be a full-time MSU mathematics or mathematics education major with a minimum 2.5 GPA in mathematics. Recipients may be considered for renewal, but must reapply for consideration with all other applicants.</p>
Joe Crosswhite Mathematics Education Middle School Scho	<p>Awarded annually to a full-time junior or greater majoring in Middle School Education with a Mathematics emphasis with an overall and Missouri State GPA of 2.75 and a GPA of 3.0 in area of study. Must have been admitted without condition to the Missouri State Teacher Education Program, have completed Foundations of Mathematics, and one of the following: Foundations of Geometry for Teacher or Foundations of Probability and Statistics for Teachers. Preference given for financial need. Scholarship recipients can be considered for renewal of the scholarship, but must reapply.</p>
John N. and Kathleen Griesemer Scholarship	<p>Awarded annually to an incoming freshman or transfer student enrolled full-time seeking a degree in the Geography, Geology, and Planning Department. Freshmen will be considered based on their academic credentials, leadership, and aptitude tests, while transfer students must have a transfer GPA of 3.0. This scholarship is not renewable.</p>

John W. Northrip Memorial Scholarship	Awarded to a full-time junior or senior majoring in Physics with an overall and departmental GPA of 3.0. This scholarship is not renewable.
Justice Jeweler's Food and Wine Fund	Student must be a full-time student majoring in Hospitality and Restaurant Administration. Consideration will be given to students who demonstrate potential for college success. When awarded to a student enrolled at the sophomore level or higher, the student must have achieved an overall GPA of 2.5. Preference is given to a student that demonstrates financial need. This scholarship may be renewed, but the student must reapply.
Karen and Bruno Schmidt Scholarship Fund	Awarded annually to a full-time student majoring in a program within the College of Natural and Applied Sciences demonstrating leadership qualities and financial need. For incoming freshman, consideration will be given to high school performance and college potential. For continuing students, academic performance will be considered. Students may be considered for renewal if they reapply and maintain a 3.0 cumulative GPA.
Kenneth A. Soxman Memorial Scholarship	Awarded annually to a full-time student majoring in Physics with a departmental GPA of 3.0. The student must have a serious desire to teach high school physics, as determined by a committee of the physics faculty. This scholarship is not renewable.
Kenneth C. Thomson Memorial Scholarship	Awarded annually to a full-time Geology major. Consideration of academic performance in the Geology field with greater weight for course taken in the previous three semesters. Preference for those expressing interest in caves and karst terrain through completion of GLG 350 or its equivalent or GLG 499 or its equivalent. Preference also given to those not receiving scholarships from the same department. This scholarship is renewable, but the student must reapply.
Kim Knight Memorial Scholarship	Awarded annually to full-time student majoring in Hospitality Leadership. Sophomores or greater must have an overall and departmental GPA of 3.0. Awards made with regard for financial need. Scholarship automatically renewed as long as the student maintains a cumulative GPA of 3.0.
Lawrence E. and Crystal Pummill Scholarship	Three scholarships will be awarded annually to full-time students, with one award going to the entering freshmen that received 1st Place in either individual or team competitions in the Lawrence E. Pummill Math Relays and two awards being given to a sophomore or greater majoring in Mathematics. Preference will be given to those preparing to teach mathematics. Freshmen award will also be based on high school academic performance and leadership qualities. Sophomores or greater must have an overall GPA of 3.0 and a departmental GPA of 3.5. All awards made with regard to financial need. The freshman award is not renewable. The other previous scholarship recipients may be considered for renewal of the scholarship, but must reapply with all other applicants.
Lisa Reece Memorial ASCend OTC Transfer Scholarship	The Recipient of this award will be an undergraduate Ozarks Technical College transfer student properly enrolled at Missouri State University. Preference should be given to students that completed an Associate of Science in Engineering, Chemistry, Biology, Math or Computer Science at Ozarks Technical College. The recipient should be enrolled in one of the following science based majors within the College of Natural and Applied Sciences: Math, Engineering, Physics, Chemistry, Computer Science or Biology. Involvement in activities will be considered, but not required. Recipient should have a minimum GPA of 2.75. A letter of recommendation from an OTC Associate of Science faculty or advisor will be taken into consideration. The student will hold the scholarship for one academic year and may not be renewed.
Louis O. and Minnie M. Smith Endowed Scholarship	Awarded annually to full-time student in the department of Mathematics with an expressed interest in a career in teaching Mathematics. Awards will be made with regard for financial need. Scholarship will be automatically renewed as long as the student maintains a cumulative GPA of 3.0.

Louise and Roland Harthcock Scholarship	Awarded annually to a full-time undergraduate student in the Department of Chemistry on the Women's Intercollegiate Softball Team, with a recipient from Chemistry and a recipient from Softball. Incoming freshmen must be in the top 25% of their class and demonstrate leadership. Sophomores or greater must have an overall GPA of 3.0. and Chemistry majors must have a departmental GPA of 3.25. This is a one-time award and may not be renewed.
Martin-Stevenson Science Scholarship	Awarded to a senior science major (not Mathematics) awarded at end of junior year based on outstanding scholastic achievement and financial need. Ineligible if receiving Board of Governors or Presidential Scholarship.
Mathematics Department Scholarships	Awarded annually to a full-time Mathematics and Mathematics Education major. Sophomores or greater must have a departmental GPA of 3.0. Recipients may be considered for renewal, but must reapply with all other applicants.
Mathematics Emeritus Faculty Scholarship	The Recipient of this award will be a(n) (undergraduate or graduate) student properly enrolled at Missouri State University within the College of Natural and Applied Sciences with a major in mathematics or mathematics education. The recipient will be a full-time student with a GPA of 3.0 in mathematics when awarded to a student of sophomore level or higher. When awarded to an incoming freshman, consideration will be given to high school academic performance and leadership. Recipients may be considered for renewal, but must reapply with all other applicants.
Mel Foster Computer Science Scholarship	Awarded annually to a full-time student majoring in Computer Science who has completed less than 46 hours. Special consideration for freshmen that have completed at least CSC 131 (or its equivalent) and at most CSC 232 (or its equivalent). This scholarship is not renewable.
Meredith Family CNAS Scholarship	The recipient of this scholarship will be an undergraduate student properly enrolled full time at Missouri State University receiving a degree in the College of Natural and Applied Sciences with a GPA of 3.0 or higher. It is also the donor's preference: The student be a first-generation higher education student; The student be a Resident Assistant at Missouri State University; Be a Tennessee or Nebraska native. The scholarship may be renewed, but the student must reapply for consideration.
Milton D. Rafferty Scholarship Fund	Awarded annually to a full-time sophomore or greater majoring in Geography or Planning with an overall GPA of 3.0 and a departmental GPA of 3.25. This scholarship may be renewed, but students must reapply each year.
Milton Topping Memorial Fund	Student must be enrolled in the Biology graduate program and submit a typed proposal describing the research to be conducted if the summer assistantship is granted. Preference will be given to beginning graduate students. This scholarship is not renewable.
Monsanto Company Science and Mathematics Scholarship	Awarded to a full-time student in the College of Natural and Applied Sciences who has completed between 90 and 110 credit hours, with a departmental GPA of 3.75. Awards will be made with regard to financial need. Students may be considered for renewal, but must reapply with all other applicants.
Morton-Wilson Memorial Scholarship	The Recipient of this award will be an incoming freshman properly enrolled full-time at Missouri State University pursuing a degree in the Hospitality Leadership Department. Consideration will be given to high school performance, college aptitude tests and to leadership qualities. Preference will be given to students with demonstrated financial need. The student will hold the scholarship for one academic year. The scholarship may be renewed automatically for one additional year so long as students maintain satisfactory academic progress and continue to have financial need. Juniors and seniors are not eligible for this award.

O'Reilly Hospitality Management Scholarship	<p>The Recipient of this award will be a Junior student properly enrolled at Missouri State University within the Department of Hospitality Leadership. The recipient must be seeking a degree in General Operations, Lodging, Food and Beverage, Tourism, or Club Management; The recipient must demonstrate financial need; The recipient must complete an essay illustrating experience or interest in community service and/or sustainability. Preference will be given to applicants currently employed by O'Reilly Hospitality Management.</p> <p>This scholarship is not renewable.</p>
Ozark Chapter Missouri Society of Professional Engineers Le	<p>\$1,500 scholarships will be awarded annually to an incoming freshman properly enrolled full-time that is a US citizen majoring in Civil Engineering, Electrical Engineering, Pre-Engineering, or any other future degree option available through the Engineering Program. The student must have a high school GPA of at least 3.0 and must submit a personal statement discussing their career goals and merit. Preference will be given to students submitting at least two letters of recommendation from high school instructors, advisors, or administrators. Preference should also be given to applicants with a parent or grandparent that is a current or life member of the Ozark Chapter Missouri Society of Professional Engineers. High school GPA, ACT score, curricular and extracurricular involvement, and high school class rank will also be considered. The student will hold the scholarship for one academic year. The scholarship is automatically renewable for a second year as long as the student maintains enrollment in the Engineering Program.</p>
Pasta Express Hospitality and Restaurant Administration Sch	<p>Awarded annually to a full-time sophomore or greater majoring in Hospitality Leadership with a departmental GPA of 3.0. This scholarship is renewable, but the student must reapply.</p>
Paul L. & Alice W. Redfearn Undergraduate Research Award	<p>Awarded annually to an undergraduate student majoring in Anthropology, Biology, Geography, or another area of Natural History. Student can be enrolled in graduate courses. Student must conceive an original research project on the natural history of the Ozarks. The award will be made for the semester/school year in which the research will be conducted. This is a one-time award.</p>
Pete Sanderson Scholarship	<p>Awarded annually to a full-time Computer Science major that has completed less than 46 hours. Special consideration for freshmen that have completed at least CSC 131 (or its equivalent) and at most CSC 232 (or its equivalent). This scholarship is not renewable.</p>
Physics and Astronomy Department and Friends Scholarship	<p>There are currently no requirements for this scholarship other than being a student seeking a degree in either Physics, Engineering Physics, Physics Education, or a minor in Astronomy. This scholarship is not renewable.</p>
Pre-engineering/Engineering Physics Scholarship	<p>Awarded annually to a full-time undergraduate majoring in the Physics, Astronomy, and Materials Science Department. Incoming freshmen considered based on high school academic performance and leadership. Sophomores or greater must have an overall GPA of 2.75 and a departmental GPA of 3.0. Preference given to student demonstrating hands-on engineering aptitude. This scholarship is renewable, but the student must reapply.</p>
Rich and Cindy Miller Computer Science Endowed Scholarsh	<p>Scholarship will be awarded annually to one undergraduate or graduate student properly enrolled full-time at Missouri State University seeking a degree within the Department of Computer Science. Eligible candidates must be in good academic standing. Demonstrated financial need is preferred as are recipients who are first generation college students. Student must also successfully complete at least one Computer Science course toward their degree each semester. The recipient will hold the scholarship for one academic year. The scholarship may be renewed, but student must reapply.</p>

Robert Lloyd Ernst Chemistry Graduate Summer Assistantship	Awarded as the equivalent of a regular summer teaching assistant stipend to a graduate student in the Chemistry Department. Preference given to student that can complete Masters degree with this additional summer funding. Preference given to a student whose graduate advisor lacks funding for summer assistantship. If all qualifications are equal, preference will be given to student demonstrating financial need. The student will receive this award in the summer semester, so they must be enrolled in at least one hour over the summer. This is a one time award and is not renewable.
Robert S. Christie Memorial Scholarship	Awarded annually to a full-time student majoring or minoring in the Chemistry Department that has worked in the chemical stockroom or in the research laboratory. If all qualifications are equal, preference is to be given to a student demonstrating financial need. Recipients may be considered for renewal, but must reapply with all other applicants.
Robin Melton Science Scholarship	Awarded annually to a full-time undergraduate majoring in a program in the College of Natural and Applied Sciences. Must have an overall GPA of 3.0 and a GPA of 3.5 in their field of study. Serious consideration will be given to all ways in which potential recipients might contribute to a diverse educational environment. Preference is given to sophomores. Scholarship recipients may be considered for renewal of the scholarship, but must reapply with all other applicants.
Russell G. Barnekow, Jr. Memorial Scholarship	Awarded annually to an outstanding graduate student in Biology. Must have an overall undergraduate and departmental GPA of 3.6. Awards made with regard to financial need. This scholarship may be renewed, but the student must reapply.
Sarah Elsea Scholarship	The Recipient of this award will be a sophomore or junior student properly enrolled at Missouri State University as a full-time student. Biology, Chemistry, Physics Astronomy and Material Science, Computer Science, Engineering, Geography, Geology and Planning or Mathematics majors who are participating in a summer internship are eligible. Recipient must have a minimum GPA of 3.0. This scholarship will be awarded in full in the summer. The scholarship may be renewed but students must reapply and be considered with all other applicants.
Shirley Huffman Scholarship	The recipient of this award will be an undergraduate student, properly enrolled as a full-time student at Missouri State University, that has completed 80+ credit hours, has a GPA of 3.0 or higher and is pursuing a degree in Mathematics. It is the preference of the donor that the recipient be a first-generation higher education student; the student have financial need, This scholarship may be renewed, but must reapply for consideration with all other applicants.

CNAS Accelerated Masters Programs

The Accelerated Master's degree option provides a transition that enables outstanding Missouri State undergraduate students to begin taking graduate course work in their senior year and thus combine components of the undergraduate and graduate curriculum.

Eligible undergraduate students may apply for preliminary acceptance into an accelerated master's program after the specific program admission requirements have been met. If accepted, a maximum of 9-12 credit hours of approved graduate level courses may be designated as "mixed credit" and count towards both the undergraduate and graduate degree programs as specified in the accelerated program requirements.

Graduate programs offering an accelerated option in the College of Natural & Applied Sciences are:

- **Biology (MS)**
- **Chemistry and Biochemistry (MS)**
- **Computer Sciences (MS)**
- **Geospatial Sciences in Geography and Geology (MS)**
- **Materials Science (MS)**
- **Mathematics (MS)**
- **Mathematics Education (MSEd)**
- **Natural & Applied Science (MNAS)**

Undergraduate students interested in the Accelerated Master's opportunity should contact their department or the Graduate College, GraduateCollege@MissouriState.edu (417-836-5335) to determine admission requirements and procedures, <https://graduate.missouristate.edu/futurestudents/Accelerated.htm>