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UNIVERSITY OF CENTRAL OKLAHOMA

TRI-CENTER SYMPOSIUM

Sponsored in part by:

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

ARL BIO PHARMA

Friday - April 12, 2024

Celebrating Student-Centered Research

UNIVERSITY OF CENTRAL OKLAHOMA

Annual Tri-Center Symposium

Friday, April 12, 2024 – 8:30 AM – 1:30 PM

8:30 – 9:30 AM	**Registration and Welcome**	STEM Lobby
9:30 – 12:00 PM	**Booth Presentations**	STEM Building
9:30 – 10:45 AM	**Poster Session 1** Odd Numbered Posters	STEM Hallways
10:45 – 12:00 PM	**Poster Session 2** Even Numbered Posters	STEM Hallways
12:00 – 1:00 PM	**Keynote Speaker and Lunch** Dr. Rebecca Snyder	STEM 101
1:00 – 1:30 PM	**Final Reception and Awards**	STEM Lobby

UCO College of Mathematics and Science, University of Central Oklahoma

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STLR Student Transformative Learning Record

2024 POSTER PRESENTATION Schedule

Friday, April 12, 2024 – STEM Research and Learning Center

Poster Session 1		
9:30 AM – 10:45 AM, STEM Hallways		
CFACS 103	CIBER 203	CREIC 301
CFACS 105	CIBER 205	CREIC 303
CFACS 107	CIBER 207	CREIC 305
CFACS 109	CIBER 209	CREIC 307
CFACS 111	CIBER 211	CREIC 309
CFACS 113	CIBER 213	CREIC 311
CFACS 115		CREIC 313
CFACS 117		
CFACS 119		
CFACS 121		

Poster Session 2		
10:45 AM – 12:00 PM, STEM Hallways		
CFACS 106	CIBER 202	CREIC 302
CFACS 108	CIBER 204	CREIC 304
CFACS 110	CIBER 206	CREIC 306
CFACS 112	CIBER 208	CREIC 308
CFACS 114	CIBER 210	CREIC 310
CFACS 116	CIBER 212	CREIC 312
CFACS 118	CIBER 214	CREIC 314
CFACS120		

COLLEGE OF Mathematics and Science
UNIVERSITY OF CENTRAL OKLAHOMA

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STLR STUDENT TRANSFORMATIVE LEARNING RECORD

KEYNOTE ADDRESS

Dr. Rebecca Snyder

12:00 PM – 1:00 PM - STEM 101

Rebecca Snyder, Ph.D., Senior Director of Conservation, Education, and Science
Chair, AZA Giant Panda Conservation Foundation
Oklahoma City Zoo and Botanical Garden

Leading, Funding, and Fostering Conservation Action

The escalating worldwide loss of biodiversity requires immediate and sustained conservation action. As a conservation organization with an audience of one million visitors annually, the Oklahoma City Zoo and Botanical Garden (OKC Zoo) has a multilevel approach to conservation. Efforts range from staff-led local and international programs to providing funding and capacity building to engaging visitors of all ages. Learn how OKC Zoo leverages its large audience to lead and support wildlife conservation in Oklahoma and around the world.

BOOTH PRESENTATIONS

9:30 – 12:00 PM

Welcome to the Tri-Center Symposium, where knowledge and inspiration await you at every turn. As you navigate through the poster presentations, don't miss out on the opportunity to visit our information booths scattered throughout. These booths serve as vibrant hubs of insight and engagement, offering a wealth of valuable resources, interactive displays, and knowledgeable experts eager to share their expertise. Whether you're seeking to learn about one of our research centers or student clubs or connect with like-minded individuals, our information booths are the perfect opportunity. So, take a moment to explore, engage, and expand your horizons – you never know what fascinating discoveries await you!

First Floor

Oklahoma Department of Wildlife Conservation
Tri-Beta Honor Society/Biology Club
Wildlife Society
CIBER-Center for Interdisciplinary Biomedical Education and Research
CFACS-Center for Wildlife Forensics and Conservation Studies
CLEAR-Center for Cybersecurity Leaders, Education and Research *(New)*
Jackson College of Graduate Studies

Second Floor

CREIC-Center for Research and Education in Interdisciplinary Computation
UCO Office of High-Impact Practices
Broncho Education and Learning Lab (BELL)
Math Club

POSTER AWARDS

1:05 – 1:30 PM

Best CIBER Poster Presentation

Best CFACS Poster Presentation

Best CREIC Poster Presentation

Best Overall Poster Presentation

People's Choice Poster Presentation

We encourage all attendees to nominate student posters for the People's Choice Poster Presentation.

ONLY ONE VOTE PER PERSON

All votes need to be submitted by 12:00 P.M

Join us for the awards announcement and reception in the STEM Lobby at 1:05 PM.

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CAMPUS MAP

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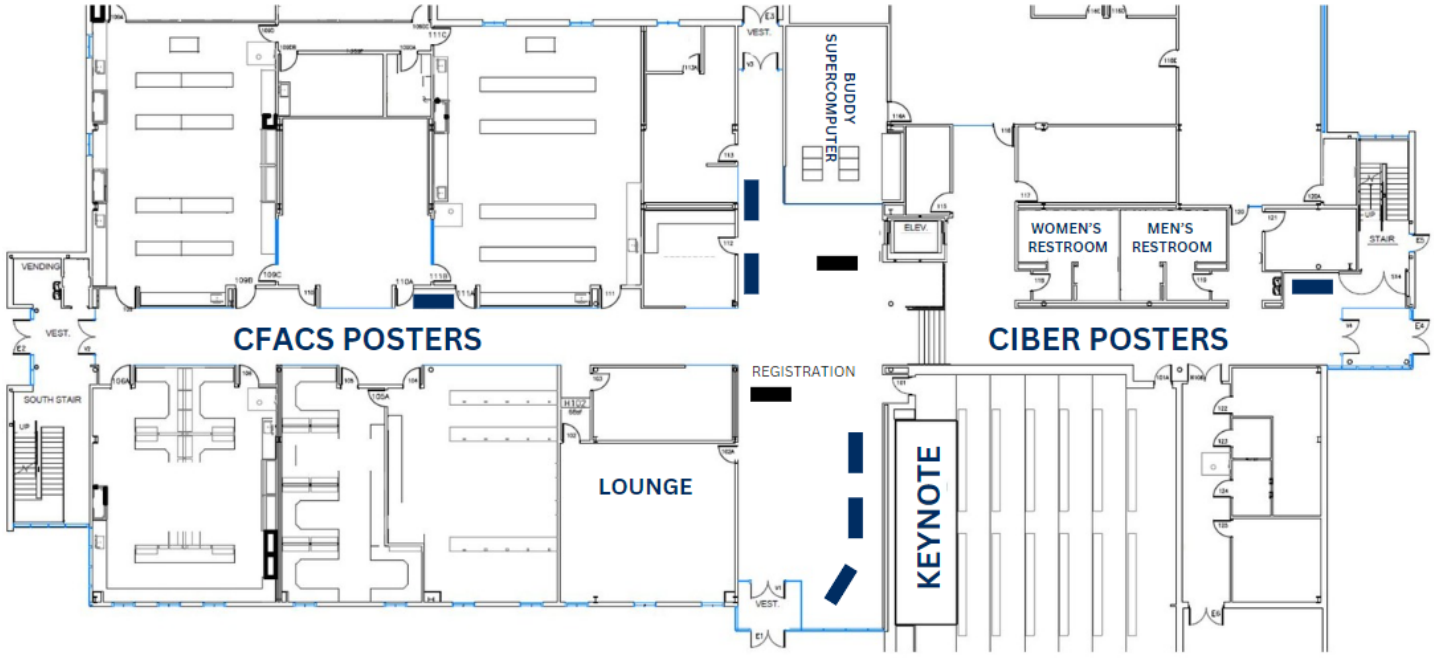
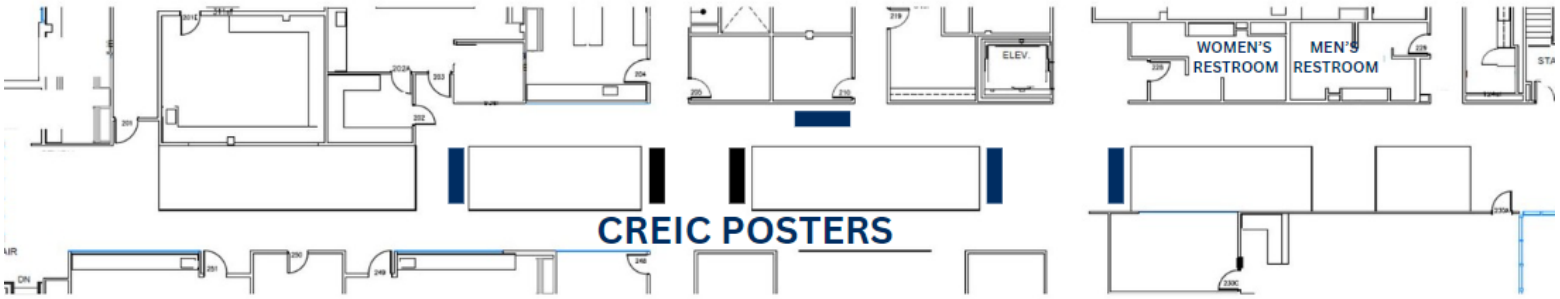
BETZ STEM RESEARCH AND LEARNING CENTER MAP



STEM FIRST FLOOR



STEM SECOND FLOOR

College of Mathematics and Science, University of Central Oklahoma

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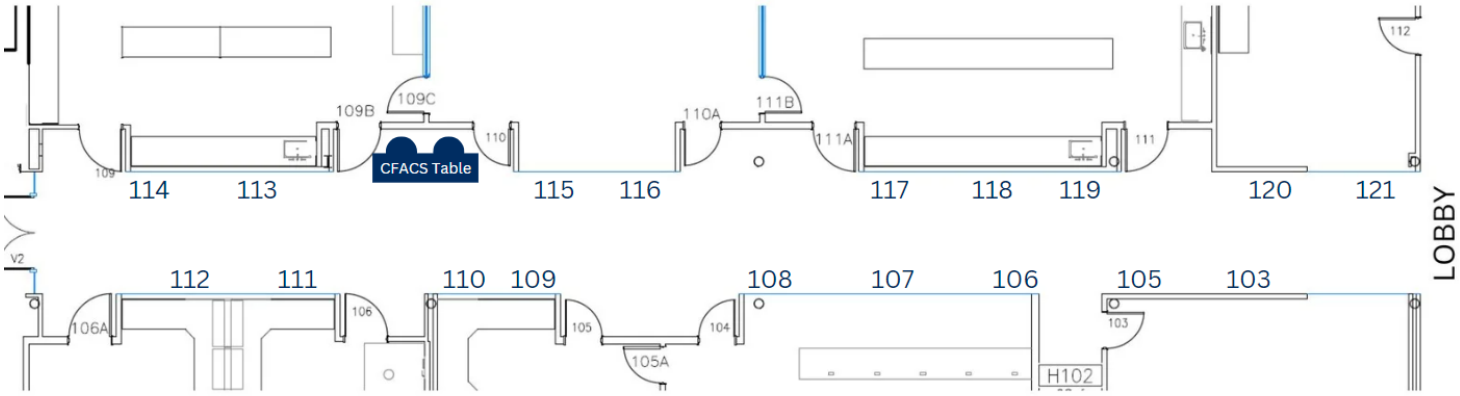
STLR Student Transformative Learning Record

CFACS POSTER MAP



STEM FIRST FLOOR

CFACS

Center for Wildlife Forensics and Conservation Studies

The UCO Center for Wildlife Forensics and Conservation Studies (CFACS) is focused on issues of environmental conservation and wildlife protection. The Center is a cooperative, multi-disciplinary partnership between the W. Roger Webb Forensic Science Institute (FSI) and the UCO College of Mathematics and Science. CFACS members include faculty who represent a wide array of expertise ranging from wildlife biology, ecology, genetics, forensic science, criminal justice, and other disciplines.

Visit the CFACS Website.

https://go.uco.edu/CFACS

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CFACS 103 **Session 1-9:30-10:45 AM**

Population Genetics Show Mediterranean Geckos (Hemidactylus turcicus) Rarely Move Among Buildings at and Near the University of Central Oklahoma)

Viannka Galarza, Dani Bright, Allyson Fenwick

Keywords: Animals, Genetics

Most invasions of exotic species are of unknown origin. In contrast, the Mediterranean gecko (Hemidactylus turcicus) was known to be introduced to the University of Central Oklahoma during 1963-1965 and 1985-1997. Researchers have tracked their spread on and off campus since 2005. Dr. Fenwick's lab has been sampling since 2014, collecting over 1550 tail tissue samples. DNA from the tail tissues allows us to evaluate genetic structure and use this population as a model for invasive species with unknown origins. However, hundreds of samples have not been able to be genetically analyzed because lab work was limited during the pandemic. We genotyped 16 previously published microsatellite loci for over 50 individuals, including samples from the STEM building that opened in 2018. We analyzed the data using STRUCTURE and ARLEQUIN. We estimated low genetic diversity and low genetic differentiation among buildings. We also found different genetic clusters between geckos sampled from distant buildings and those near the original introduction site (Howell Hall). We expect new data to clarify patterns of gene flow between on and off campus buildings. Going forward, this project will continue to perform genotyping and analyses on the approximately 300 samples that have not yet been extracted, including new samples.

CFACS 105 **Session 1-9:30-10:45 AM**

Population Diversity of Mammalian Species Found on Moderately and Highly Disturbed Land Plots in Cushing, Oklahoma.

Nadiya L. Cavallo, Richard W. Dolman, Michelle L. Haynie

Keywords: Animals, Ecology

Wildlife populations are susceptible to habitat fragmentation caused by the harvest of natural resources, industrial infrastructure, urbanization, roads, and conversion of land for agriculture. In Cushing, Oklahoma, there are two privately owned land plots—one described as moderately disturbed due to hayed fields and occasional use of farm equipment, the other described as heavily disturbed due to orphaned oil wells on the property. Floristic Quality Assessment will be used to measure disturbance levels between the two sites. Preliminary data was collected during a pilot study conducted from July 2023 to December 2023. I did a general mammalian survey using Sherman traps, Tomahawk traps, and Reconyx Hyperfire camera traps to gather data on mammalian communities from both properties. Data will be analyzed by either a Goodness of Fit Test or Shannon's diversity index. Resulting data will be used to determine any variation within the communities and identify impacts of petroleum extraction on species diversity.

CFACS 106 **Session 2-10:45-12:00 PM**

Investigating the Stability of Microbial Samples as Evidence for Forensic Use

Shelby Wilson, James Creecy, Matthew Parks

Keywords: Animals

Samples collected from the human skin microbiome have potential for use in human identification in forensic investigations; however, the stability of microbes in these samples has not been identified during the time it is stored as evidence. This research will investigate the stability of microbial samples after being collected under standard evidentiary protocols over the span of ten months. Samples will be collected from participants at multiple time points, half of which will be stored under standard evidentiary protocol. The microbial DNA from the remaining samples will be extracted immediately following collection. Following collections at each time point, microbial DNA will be amplified and sequenced for further analysis. The bioinformatics pipeline QIIME2 will be utilized to identify the different groups and classes in each sample. These classifications will be further utilized to determine any changes that may have occurred during time in storage, as well as colony trends in samples from each participant.

CFACS 107 **Session 1-9:30-10:45 AM**

Utilizing Honey Bees (Apis mellifera) as a Surveillance and Monitoring Technique for Bacterial Pathogens in Specific Environments

Jordan Walter, James Creecy, Wayne Lord, John Barthell, Matthew Parks

Keywords: Animals

Biological threats, in the form of infectious diseases and pathogens, are attacking and harming environmental populations around the globe. These threats occur through both deliberate acts and naturally occurring outbreaks. Microbiologists, epidemiologists, and forensic scientists have worked to find ways to detect these threats and protect all populations. Through the implementation of technologies, practices, and infrastructure, these various entities have provided possibilities to aid in detecting pathogen spread. While this has been beneficial, there are still challenges, limitations, and a need for specific practices for the defense aspect of biosecurity and biosafety. One primary practice is surveillance and monitoring, which is used to detect pathogen spread and epidemics. Due to that, finding ways to effectively surveillance and monitor infectious diseases and pathogens is of utmost importance. Honey bees (Apis mellifera) are uniquely positioned to serve as bioindicators that can sample the microbiome of specific environments, including pathogens that are hazardous to human, animal, and plant health. Honey bees can have large foraging territories spanning up to 100 km2. Through their routine collection activities, they can passively accumulate microbes from vegetation and water sources, airborne particulates, and other environmental contaminants. These contaminants and potential pathogens adhere to the bodies of forager bees and are subsequently transported back to the hive environment. We hypothesized that the foraging behavior of honeybees grants them the ability to interact with microbes within that specific environment, therefore revealing the microbial landscape and providing information for early pathogen surveillance and monitoring. We then proposed designing a study with three experiments focusing on identifying and understanding microbial residues and pathogen detection in different environments.

CFACS 108 **Session 2-10:45-12:00 PM**

Comparative Dental Complexities of the Late Jurassic Rhynchocephalian Opisthias

Tanner Scott, Keegan M. Melstrom

Keywords: Animals, Computational

Morphological differences have long been attributed to adaptations for the unique conditions present in different ecosystems. These variations may be for locomotion, such as flippers for swimming, long forelimbs for brachiation, or adaptations in tooth shape for diet. The rhynchocephalian Opisthias is a common fossil found in the Upper Jurassic Morrison Formation (163–145 Ma), often recovered as isolated jaw fragments. These jaw fragments have been used for the qualitative interpretation of diet, but so far, quantitative measurements have been lacking. We micro-CT scanned 15 jaws from the Natural History Museum of Los Angeles County (LACM), most identified as Opisthias, and sought to quantify dental complexity of these preserved elements. Using the Orientation Patch Count Rotated (OPCR) method, we found that dental complexities were between 8 and 16 patches per tooth. This patch count is relatively low compared to ornithischian dinosaurs but resembles that of theropods and sauropods that lived in the same environment. In comparison to Sphenodon, the closest living relative of Opithias, the dental complexity is almost identical, suggesting that the diet and strategies of the two may be similar. We hypothesize that the diet of Opisthias would resemble that of the omnivorous habits present in the extant Sphenodon. This omnivorous diet suggests a different dietary niche and possible ecological interactions than other hypothesized diets of Late Jurassic rhynchocephalians.

CFACS 109 **Session 1-9:30-10:45 AM**

Ecological Disturbance in The Anthropocene: Legacy Effects of Orphaned Oil Wells on Vegetative Communities and Metabolic Phenotype of Free-Living Rodents

Jess Warr, Richard Dolman, Chris Goodchild, Vicki Jackson, Jenna Messick

Keywords: Animals, Ecology

Persistent organic pollutants have been studied intently for the last thirty years, and many are known to be mutagenic, some carcinogenic. Among the most commonly studied environmental organic contaminants are polycyclic aromatic hydrocarbons (PAHs), 16 of which are listed by the United States Environment Protection Agency (US EPA) as priority contaminants of concern. Many PAHs are found in crude oil and can remain in the environment long after crude oil spills have occurred. While catastrophic large marine oil spills often receive considerable media attention, smaller-scale inland spills occur much more frequently, resulting in legacy PAH contamination. Oklahoma currently has 15,965 documented orphaned oil rigs that were operated under less regulatory oversight. Oklahoma Energy Resources Board (OERB) is working diligently to plug orphaned wells; however, the toxic legacy effects on surrounding ecosystems are not well understood. Using 2 separate field sites in Cushing, Oklahoma, we collected soil samples to compare surface PAH concentrations. We targeted areas surrounding unplugged oil wells and

will compare soil PAH concentrations to EPA soil screening levels (SSLs) and a reference location having no known recent crude oil production activity. To assess site-specific disturbance, we will conduct vegetative surveys to generate Floristic Quality Assessments (FQAs) for each site. In accordance with substantial data showing PAH exposure causes hematological damage, altered immune function, and shifts in organismal metabolic rates, we hypothesize legacy PAH contamination will lead to physiological differences in free-living Peromyscus populations inhabiting the individual sites. We will measure white blood cell differentials, packed cell volume, hemoglobin concentration, and organismal resting metabolic rate. Collectively, this data will allow us to evaluate the legacy effects of unplugged oil wells on multiple ecosystem components.

CFACS 110 **Session 2-10:45-12:00 PM**

Trends in Small Mammal Populations After Six Years of Mark-Recapture Research in the Gypsum Hills of Western Oklahoma

Claire Wiley, Francisca M. Mendez-Harclerode, Gloria M. Caddell, Chad B. King, Michelle L. Haynie

Keywords: Animals, Climate Change

The purpose of this project is to monitor changes in small mammal populations and communities over multiple generations to determine what factors affect how the populations and communities change over time. In March 2018, a permanent trapping web was established at the University of Central Oklahoma's Selman Living Lab (SLL). Two additional permanent webs were established in June of 2018. The SLL is located in the gypsum hills of Woodward County in western Oklahoma. Surveys of the 3 webs are conducted for 3 nights, 4 times a year, and include the collection of mammalian and vegetation data. Climate data is also obtained for each day of the trip; monthly and yearly climate data will also be assessed. To date, 21 mammalian and 20 vegetation surveys have been conducted. Based on preliminary data, seasonal and habitat trends have been detected in mammalian populations, with the lowest capture numbers occurring in summer and reaching peak numbers in spring. The trapping web located on mixed, slightly disturbed habitat has the most diverse community and the most number of captures/recaptures. In the future, the animal, climate, and vegetation data will be used to build mathematical models that can be used to determine which factors have the largest impact on population and community persistence.

CFACS 111 **Session 1-9:30-10:45 AM**

ArcGIS Mapping of a Watershed Tracking Flow Accumulation of an Abandoned Oil Well Site

Damon Corvelo, Jess Warr, Jenna Messick, Christopher Goodchild

Keywords: Conservation, Ecology

Oklahoma currently has 15,965 documented oil wells that have been orphaned on private land. The Oklahoma Energy Resources Board (OERB) is working to plug abandoned oil wells, however, some of these wells have been abandoned and untouched, while many others have been patched but still require upkeep into the future. Oil well sites contain many persistent organic pollutants (POPs), which can sit on top of land and form leachate when it rains. One such site is located in Payne County, Oklahoma, just outside the city of Cushing. This site has been removed, and the oil well fenced off. However, many visible traces of crude oil still exist directly on top of the ground and in nearby runoff areas. This abandoned oil site is situated right in the middle of a watershed along the Cimarron River. We used the Hydrology toolbox in ArcMap to determine the potential flow direction of the POPs from the site. We found that the POPs contained in the residual crude oil flow directly into the Cimarron River following heavy rainfall. The Cimmaron River flows directly into Keystone Lake, meaning that a currently unmeasured number of POPs from this oil site are flowing directly into Keystone Lake.

CFACS 112 **Session 2-10:45-12:00 PM**

Camera Trapping Survey to Measure Mammalian Diversity and Determine Human Impact at Chandler Park, Tulsa County, OK

Makenzi Hines, Victoria Jackson

Keywords: Animals, Ecology

Once an active quarry, Chandler Park in Tulsa, Oklahoma, is now one of Tulsa County's busiest parks for recreation. Prior to this survey, the park had never conducted an official biological survey of mammals in the area. In an effort to document mammalian diversity in Chandler Park, we surveyed 4 locations using camera traps during the months of July 2023 through March 2024, choosing locations based largely on prior knowledge of animal presence. Cameras were baited with a number of different baits, including sardines, peanut butter, and cinnamon. We detected a variety of mammals in the 4 locations, including raccoons, armadillos, and bobcats, with 2 of the locations having an increased diversity than the other 2. Both human and animal presence was documented for each location on a monthly basis. Analysis is actively being completed to determine the relationship between animal diversity and human presence and to see what impact, if any, humans are having on the mammal diversity in the park. Ahead of completion of analysis, we have noticed limited impact on diversity where we counted a large number of human individuals, and presume this to likely be consistent with our finalized results. Information resulting from this study has two-fold importance, in producing documentation of the park's mammalian diversity, and providing a baseline of human impact to compare to in future studies.

CFACS 113 **Session 1-9:30-10:45 AM**

Deep Fork River: A Headwaters in Peril

Alexa Kirksey, Matthew Parks, Sean Laverty

Keywords: Conservation, Ecology

Every year, approximately 300 million tons of waste is produced in the United States, placing us as a leading global contributor of plastic waste and plastic waste entering coastal environments. Garbage in waterways has profound effects on natural habitats, negatively impacting wildlife and our health. The Deep Fork River (DFR) begins its headwaters in Oklahoma City (OKC), Oklahoma, and runs approximately 230 river miles to Lake Eufaula in eastern Oklahoma. Within OKC, the DFR serves as a vital habitat for wildlife but has become heavily impacted by runoff and pollution from commercial and urban development. The aim of this project is to create awareness of the current conditions of the DFR and to motivate positive action toward cleanup efforts and policy, ensuring the future health of the river. We completed a kayak excursion in March 2023, photo-documenting garbage accumulation along a ~6-mile stretch of the DFR headwaters in the urban OKC area. We observed large accumulations of single-use plastics, tires, shopping carts, and clothing within the river. We built a website (www.DFRneedsHelp.org) to host representative photos from our documentation and inform the public about the condition of the DFR. We subsequently contacted non-profit, governmental, and media organizations with a link to our website and a call to action. Our documentation supports that the DFR is heavily impacted and is in dire need of cleanup and preventative measures, such as floatation devices to catch trash like WATERGOAT or Trash TroutTM.

CFACS 114 **Session 2-10:45-12:00 PM**

Critical Thermal Limits of the Mediterranean Gecko Hemidactylus turcicus

Jade Langoc, Tanya Korotiuk, Allyson Fenwick, Christopher Goodchild

Keywords: Ecology, Evolution

Mediterranean geckos (Hemidactylus turcicus) are small, nocturnal lizards that live on building walls in their non-native range. Critical thermal limits have been measured but only for populations much further south. At the University of Central Oklahoma (UCO), geckos were found outside in temperatures far below the published critical thermal minima, suggesting that Oklahoma geckos are more cold tolerant than those in Texas, Louisiana, or Alabama. We are also interested in whether shifts in gecko metabolic physiology are associated with acclimation to low temperatures. Third, we want to know if non-adults respond differently than adults. This winter, we have been collecting geckos from the UCO campus, measuring critical thermal minima and maxima, and evaluating resting metabolic rates. We predict that UCO geckos will have critical thermal minima lower than published limits but higher than the coldest locations where they were found. We also predict geckos at different life stages will have similar limits and metabolic responses. Critical thermal minima measured to date averaged lower than published values, and maxima averaged between published values for west Texas and Gulf Coast sites. We are currently analyzing metabolic rate data. We plan to continue sampling and measurements for a full year, which will result in a stronger understanding of metabolic responses, differences across seasons, and differences across life stages.

CFACS 115 **Session 1-9:30-10:45 AM**

UCO Natural History Collections

Lillian Gunelson, Lynda Loucks

Keywords: Animals, Science Communication

The University of Central Oklahoma is home to the UCO Natural History Museum, housed primarily in Howell Hall. Significant collections of plants, fungi, lichens, vertebrates (birds, mammals, fish, reptiles, and amphibians), invertebrates (aquatic and terrestrial), and frozen tissues are cataloged, organized, stored, and maintained to preserve these valuable specimen records and associated data. Global natural history collections are crucial for academic research and education, providing a window into biodiversity past and present and helping us determine distribution and migration patterns, morphological changes, and ecological relationships.

The three pillars of UCONHM are utilization in education, research, and outreach to broaden the understanding of the biological world. Student workers play an important role in efforts to preserve, protect, and expand collections and working in UCONHM provides an opportunity to develop museum and archival skills required to maintain natural history records. Collections require constant upkeep and maintenance to uphold museum standards, and the following tasks are part of this museum internship: reviewing and updating specimen tags, topping off alcoholic specimen jar levels with 70% ethanol, replacing old lids with better-sealing polypropylene lids, and adding quality specimens to the collection through preparation and cataloging efforts. In two semesters, 12 bird flat skins were prepared and cataloged into the ornithology collection, 50 vials and jars were labelled, filled with ethanol, and organized in the ichthyology collection, dozens of jars were cleaned and topped off, shelving units were cleaned and organized, and 40 bat specimens were processed for future entry into the mammal collection.

CFACS 116 **Session 2-10:45-12:00 PM**

Comparison of Three DNA Extraction Kits on Diverse Microbial Sources

Hayden Linse, Delaney Donnohue, Mathew Parks

Keywords: Genetics

DNA extraction techniques are generally designed to provide affordable, rapid, and accurate methods for extracting DNA from a variety of sources. Manufacturers create different kits specific to isolating DNA from varying sources, ranging from fecal material, biological tissues, aquatic environments to soil. Our research aims to compare the effectiveness of three commonly used extraction methodologies that differ in cost and time investment: Chelex, Qiagen QIAamp BIOstic Bacteremia, and Qiagen DNeasy PowerSoil Pro. Each of these methods was tested against three sample sources of biological communities, including of biological, soil/fecal and biofilm origins. We assessed the performance of methodologies through both DNA extraction quantity, quality, and PCR amplification success using a common 16S rRNA primer set. Our results enable evaluation of the importance of method selection for DNA extraction and provide insight into the reliability of these strategies across diverse sample origins. This research will help guide future DNA extraction endeavors and help facilitate the selection of proper extraction methodologies.

CFACS 117 **Session 1-9:30-10:45 AM**

Effects of Alternative Reproductive Tactics on Hematological Indices, Leukocyte Counts, and Oxidative Stress in Male Collared Lizards (Crotaphytus collaris)

Sean Johnson, Troy Baird, Christopher Goodchild

Keywords: Animals, Ecology

Male Collared Lizard (Crotaphytus collaris) can be categorized as 'territorial' or 'non-territorial' according to display frequency of certain behaviors. Territorial males spend more time courting females and defending their territory against nonterritorial lizards, and previous studies have shown the annual fitness (number of mates, offspring sired) is greater for territorial males. However, it is unclear whether there is a physiological tradeoff associated with a territorial reproductive tactic. Therefore, the primary objective of this study was to examine whether territorial and nonterritorial males exhibit differences in immune function, oxidative stress, and hematological indices. Additionally, a secondary objective was to examine sex-specific differences in these physiological variables. To differentiate between territorial and nonterritorial males, we conducted focal observations of male Collared Lizards from a long-term study population at Arcadia Lake and categorized them according display behaviors during their breeding season. We collected blood from male Collared Lizards over three breeding seasons and measured packed cell volume, hemoglobin, and mean corpuscular hemoglobin concentration. To determine white blood cell differentials, we prepared blood smears, manually counted white blood cells by light microscopy, and recorded the number of each type of white blood cell. Additionally, we assessed oxidative stress by measuring the amount of reactive oxygen metabolites in plasma. Although territorial males tended to have lower PCV and hemoglobin, these trends were not significant. Additionally, territorial males appeared to have lower heterophil counts and higher lymphocyte counts compared to nonterritorial males. Males exhibited higher hematocrit and hemoglobin compared to females, but there was no difference in MCHC or white blood cell counts across sexes. Collectively, these data may indicate territorial males exhibit a different physiological phenotype compared to nonterritorial males, but further data collection is required to confirm these preliminary results.

CFACS 118 **Session 2-10:45-12:00 PM**

Effects of Embryonic Exposure to Polycyclic Aromatic Hydrocarbons on Hepatic mRNA Expression of Detoxification Enzymes in Chick

David Serrano, Yulianis Pagan, Christopher Goodchild

Keywords: Developmental Biology, Genetics

Large oil spills leave long-lasting effects on the species that occupy the areas affected. Post-incident mortality estimates of avian species are performed by field observations, aerial surveys, and carcass recovery. Yet, none of these methods take into consideration eggshell-surface oiling from the feathers of parents or oiled covered nesting material. Polycyclic aromatic hydrocarbons (PAHs) are chemicals found in crude oil that can pass through the external eggshell surface and

have the potential to cause developmental defects in avian embryos. Previously, our lab conducted an egg injection study with White Leghorn chicken (Gallus gallus) eggs examining the effects of six PAHs at a range of concentrations on chick embryo development and hepatic gene expression. In this study, we examined whether simultaneous exposure to two PAHs, Chrysene (Chr) and Phenanthrene (Phe), causes greater hepatic toxicity. Chicken embryos were exposed to Chr (800 ng / g of egg mass), Phe (800 ng / g egg mass), and Chr and Phe in combination (∑ PAH 1600 ng /g ng egg mass) via egg-injection. We then collected liver tissue on embryonic day 18 for mRNA expression of hepatic detoxification enzymes. We are currently isolating mRNA from embryonic liver tissue to measure CYP1A, interleukin-6, and glutathione peroxidase expression. All of which are crucial for detoxification processes and immune function. Considering these implications, it is crucial to account for sublethal eggshell surface oiling in order to accurately assess the overall impact of crude oil spills on avian populations.

CFACS 119 **Session 1-9:30-10:45 AM**

Effects of in Ovo Chrysene and Phenanthrene Exposure on Chicken Embryo Development and Cardiac Function: Is There Evidence for Synergism?

Yulianis Pagan, Hallum Ewbank, Christopher Goodchild

Keywords: Animals, Conservation

Polycyclic aromatic hydrocarbons (PAHs) are naturally occurring toxic chemicals found in crude oil and are known to transfer from the external eggshell surface to egg contents. Previously, we conducted an egg-injection study with White Leghorn chicken (Gallus gallus) eggs and identified two PAHs, chrysene (Chr) and phenanthrene (Phe), that increased embryonic heart mass and decreased embryonic heart rate. In this study, we investigated whether co-exposure to Chr and Phe resulted in additive or synergistic effects on chick embryo development. Chicken embryos were exposed to Chr (800 ng / g of egg mass), Phe (800 ng / g egg mass), and Chr and Phe in combination (∑ PAH 1600 ng /g ng egg mass) via egg-injection, and we collected embryonic organ mass, heart rate, metabolic rate, and cardiac and hepatic mRNA expression of detoxification enzymes on embryonic day (ED)18. We observed a decrease in ED 18 heart rate across all treatments. We also saw an increase in ED 18 liver mass in eggs exposed to Chr and Phe simultaneously, and shifts in metabolic rate and mRNA expression of cardiac detoxification enzymes. However, embryonic growth or morphology did not vary among treatments. Collectively, these data suggest in ovo exposure to PAHs may lead to congenital heart defects, which may have long-term implications for hatching success and hatchling survival.

CFACS 120 **Session 2-10:45-12:00 PM**

Effects of Bis(2-Ethylhexyl)-2,3,4,5-Tetrabromophthalate (TBPH) Flame Retardant on Heart Rate, Metabolic Rate, and Organ Development of White Leghorn Chicken Embryos

Jennifer Wilson, Christopher Goodchild

Keywords: Ecology

Flame retardants are a diverse group of chemicals applied to manufactured materials to prevent or slow the spread of fires. However, flame retardants are not chemically bonded to the products they are applied to and can leach into the environment. The persistence of flame retardants in the environment led to toxicity concerns for free-living animals, including birds. Adult birds are exposed to flame retardants that have bioaccumulated in their prey, and trophic transfer of flame retardants lead to flame retardants being detected in hepatic tissue of adult birds. Flame retardants can be passed on to eggs by maternal deposition and cause embryotoxicity. Given their persistence and toxicity, traditional flame retardants were banned in 2004 and replaced by 'alternative' flame retardants. However, alternative flame retardants have also been found in environmental samples, but the effects of many of these chemicals have not been fully tested for potential adverse developmental outcomes. Bis(2-ethylhexyl)-2,3,4,5-tetrabromophthalate (TBPH) is an alternative brominated flame retardant found in rubber, appliances, and polyurethane foam. In this study, we examined the effects of in ovo exposure to TBPH at two concentrations (50 ng/g egg mass and 150ng/g egg mass) on white leghorn chicken embryos. Chicken eggs are an established model for embryonic toxicity. We drilled small holes into the eggshell and injected TBPH was into the albumin. Heart rate was measured on embryonic days 14 and 18. On day 18 metabolic rate, we measured crown-rump length, and body and organ (heart, liver, brain) masses. Preliminary analysis indicates exposure to TBPH reduces crown-rump length, body mass, and liver mass. Exposure to TBPH did not reduce heart mass or heart rate. Collectively, these results suggest in ovo exposure to TBPH suppresses embryonic growth but does not directly impair cardiac function.

CFACS 121 **Session 1-9:30-10:45 AM**

Potential Distribution of Hydrastis canadensis

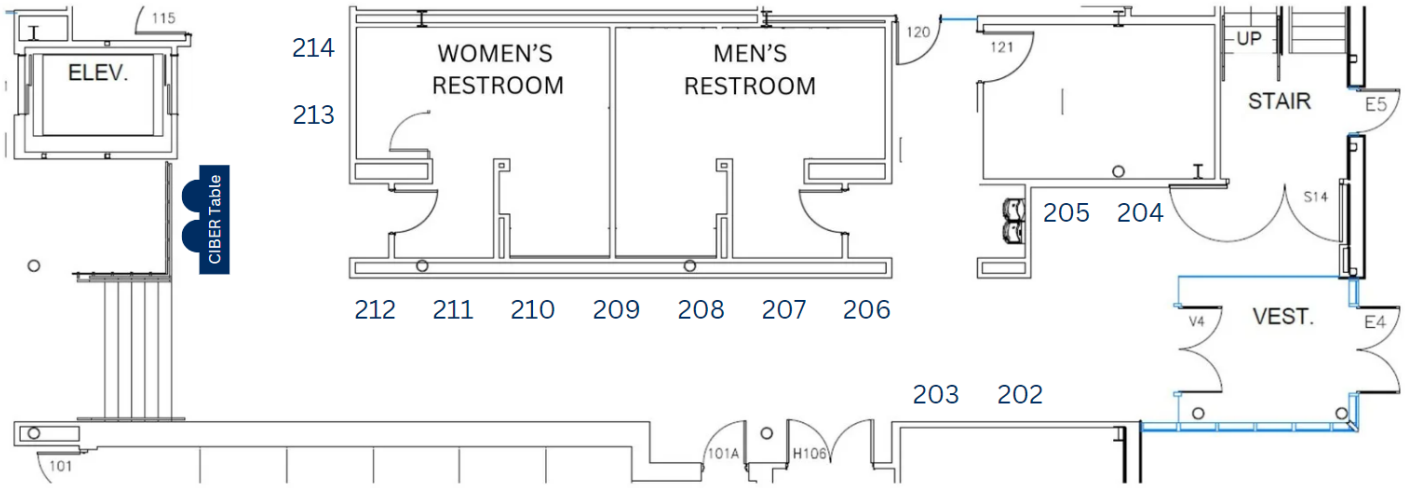
Teresa Trail, Dr. Jenna Messick

Keywords: Plants

Hydrastis canadensis (goldenseal) is an herbaceous plant in the family Ranunculaceae. H. canadensis is found in shaded, rich loamy soils which holds enough moisture to support other woodland flora. H. canadesis has been gathered for many years by many tribes for its medicinal properties. It has been shown to be effective combating MRSA(G+) and Helicobacter pylori (G-). It has been used for antimicrobial, anti-virulence, efflux pump inhibitory processes and also lowers LDL cholesterol. Goldenseal has been collected aggressively and has been listed on Appendix II by the Convention on International Trade in Endangered Species (CITES) since 1987. The International Union for the Conservation of Nature lists H. canadensis as vulnerable. The goal

of this study is to use species distribution modeling to determine suitable habitat for H. canadensis (goldenseal) in Oklahoma. H. canadensis has not been documented in Oklahoma to date. Habitat similar to H. canadensis habitat in Arkansas occurs in northeastern Oklahoma. Coordinates from previously collected herbarium specimens documented in the SERNEC (Southeast Regional Network of Expertise and Collections) database were used in MaxEnt with various environmental and climatic variables to create a probability of occurrence map. Ground truthing searches will be during the flowering period in April and May, based on areas showing the highest probability of occurrence for this species within Oklahoma.

CIBER POSTER MAP



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CIBER 202 **Session 2-10:45-12:00 PM**

The Investigation of Alcohol-Induced Dose Dumping of Acetaminophen

Natalie Wimer, Emily Bakhtiari, Abigail Organ, Sanjeewa Gamagedara, Ph.D.

Keywords: Chemistry

Acetaminophen is commonly used as an over-the-counter pain medication. However, its combination with alcohol may lead to lasting damage to vital organs, particularly the liver. This experiment aimed to assess the impact of solutions with differing amounts of alcohol on the dissolution of acetaminophen. In pharmaceutical testing, dissolution refers to the speed at which a drug is released into a solution.

Employing the concept of alcohol-induced dose dumping (AIDD), acetaminophen tablets were dissolved in HCl with varying amounts of a water-ethanol solution to investigate if alcohol plays a role in the dissolution of acetaminophen in the stomach. Initially, a 100-ppm acetaminophen stock solution was created, and a 10-ppm dilution was made to determine the λmax of acetaminophen. Six calibration standards at various concentrations of acetaminophen were analyzed using the BioTech Epoch 2 Microplate Spectrophotometer with the λmax from the Cary 60. Absorbance values were collected and plotted on a calibration curve.

Five solutions were prepared to simulate a stomach environment with a constant amount of hydrochloric acid and varied deionized water to ethanol ratios, representing different alcohol percentages: 0%, 5%, 12%, 24%, and 40%. A 325-mg Tylenol tablet was immersed in each solution, and samples were taken at intervals of 0, 0.5, 1, 2, 4, 7, 12, 16, and 20 minutes. Absorption values were measured using a Biotech Epoch 2 Spectrophotometer.

In the initial run of the experiment, there was no discernible trend in results. However, after adjusting some parameters, a consistent trend emerged, indicating that the 0% alcohol solution took the longest time to dissolve the tablet, while the 40% alcohol solution dissolved the tablet most rapidly. AIDD dissolution study serves as a crucial method for evaluating the impact of alcohol on the dissolution rate of specific pharmaceuticals.

CIBER 203 **Session 1-9:30-10:45 AM**

Genetic Evaluation of Bile Salt Resistance and Sensitivity in a Subculture of Escherichia coli K-12 Substrain JC3272

Zane Henderson, Parker Brecheen, Jennifer Vega, James Bidlack

Keywords: Genetics

Escherichia coli is known to live in parts of the gastrointestinal tract with high concentrations of bile salt and is thus adapted to resist their cytotoxic effects via active transport. However, not all E. coli strains have functional copies of the genes related to bile salt resistance. Unpublished work by Bidlack & Silverman suggests that a culture of E. coli JC3272 - dubbed “JC3272I” - was more sensitive to bile salt than another subculture - dubbed “JC3272F” - due to a mutation affecting the lapAB operon. To confirm these findings, growth of each E. coli JC3272 subculture was measured at

various concentrations of bile salts via spectrophotometry, and the response of each subculture was analyzed using analysis of variance (ANOVA). Samples of each subculture were also sent twice for DNA extraction and whole-genome sequencing, and Snippy was used to compare the sequences to that of E. coli MG1655 to locate single-nucleotide polymorphisms (SNPs). Analysis of the spectrophotometry data implied that the response to bile salt was affected significantly by culture ($F_{1,6} = 37.692$, $p < 0.001$). Genetic analysis found 103 SNPs which differentiated the two subcultures, but no mutations were found in the lapAB operon in either JC3272I sequence. These data suggest that the two cultures differ in bile salt resistance, though the gene responsible for this difference remains unidentified.

CIBER 204 **Session 2-10:45-12:00 PM**

Mass Spectrometry-Based Proteomics Evaluation of Plant Protein Extraction Kits and Serum-Abundant Protein Depletion Kits

Sanjeewa Gamagedara, Erin Dowd, Mohammad Hossan, Nagib Ahsan

Keywords: Biochemistry, Chemistry

Specialized protein extraction kits have been instrumental in enhancing the precision, sensitivity, and efficiency of mass spectrometry-based proteomics analysis. Specifically, Plant protein extraction kits are designed for use in plant bioscience to extract a qualitative sample of all proteins from any plant species or plant organs such as leaf, stem, root, seed, and flowers. On the other hand, Serum abundance protein depletion kits have emerged as indispensable tools for removing highly abundant proteins, such as albumin and immunoglobulins, which often obscures the detection of low-abundance proteins with clinical and biological significance. Inefficient protein extraction methods are one of the major limiting factors that contribute to missing proteins, especially hydrophobic membrane proteins and low-abundant proteins (LAPs).
To investigate the efficacy in terms of protein/peptide identification of protein extraction buffers, total pollen proteins were extracted from Bermuda grass and big bluestem grass using four different protein extraction buffers namely Pierce Plant Total Protein Extraction Kit (Thermo Fisher), Plant Total Protein Extraction Kit (Sigma Aldrich), Minute™ Total Protein Extraction Kit for Plant Tissues (Invent Biotech), and Plant Tissue Extraction Kit (Bio Vision).

To investigate the high abundance protein depletion kits, rabbit serum proteins were extracted from ProteoSpin columns (Norgen Biotek), High Select™ HSA/Immunoglobulin Depletion Mini Spin Columns (Thermo Fisher Scientific), High Select™ Top14 Abundant Protein Depletion Mini Spin Columns (Thermo Fisher Scientific), ProteoExtract® (Millipore Sigma), Proteome Purify™ 2 (R&D Systems). The LC-MS/MS proteomics analysis was performed on a fully automated proteomic technology platform that includes a Dionex UltiMate ® 3000 system connected to a Q Exactive HF-X mass spectrometer. The MS/MS analysis was done according to the earlier published protocol (Ahsan et al., 2023). Detailed experimental procedures, results, and future directions will be presented at the symposium.

CIBER 205 **Session 1-9:30-10:45 AM**

Comparison of Sampling Methods for Diversity Assessments of Small-Mammals in Gypsum Prairie of Western Oklahoma

Allison Martindale, Xander Molina, Richard Dolman, Ph.D.

Keywords: Animals, Ecology

Habitat loss and fragmentation are major threats to global biodiversity, negatively affecting all major taxonomic groups. Small mammal diversity and community composition represent powerful tools for understanding these threats. Because they occur in high abundance, are ubiquitous, and are active year-round, they serve as a power tool for examining aspects of the landscape. Small mammals also provide important ecological services, including the dispersal of native plant seeds and spores and the aeration of soil through burrowing. Together, these contribute to increased rates of nutrient transfer throughout the landscape. Surveys of diversity and evenness commonly use one of two spatial designs: transects and grids. To compare these two methods, our project is working in collaboration with an ongoing small mammal diversity study being performed by a colleague at the Selman Living laboratory in western Oklahoma. Our project has been comparing diversity and evenness estimates using linear transects with those estimates generated by the current study using grids. Four transects, each containing 50 Sherman live traps, will be used to survey small mammals throughout the approximately 135 ha of Selman laboratory property. Transects will be sampled for 3 consecutive nights using current established live trapping guidelines used by the American Society of Mammalogists. Species diversity and evenness will be compared with data collected from our collaborator's grid-based spatial design. To put to date, we have been trapped for four seasons, and currently, we have an average of 12% catch rate with transects compared to 6% catch rate with the grids.

CIBER 206 **Session 2-10:45-12:00 PM**

3D Printed Sodium Alginate with Neural Cells for Traumatic Brain Injuries.

Yaqeen Aldubaisi, Morshed Khandaker

Keywords: Biology

Traumatic Brain Injuries occur when external forces cause damage to the brain and its nerve cells. Once the nerve cells are injured, they cannot regenerate due to the body’s immune response and scarring in the damaged area. However, one treatment that proposes theoretical healing the injured area is the electromagnetic field therapy (EMF). According to this technique, neural cells will be cultured with brain scaffolds where then will be tested under EMF and to combine a complex nerve conduit with an engineered brain scaffold along with testing the design with a custom-built EMF device.

CIBER 207 **Session 1-9:30-10:45 AM**

Developing a Deep-Learning Algorithm to Classify Smartwatch Data to Evaluate Manual Wheelchair Users' Pressure Relief Exercises

Stephen Ketola, Dr. Jicheng Fu

Keywords: Biomedical Engineering, Computational

As wheelchair users sit for long periods of time, they are susceptible to developing pressure ulcers, which can often be painful and even deadly, accounting for 60,000 deaths in the U.S. each year. Clinical Practice Guidelines (CPGs) outline a set of exercises for manual wheelchair users and how often to perform them. However, although researchers have proven the effectiveness of these guidelines in preventing pressure ulcers, the number of cases has not decreased since their introduction into the standard. This project aims to answer why and, in the process, provide manual wheelchair users and their healthcare providers a practical method to assess whether they are following the CPGs correctly.

Previous research that has used sensor data to evaluate movements of wheelchair users often depended on clunky and expensive sensors that require extra effort to install and maintain. Our project aims to overcome this issue by collecting data with a smartwatch, which takes comparatively little effort on the part of the user to install and maintain, especially if they are already accustomed to wearing and using one.

We have designed and implemented a machine-learning algorithm, which employs a deep Convolutional Neural Network (CNN) to process the watch sensor data such that we will be able to classify the CPG-recommended exercises. Currently, we are collecting data and training the model. We are experimenting between fine-grained classifications with higher numbers of classes and coarse-grained classifications with lower numbers of classes to see which can achieve a higher accuracy. As sensors are subject to noise, we will implement an advanced differentiation approach that finds the difference between each adjacent measurement to negate most of the noise. The success of this project will advance research in pressure ulcer prevention and equip wheelchair users with the ability to self-assess their adherence to CPGs.

CIBER 208 **Session 2-10:45-12:00 PM**

Exposure to 'Alternative' Flame Retardants Alters Rat Aortic Smooth Muscle Cell Function In Vitro and Decreases Heart Rate In Ovo

Alex Webb, Melville Vaughan, Austin Aduddell, Matthew Roberts, Christopher G. Goodchild

Keywords: Cell Biology,

Flame retardants are routinely incorporated into common household items, including furniture, car seats, and crib mattresses, to enhance fire safety. In 2004, concerns regarding the toxicity of traditional flame retardants, such as polybrominated diphenyl ethers (PBDEs), led to their replacement with 'alternative' flame retardants. However, the potential toxicity of these alternatives remains largely unknown. A particular concern is the risk of maternal transfer to the developing embryo, as these flame retardants have been detected in breast milk and placental fluid of pregnant women. In utero exposure

to alternative flame retardants may lead to congenital defects, especially if exposure occurs during early embryonic development, which involves sensitive processes. This study focused on the potential effects of two alternative flame retardants, Triphenyl phosphate (TPP) and Tris 2-chloroethyl phosphate (TCEP), on arterial wall development. We employed in vitro tests, including wound scrape migration assays and microscopy, to assess cell migration and proliferation. To better understand adverse outcomes on cardiac function, we conducted in ovo experiments with chicken embryos to examine the effects of TPP and TCEP on embryonic heart rate and organ mass. Our findings suggest that TPP and TCEP may inhibit aortic smooth muscle cell function, which could potentially impact proper heart development and function. These results underscore the importance of further investigation into the safety of alternative flame retardants in household products.

CIBER 209 **Session 1-9:30-10:45 AM**

A Comparative Analysis of Accuracy and Sensitivity in Semen Presumptive Testing: ABAcard P30™, RSID Semen™, and Seratec PSA™

Heather R. Rogers, Rhonda C. Williams

Keywords: Biology

Semen presumptive tests are often used in forensics to detect the possible presence of semen on evidence from a crime scene. These tests work by identifying enzymes or proteins commonly found in semen, such as prostate-specific antigen (PSA) and semenogelin. However, presumptive tests can produce false positive results, as these biomarkers may also be present in other bodily fluids. Despite this limitation, some agencies still rely on presumptive test outcomes as a confirmation test for semen in legal proceedings.

This study evaluated and compared the accuracy and sensitivity of three rapid immunochromatographic test kits for semen detection: Rapid Stain Identification Series (RSID) Semen™, Seratec PSA™, and ABAcard P30™. The RSID Semen™ test detects semenogelin, while Seratec PSA™ and ABAcard P30™ detect PSA. Samples tested included serial dilutions of semen, as well as an array of bodily fluids and materials that could potentially cause false positive results. All samples were tested in triplicate with each kit.

The study found differences in sensitivity between the three test kits, with false positives occurring to some degree with all methods. RSID Semen™, Seratec PSA™, and ABAcard P30™ all had issues detecting semen in a 1:10,000 dilution. Additionally, RSID Semen™ could not detect semen when it was mixed with dirt. There was an issue of non-specificity with all three of the test kits with various absorbent hygiene products. RSID Semen™, Seratec PSA™, and ABAcard P30™ all had several false positive test results with tampons, menstrual pads with blood, and diapers with urine samples. Additionally, ABAcard P30™ had false positive test results with female urine samples.

Overall, Seratec PSA™ showed the highest sensitivity among the test kits evaluated, it had a concerning false positive rate of 12%, the highest rate observed. Of the three rapid semen detection kits compared, the ABAcard P30™ kit showed the most accuracy. ABAcard P30™ had both the lowest false positive rate at 6% and the second-lowest false negative rate at 2% out of the kits tested.

CIBER 210 **Session 2-10:45-12:00 PM**

Insights into Hantavirus in the Southwest Region of the United States

Tianna Samuel, Michelle L. Haynie

Keywords: Science Communication

There are over 53 species of Hantavirus, with many of them being transmissible to humans: including Seoul virus (SEOV), Bayou Virus (BAYV), and Sin Nombre Virus (SNV). This highly contagious virus is transmitted through bites, scratches, feces, urine, and aerosol particles from reservoir hosts, typically rodents. Common rodents that carry Hantavirus in Oklahoma are deer mice of the genus Peromyscus (including P. maniculatus and P. leucopus) and the cotton rat (Sigmodon hispidus). While reservoir hosts are typically asymptomatic, they can transmit the virus horizontally to their offspring or vertically to humans and other rodents. Hantavirus infections are known to develop into Hemorrhagic Fever and Renal Syndrome or Hantavirus CardioPulmonary Syndrome in human hosts. This review examines the advances that have been made in recognizing transmission of Hantavirus, understanding its pathology, and improving preventative measures, with a focus on the southwest region of the United States.

CIBER 211 **Session 1-9:30-10:45 AM**

Motion Artifacts Correction Algorithm for TMS-fNIRS Imaging

Gagandeep Singh, Dr. Nesreen Alsbou, Dr. Imad Ali

Keywords: Biomedical Engineering, Biomedical Imaging

This research focus on Developing an algorithm designed to eliminate motion artifacts from brain scans. This research holds significant importance as it enhances the utility of each scan by effectively addressing any distortions. Motion artifacts can arise from both conscious and unconscious movements which introduce subtle corruptions in the obtained scans. Leveraging the MATLAB-based algorithm, this research integrates two correction methods into a unified approach. These correction techniques collaboratively rectify images, specifically targeting baseline shifts and high-frequency spikes within neuroimaging data. The developed algorithm not only combines these correction strategies but also ensures computational efficiency. It demands meticulous selection of the smoothing parameter, a critical aspect to strike a balance between reducing noise and preserving hemodynamic responses. This method, with its dual-correction mechanism and careful parameter tuning, emerges as a robust solution to rectify motion artifacts in brain scans, elevating the overall quality and reliability of neuroimaging data.

CIBER 212 **Session 2-10:45-12:00 PM**

The Matrix: Seen through with Optical Coherence Tomography to Study Dupuytren's Contracture

Lauren Sowards, Xuan Fey Chew, Melville Vaughn, Gang Xu

Keywords: Biomedical Engineering, Biomedical Imaging

The fibroblast-populated collagen matrix (FPCM) serves as an optimal model system for investigating cells associated with contractive diseases, exemplified by Dupuytren's Contracture (DC). This collagen matrix affords a structural and mechanical context conducive to replicating the conditions surrounding contractive diseases, facilitating the observation of cellular behavior. The objective of this project is to use this model to characterize the mechanobiology of fibroblasts from DC patients. Utilizing optical coherence tomographic (OCT) imaging, we captured cross-sectional structures of the FPCM during development or treatment. This not only enhanced image clarity, but also facilitated the longitudinal assessment of cell behavior. Cell-dependent compaction of the collagen matrix was assessed daily, and compared between normal and DC fibroblasts. Notably, this data enables the estimation of cell-dependent tension generation in FPCM, offering comparative insights into cell characteristics. The correlation between cellular contraction and tissue compaction induced by DC cells was discerned. Our preliminary data showed that compared with normal dermal fibroblasts, DC fibroblasts can lead to faster and further compaction of the collagen matrix, which in turn resulted in more differentiation into myofibroblasts. The accrued data not only sheds light on the biophysical mechanisms underlying DC, but also paves the way for more effective identification of required treatments. Beyond contractive diseases, this study extends its relevance to wound healing and other fibrotic disorders.

CIBER 213 **Session 1-9:30-10:45 AM**

Motion Artifact Correction in TMS-fNIRS

Halie Elston, Dr. Nesreen Alsbou, Dr. Imad Ali, Afia Asif, Gagandeep Singh

Keywords: Biomedical Engineering, Biomedical Imaging

This study addresses motion artifacts associated with functional near-infrared spectroscopy (fNIRS) scans by developing an algorithm for artifact detection and correctio. fNIRS scans measure a patient’s hemodynamic response in accordance with brain activity. Artifacts in these scans can greatly impact the course of treatment. Several articles were reviewed leading to the combination of two specific algorithms. The algorithm developed accounts for detection and correction of artifacts due to voluntary and involuntary subject movement, physiological movement, facial muscle movement, head rotation and head tilting. The combination of the two algorithms will reduce the noise present in the final scan images, increasing the reliability of the scan overall. The code for the algorithm was developed using MATLAB and will be implanted on existing scan images to ensure accuracy, allowing for adjustments if necessary. The algorithm will be implemented within the fNIRS device itself if good results are obtained.

CIBER 214 **Session 2-10:45-12:00 PM**

Studying Motion Artifacts in TMS-fNIRS Imaging

Afia Asif, Dr. Nesreen Alsbou, Dr. Imad Ali

Keywords: Biomedical Engineering

This research study the motion artifacts in Transcranial Magnetic Simulation (TMS) and Functional near-infrared spectroscopy (fNIRS) imaging. The fNIRS is a noninvasive scan that uses a low-level nonionizing light to monitor changes in cerebral flow in the brain. In comparison to other scanning devices, it is cost-effective and can show better temporal resolution. This is done by using multiple sensors placed on the scalp while the patient is alert and oriented. Due to the placement of the sensors, there is major interference in the scan which causes artifacts in the images due to involuntary and voluntary movements such as breathing, blinking, clenching, muscle spasms and other patient's related movements. The movement leads to data loss and inaccuracy in the results. To solve this problem, a literature review on different motion artifacts were done and the relation between motion artifacts and TMS-fNIRS imaging is identified. An algorithm was developed to sort out the artifacts and leave usable data. The algorithm is a mixture of different algorithms sourced from various articles and experiments which was then combined into one to reach our desired outcome. The algorithm is expected to improve the TMS-fNIRS images and produce more accurate results.

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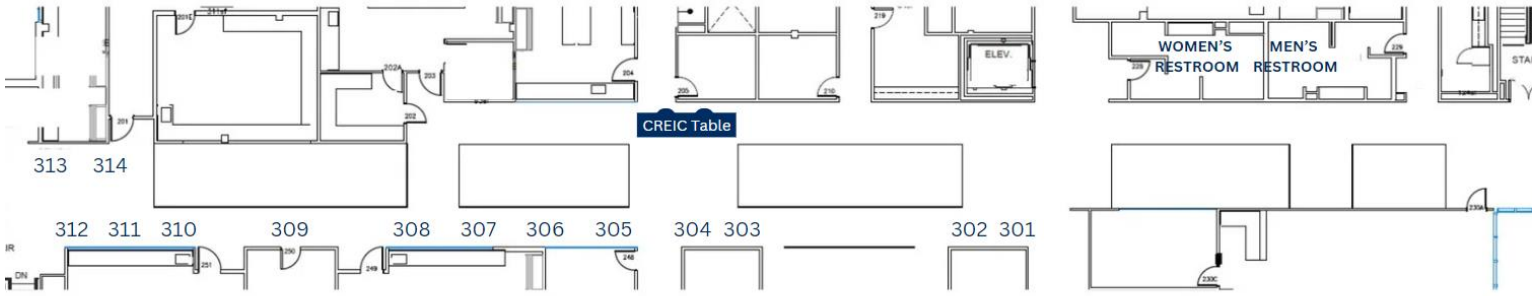

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CREIC 301 Session 1-9:30-10:45 AM

Machine Learning for Diagnosis of Traumatic Brain Injury and Developing Tools for Educating the General Public

Chidera Osaji, Dr Benjamin Tayo

Keywords: Biomedical Engineering, Biomedical Imaging

Identifying brain injuries in the preliminary stages through machine learning to avoid more complex situations in the brain. Machine Learning is important and useful in avoiding the late realization of fatal brain injuries and being a cheaper medical option. Increased diagnostic accuracy of this technique reduces patient exposure to radiation by reduction of required scans. This research is due to the high rate of unattended and undetected injuries and the excessive cost of checking those injuries, especially for low-income families. Machine learning techniques to diagnose traumatic brain injuries from MRI datasets using classification and clustering approaches. Using supervised machine learning to train an algorithm to diagnose traumatic brain injuries against healthy brain scans. Preprocessing, learning and then evaluation. Utilizing unsupervised machine learning to build upon current research in the field to identify new features that may be used to train machine learning algorithms to identify traumatic brain injuries. It assists individuals in being aware of these injuries and the benefits of finding out early. Long-term effects of brain injury can be associated with an elevated incidence of Alzheimer's disease and chronic traumatic encephalopathy. A relationship between exposure to repetitive head impact and subsequent development of chronic neurodegenerative disease has not been established but will use MRI, PET, and Neurocognitive data for research. FMRI is going to be focal in the development as it is a technique for measuring and mapping brain activity that is noninvasive and safe. It helps to better understand how the brain works. ASL and BOLD imaging can be used together to provide a more quantitative probe of brain function, additionally with the assessment of oxygen metabolism changes.

CREIC 302 Session 2-10:45-12:00 PM

Cross-platform Software Similarity Analysis: Learning from Recent Advances in Large Language Models

Cody Tompkins, Fei Zuo, Junghwan Rhee

Keywords: Computational,

Binary Code Similarity Analysis (BCSA) is the practice of comparing code at a low level, without access to the higher-level source code in which it was written. This could be used to see if the same code is used in two programs, even if one cannot get access to the source code of either program. However, this is difficult due to the distinct instruction set architectures (ISAs) used by different platforms. Inspired by the recent success of ChatGPT and other large language models (LLMs), our technique for this task was to treat it as a natural language processing (NLP) task.

Reverse engineering techniques were used to convert given binary code into a dataset of assembly language snippets. A deep learning model using the transformer architecture for binary classification was constructed to classify semantic equivalence of two code snippets. The model was trained and validated on disjoint subsets to ensure that the results were fair. Different combinations of ISA and compiler were used to ensure consistency across all settings. The transformer architecture was chosen due to the results it has shown as the backbone of current state-of-the-art LLMs.

Area under the receiver operating characteristic curve remained high in all test cases. Accuracy, precision, recall, and F1 score were high in simple tests where training and validation were on the same compiler. In test cases where the compiler was different for the training and validation sets, these values dropped dramatically. However, a training set containing examples from each compiler could get the same high scores on validation sets from either compiler.

Conclusion: When trained with assembly code generated by the same compiler, the model achieved excellent performance in classifying pairs of snippets as similar or dissimilar.

Relevance of Study: Given a closed-source program, such as most commercial software and malware, BCSA is a powerful tool for computer security. It can be used to detect security vulnerabilities that come from shared code, to identify plagiarism in proprietary software, or to analyze malware construction.

CREIC 303 **Session 1-9:30-10:45 AM**

A Comparison of Multi-Lead ECG Arrhythmia Detection Methods Using Variational Autoencoders

Ethan Fogarty, Kayla Hallmark, Emily Hendryx Lyons, Tyler Cook

Keywords: Computational, Data Science

This work studies electrocardiogram (ECG) arrhythmia detection, an essential tool in diagnosing and managing cardiac irregularities. Data from an ECG can be collected and stored in different ways depending on the needs of the physician and/or the technology available. We consider data acquired from a 12-lead ECG and a single lead ECG. Variational autoencoders are trained using each data type to generate normal heartbeats, and the results are used in various classifiers to distinguish between arrythmias and normal beats. Each classifier and data type combination is evaluated according to several different classification metrics. This research seeks to strengthen automated clinical tools, offering insights into optimizing ECG arrhythmia detection methods in different data types for improved patient outcomes.

CREIC 304 **Session 2-10:45-12:00 PM**

Preliminary Analyses of Sediment-Water Microbial Dynamics of The Oklahoma River

Delaney F. Donnohue, Rigoberto Lozano, Kaitlyn Kraft, Matthew B. Parks, Michelle L. Haynie

Keywords: Climate Change

Freshwater microbial communities' impact critical ecological processes, including carbon and nutrient cycling, and significantly impact human health through environmental quality. Benthic sediment microbial communities and their interactions with freshwater communities are poorly studied, despite contributions to ecosystem function and pathogen release during sediment-disrupting events. For this project, we are 1) assessing benthic and freshwater microbial communities along the North Canadian River, and 2) under contrasting flow regimens experienced on an annual scale. Preliminary sampling was completed at four near-shore sites along the Oklahoma River (OKR) at 500m-upstream, and 10m, 500m, and 1000m downstream of the Oklahoma National Stockyards. Water and sediment samples were collected in summer 2023, at 1-, 6-, and 12- days post significant rainfall (>0.25 inches). Extracted DNA was amplified for a universal 16s rRNA metabarcoding locus, and sequenced on the UCO Illumina MiSeq. Preliminary results include 1) sediment microbial communities are clearly distinct from and more diverse than water communities, 2) water communities are dominated by Sporichthyaceae and Ilumatobacteraceae bacteria, which have been implicated in the antibiotic 'resistome' of freshwater-associated communities, and 3) sediment communities are not strongly affected by rain events, while water communities differed at 12 days vs. 6- and 1-days post-rain. Our findings support that both sediment and water microbial communities should be considered in assessing and mitigating freshwater environmental quality, since each harbors different microbial communities and responds differently to precipitation events. High-frequency antibiotic-resistant bacteria highlight risks to public safety, emphasizing the need for proactive measures for individuals in direct contact with OKR water.

CREIC 305 **Session 1-9:30-10:45 AM**

Internalizing Climate Change: Fecal Metabarcoding of a Small Mammal Community

Delaney F. Donnohue, Michelle L. Haynie, Matthew B. Parks

Keywords: Climate Change

Climate change is expected to impact ecosystems, potentially with the most impactful changes at the lowest trophic levels. Our project involves collecting data from a long-term small mammal mark-recapture survey at the UCO Selman Living Laboratory (SLL) in northwestern Oklahoma, including vegetation and climate data, as well as physical and molecular characteristics of small mammal populations. Fecal pellets from trapped and ear-tagged rodents are collected for DNA extraction and subsequent 16S rRNA metabarcoding is applied to assess the impacts of species, vegetation, climate, and season on rodent microbiomes. So far, fecal pellets from eight species of mice have been collected (total samples = 68), including six species from the Cricetidae family and two from the Heteromyidae family. DNA was extracted from fecal pellets using a Qiagen QIAamp Fast DNA Stool Mini extraction kit, PCR-amplified using 16S primers Pro341F-805R, and

sequenced on an Illumina MiSeq at the University of Central Oklahoma. Preliminary results support: 1) differing microbiome composition between small mammal species, 2) seasonal differences in microbiomes within small mammal species, 3) significant differences in alpha diversity between small mammal species, for example lower alpha diversity in Perognathus compared to Onychomys leucogaster, Peromyscus maniculatus and Sigmodon hispidus, and 4) beta diversity differentiation by feeding guild, for example granivores are separate from generalists, and both are distinct from herbivores and carnivores. Ultimately results of our study will add to our understanding of small mammal population dynamics and bring insight to higher level ecosystem processes including predation and dispersal. In the future, sampling will be increased to overcome statistical limitations, and additional factors including parasites and viruses will be integrated with microbiome data to provide a holistic picture of SLL small mammal population dynamics.

CREIC 306 **Session 2-10:45-12:00 PM**

Improving Object Detection Accuracy of Edge Devices through Multifactorial System Enhancement

Chad Beardain, Dr. Hong Sung

Keywords: Computational, Data Science

Edge computing devices, such as cellular phones or single-board computers (SBCs), have become pivotal in decentralized data processing, enabling real-time analytics and decision-making near the source of the data. The neural network models must balance precision with computational efficiency required for real-time processing on devices with limited resources. This can result in lower detection rates or higher rates of false positives and negatives. This research explores how certain factors affect those results: among them are the hardware configuration of the edge device, camera characteristics and placement, luminance, selected model, and environment. Specifically, it uses Raspberry Pi units equipped with Google Coral TPUs that run TensorFlow Lite with an EfficientDet model. The application and context of this research is to enhance a pet monitoring system that reports behavior detected by the monitoring stations. Accurate object detection is crucial; for example, it ensures the correct measurement of a dog's water intake without inaccuracies caused by a cat's interference. The initial deployment of the object detection segment saw frequent misidentification of a dog as other animals. Therefore, the primary goal is to determine which combination of factors results in the greatest accuracy. The secondary goal is to determine how to maximize the accuracy of each monitoring station. The project employs fractional factorial experimentation to efficiently meet the objectives. Time-series data are captured in InfluxDB, and real-time data visualizations and analysis generated by Grafana reveal trends, anomalies, and the effect of various factors on system performance.

CREIC 307 **Session 1-9:30-10:45 AM**

Unveiling AWS Cloud Vulnerabilities: A MITRE ATT&CK Framework Analysis of Stratus Red Team Simulated Attacks

Prerana Madhira, Jeehyun Oh, Junghwan (John) Rhee, Fei Zuo, Grace Park

Keywords: AWS Security, Cloud Security, Threat detection, Cybersecurity

This research investigates the security posture of Amazon Web Services (AWS) by employing MITRE ATT&CK framework to analyze simulated cyber-attacks. The study focuses on MITRE ATT&CK techniques such as persistence, privilege escalation, and credential access utilizing Stratus Red Team to execute controlled attack scenarios on key AWS resources, including Elastic Compute Cloud (EC2), CloudWatch, CloudTrail, and GuardDuty. The collected data from these simulated attacks is systematically analyzed using python functions to identify patterns in the behavior of compromised resources and responses from AWS security services. By leveraging the attack techniques, this research aims to provide a comprehensive assessment of AWS security measures, offering insights into potential vulnerabilities and proposing recommendations for enhancing cloud security. The research contributes to the cybersecurity community by demonstrating a practical application of open-source tools for evaluating and fortifying cloud security in AWS environments.

CREIC 308 **Session 2-10:45-12:00 PM**

Towards Natural Language Processing-based Software Behavior Anomaly Detection

Jeehyun Oh, Zhiqiang Zhang, John Rhee, Fei Zou, Grace Park

Keywords: Computational

Software behavior is an important characteristic that has been used widely in the fields of software engineering and cyber security to determine software bugs and cybersecurity attacks. Software behavior can be expressed in multiple data formats such as instruction sequences, control flow graphs, performance counters, and system call traces. System calls, which are low-level API calls of operating systems, are useful information that reveals the software's resource needs. Because many attacks utilize operating system resources such as files and network connections, this data has been used by a large body of approaches in cybersecurity. Monitoring this data is a laborious task due to the high volume of the data amount. Our goal is to develop a scheme to automate this analysis and determine software behavior anomalies using an algorithm.

Our approach is composed of 5 steps. First, we record system calls of a whole operating system in benign and anomalous situations. Second, we construct a big original graph of their dependence relationships. This graph is partitioned into multiple subgraphs that represent individual software's behavior and characteristics regarding what they do including program invocation, file accesses, and network connections. These graphs are diverse, repetitive, and noisy which are still laborious to be consumed by humans as well as by machine learning

algorithms. Third, we apply multiple normalization approaches to reduce noise and convert this dataset to patterns of numbers. Fourth, we train two different machine learning models with this dataset, which are a graph-based model and a Natural-Language-based model. Lastly, our algorithm predicts anomalies with a test dataset and evaluates the trained model. We are currently halfway through our implementation. We present our current progress in our approach and discuss the next steps.

CREIC 309 **Session 1-9:30-10:45 AM**

Infrastructure Surveillance System to Assist Security Operation Centers

Zhiqiang Zhang, Jeehyun Oh, John Rhee, Fei Zou, Grace Park

Keywords: Computational, Data Science

Complex recent threats such as advanced persistent threats (APT) perform stealthy attacks against infrastructure which often involve slow and low-profile intrusions. In order to investigate such attacks, we need to be able to inspect fine-grained details regarding program, file, and network behavior. Cyber analysts working at security operation centers spend a lot of time and effort to inspect detailed machine logs and behaviors manually. This process requires innovation to lower their effort. We developed an analysis system to query, navigate, and inspect the details of surveillance data monitored from the operating systems. It has multiple useful functions to assist security operation centers.

First, the Statistics Act inspection function is designed to showcase the evolving trend of the number of events executed by the machine over time. Users can select the time granularity (year, month, day, hour), define a time range, and apply limit conditions for data queries. The displayed data supports pagination for convenient exploration. Second, the Process Graph inspection function serves to visualize the hierarchical structure of program interactions on the machine. Users can query data based on time elements (year, month, day, hour), time zone, and apply limit conditions. The graphical structure encompasses program nodes, network nodes, and file nodes. It supports both zooming in and out. Left-clicking on nodes provides detailed information, and a right-click menu enables backtracking options, allowing users to trace the entire chain from the current node to the root node. Lastly, the Live View inspection function extends the capabilities of the Process Graph function by dynamically querying data over time. This feature enhances the graphical representation as data evolves. These functions are the outcome of our initial effort to assist security operation centers. We are currently developing advanced functions to automate and summarize the surveillance data.

CREIC 310 **Session 2-10:45-12:00 AM**

Machine Learning Prediction of Plate with Hole Stress and Displacement when Load is applied using ANSYS Finite Element Dataset.

Dr. Sezin Kadioglu, Ashok Gorli

Keywords: Computational, Data Science

This study will predict approximate stress and displacement of a 2D plate with hole using machine Learning algorithms and see how accurately machine learning algorithms will predict the desired results. Dataset contains different configuration of a plate with hole and calculated values of finite element analysis stress and displacement results. Training set contains 0.7 percent of the data and testing set contains 0.3 percent of the data. And we will be training a model using different ML algorithms and comparing its results.

CREIC 311 **Session 1-9:30-10:45 AM**

Towards the Improvement of 5G Software Vulnerability Search

Hashem Hosseinzadeh, Jarred Arthurs, Junghwan Rhee, Fei Zuo

Keywords: Data Science,

With the worldwide adoption of 5g technology, it has been a target of new vulnerabilities and threats. Due to the significance of communication and related ecosystems, securing 5g software is a very important topic in our society. This research aims to inspect 5g core software and discover its potential vulnerabilities by using a testing technique called fuzzing.

Traditional testing techniques can analyze the code and runtime operation of the software using dynamic analysis and network techniques. We would like to enhance such testing methods by utilizing the internal knowledge about the 5g software as a gray box testing. By conducting a thorough analysis of the 5G core network architecture, protocols, and communication network traffic among servers, our study seeks to identify potential weaknesses that could be exploited by malicious actors with improvement.

We have created a testbed of 5g core software deployed where multiple server software programs are producing traffic, which is recorded from the testbed as the dataset. Our analysis examined the details of the traffic regarding the communication patterns and protocols. Currently, we are working on the next step to apply our findings to testing methods. We will present our current progress and our plan for the next steps. The findings of this study can serve to strengthen the security of 5G networks and ensure their resilience against threats in the ever-evolving world of communication technology.

CREIC 312 **Session 2-10:45-12:00 PM**

Contrasting Subset Selection Methods in Multilead Electrocardiogram Data

Autumn Langer, Kassidy Crockett, Emily Hendryx Lyons, Tyler Cook

Keywords: Computational, Data Science

Serious heart health complications are often identifiable by the presence of anomalous heartbeat morphologies. Unfortunately, the unassisted review of electrocardiogram (ECG) data often relies on limited observation. Hence, the automated summarization of significant beat morphologies can aid clinicians in moving forward with patient care to ensure a more comprehensive assessment. Since ECG data can be presented using a variety of signal leads, we investigate the use of different CUR matrix decomposition algorithms in generating summaries of single-lead ECG, 12-lead ECG, vectorcardiogram (VCG), and VCG magnitude data. Each CUR method (for example, using leverage scores or the QR factorization) is applied to identify a representative subset from each of these different ECG data types derived from the St. Petersburg INCART 12-lead Arrhythmia Database. The presented results aim to provide insight regarding appropriate methods for single-/multi-lead ECG summarization for clinical support.

CREIC 313 **Session 1-9:30-10:45 AM**

ParaView-ing Data at NERSC Remotely Using Jupyter Hub

Kayley McBride, Johannes Blaschke, and Gang Xu

Keywords: Biomedical Engineering, Computational

ParaView is an open-source data analysis and visualization program that is used by researchers around the world to analyze complex scientific datasets, containing things like a mixture of particles and fluids. Due to their size and complexity, these datasets cannot be easily analyzed with general-purpose tools like Microsoft Excel. Prior to this project, ParaView data at Lawrence Berkeley National Laboratory was exclusively analyzed using the ParaView graphic user interface (GUI) client. However, Jupyter is an increasingly popular web-based application that allows users to create and share documents containing code. This project is exploring ways to extend ParaView support in Jupyter. Kitware (the creators of ParaView) have developed a kernel for Jupyter that allows a Python representation of the ParaView scene in Jupyter to be rendered by ParaView and displayed in the same notebook. In previous work we have shown that Jupyter notebooks running the ParaView Kernel can be set up on a personal computer and connected to a ParaView server that is running on a super-computer. This project aims to fully implement this kernel on the supercomputers at the National Energy Research Scientific Computing Center (NERSC) through Jupyter Hub.

CREIC 314 **Session 2-10:45-12:00 PM**

Strategies for Self-Defense Against Knife Attacks: Insights from Practical Techniques and Psychological Preparedness

Monique Agura, Theodore Larson

Keywords: Computational, Data Science

Knife attacks pose a significant threat in both urban and rural environments, necessitating effective self-defense strategies for individuals to protect themselves in such perilous situations. This research abstract investigates various methods to defend against knife attacks, drawing insights from practical techniques demonstrated in instructional videos and incorporating supplementary knowledge from academic literature.

The primary source of information utilized in this study is a comprehensive instructional video available on YouTube, featuring over 200 demonstrations and explanations by self-defense experts. The video emphasizes several fundamental principles crucial for effective defense against knife attacks, including situational awareness, body positioning, and strategic utilization of available resources. Techniques such as evasion, blocking, disarming, and incapacitating the attacker are thoroughly illustrated, highlighting the importance of swift and decisive action in mitigating the threat posed by a knife-wielding assailant.

Furthermore, these external research findings augment the understanding of self-defense mechanisms against knife attacks. Psychological preparedness emerges as a critical component, as individuals must cultivate a mindset of vigilance and assertiveness to enhance their response capabilities in high-stress situations. Additionally, studies on biomechanics and human anatomy offer valuable insights into identifying vulnerable areas on the attacker's body and optimizing counter-attack strategies for maximum effectiveness.

The synthesis of practical demonstrations and theoretical knowledge underscores the multifaceted nature of self-defense against knife attacks. By combining physical techniques with mental resilience, individuals can better equip themselves to confront and neutralize threats posed by assailants wielding knives. Moreover, the interdisciplinary approach presented in this abstract offers a comprehensive framework for enhancing personal safety and security in potentially dangerous environments.