



Iowa Regent Universities present the

# 16th Annual Research in the Capitol

**Monday, March 6, 2022**

**11:30am - 1:30pm**

**Iowa State House, Rotunda  
Des Moines, Iowa**



# Schedule

## 11:30am Opening Remarks

- Bob Kirby - Director, Iowa Center for Research by Undergraduates
- Student Speaker - Mackenzie Wisneski, University of Northern Iowa

## 11:45am-1:30pm

- Student Poster Presentations

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# Welcome



Welcome to the sixteenth annual Research in the Capitol. In the last decade, over 500 undergraduates from our three Regent's Universities have come to the Iowa Statehouse to present their work to legislators, members of the Board of Regents, and the public. These students have gone on to contribute to our state as doctors, educators, engineers, lawyers, nurses, and professionals in various disciplines. The opportunity for our students to share their knowledge and exuberance with legislators, Regents, and guests in the Iowa Capitol is a special honor that has stayed with them across the years.

Research involvement plays a central role in undergraduate education. Students who take part in research are more successful academically, are more developed in their career and professional preparation, and are more satisfied with their college experience. Research engagement provides the conditions for collaborative learning and critical thinking that benefit our students as they move into the workforce or on to graduate or professional training. The presentations before you today required countless hours of effort on the part of the students and their mentors outside of the classroom and represent the shared commitment our students, staff, and faculty place on the undergraduate experience.

As you speak with these outstanding students, you will learn first hand the impact research involvement has on Iowa's students and the impact those students have on the research conducted at our outstanding Iowa Public Universities.

Robert Kirby  
Director, Iowa Center for Research by Undergraduates

# Presenters

**1. Winfred Afeaneku (UNI)**

*SocioApp: Detecting Your Sociability Status with Your Smartphone*

**2. Morgan Aitchison (UNI)**

*New Policy Opens Trade with India for Pork Producers in the US*

**3. Emily Allen (ISU)**

*Forgery Detection Using Statistical Analysis*

**4. Andrew Behrens (UofI)**

*Assessment of Metatarsal Joint Structure in Patients With Bunion Deformity*

**5. Lydia Berns-Schweingruber (UNI)**

*The Effect of K-12 Public Education Spending on Student Academic Achievement in Iowa*

**6. Kelly Biscoglia (UNI)**

*Analysis of Cytokinin Response Factors in *Artemisia tridentata**

**7. Josie Bliss (UofI)**

*Sanibel Captiva Ecology*

**8. Hannah Blumhoefer (ISU)**

*An Analysis of Variable-Shape Wave Energy Converter Modifications*

**9. Denisse Camarena (ISU)**

*Taking a Closer Look at the Hair of a Bumble Bee*

**10. Alison Carr (ISU)**

*Risks and Fear of Falling in Older Adults*

**11. Karlee Colby (UNI)**

*Her Story, Her Right: Narrative as a Basic Human Right*

**12. Emmet Cummings (UNI)**

*Underground Iowans*

**13. Anthony David (ISU)**

*Fabricating Biosensor Platforms for Real-Time Biothreat Detection*

**14. Makayla Dove, Mckenzie Sanden (ISU)**

*Gene Editing of Human Cells for Alzheimer's Disease Research*

**15. Hugh Duffy (ISU)**

*Lowering Carbon Footprint with 3D Printed Concrete Buildings*

**16. Harper Dunne (UofI)**

*We Looked at 6,795 Articles So You Didn't Have To: A Scoping Review of Studies Investigating MSS (Multisensory Sensitivity) in Pain Populations*

**17. William Fettkether (ISU)**

*Using Glass to Develop the Next Generation of Solid-State Batteries*

**18. Daniel Fu (UofI)**

*RGS6 mediates exercise-induced rescue of impaired cognition and hippocampal neurogenesis in mice with Alzheimer's*

disease

**19. Noah Gilkes (Uofl)**

*Traumatic brain injury is associated with neurological deficits and leads to activation of the type I interferon pathway*

**20. Grace Hagedorn (ISU)**

*Creating effective G418 antibiotic plates for yeast transformation*

**21. Jenna Heinen (UNI)**

*Spectroscopic Characterization of Wind Cave National Park*

**22. Dela Houssou, Erik Dralle (ISU)**

*Resiliency of Electric Power Network under Wind Event*

**23. Karly Jans (ISU)**

*Mental Health Issues within Iowa Veterinary Clinics*

**24. Vesha Jayswal (UNI)**

*The Power of Homeownership*

**25. Elle Jones (UNI)**

*Government and Institutional Changes regarding Human Rights that affect Citizen Involvement*

**26. Emmeline Kraus (Uofl)**

*Seasonal effects of the fungal pathogen *Tubakia iowensis* (bur oak blight) on the photosynthetic capacity of infected *Quercus macrocarpa* (bur oak)"*

**27. Victoria Kyveryga (ISU)**

*Structure and Energy-Related Properties of Novel Barium-Arsenide Materials*

**28. Trevor Larkin (Uofl)**

*Preparation and Evaluation of Lanthanide Catalysts for Oxygen Reduction*

**29. Priscilla Lee (ISU)**

*Differences in Working Memory Between Monolingual and Bilingual Learners*

**30. Haley Lightfoot (Uofl)**

*Novel Green Solventless Synthesis of Uranium Metal Organic Frameworks via Temperature Dependent Flux Reactions*

**31. Kobie Long—(Uofl)**

*Identifying Areas of Groundwater-Surface Water Exchange along Camp Cardinal Creek at Ashton Prairie Living Laboratory*

**32. Julie Matta (UNI)**

*Hidden in Plain Sight: The Influence of Indigenous and Latin Theatre*

**33. Rowan McCarthy (UNI)**

*Development of a Water Quality Index Calculation Tool using Excel*

**34. Tamara McConnell, Mia Riddley (ISU)**

*Biological and Geochemical Controls on Iron Deposition in an Intermittent Stream*

**35. James McMillan (Uofl)**

*Impact of Violence over the Life Course*



**36. Jesse Miller (Uofl)**

*"License to do Evil in the Name of Good": Political Radicalization and Rhetorical Adaptation During the Wilmington Coup*

**37. Aracely Miron-Ocampo (Uofl)**

*Searching for Novel Antifungal Treatments and Regulatory Pathways via the Characterization of a Fluphenazine Derivative Against C. albicans*

**38. Ryleigh Mulcahey (Uofl)**

*Sanibel Capitva Ecology*

**39. Diana Mulder (ISU)**

*Verification of a qPCR Assay for Detection of Phialophora gregata in varied Soybean Tissue and Brown stem rot suspect samples*

**40. Stephanie Orellana (Uofl)**

*We are listening: Educator experiences during COVID-19*

**41. Zach Palmer (Uofl)**

*Captive Labor Market: Addressing Iowa's school-to-prison pipeline*

**42. Jacob Parker (UNI)**

*Using an Aminimide Functional Group to Selectively Uptake Lithium*

**43. Jeanetta Plotzke (ISU)**

*Drainage District Main Improvements in Iowa*

**44. Olivia Poppen, Tatum Englund, Madison Bemis (ISU)**  
*Ergonomic Assessments via Virtual Reality: Is it Possible?*

**45. Tristen Prouse (UNI)**  
*How to Not Save the World From COVID-19: The Dire Consequences of Giving Away the Vaccine Formula*

**46. Tanzeel Ur Rehman (UNI)**  
*IoT in the Air: Thread-enabled Flying IoT Network for Indoor Environments*

**47. Matthew Shafer (ISU)**  
*Creating Curriculum to Inspire Young Scientists*

**48. Megan Smith (ISU)**  
*Structural Analysis of a Tyrosine Kinase-Substrate Complex - a Target of Cancer Drugs*

**49. Grayson Talaski (UofI)**  
*The Impact of 3D Foot Alignment on Detection of Distal Tibiofibular Syndesmotoc Widening after Injury using Comparative Contralateral Distance Mapping*

**50. Eric Thomas (UofI)**  
*Comparison of Intentionally Planted Species to Observed Population: Survey of plant biodiversity at Ashton Prairie Living Laboratory Prairie Restoration*

**51. Abigail Tibben, Megan McGuire (ISU)**  
*Producing Mock Crime Scene Footwear Impressions Dataset*

**52. Zach Vig (UofI)**

*Detecting Iowa's CO<sub>2</sub> in the Stratosphere using the High Altitude Near Infrared Spectroscopy Experiment (HA-NICSE)*

**53. Morgan Wickman (UNI)**

*Secondary Traumatic Stress: Therapists' Past Trauma and Workplace Intervention*

**54. Raquel Wilhelm (UNI)**

*Investigation of Unexpected Purple Substance Extracted from Newsprint Paper*

**55. Mackenzie Wisneski (UNI)**

*Using Color with Care: An Exploration of the Application of Psychological Color Theory within Language Classrooms*

# Abstracts

## 1. Winfred Afeaneku (UNI)

Hometown – Moline, IL

Major – Computer Science

Mentor – Dheryta Jaisinghani

### *SocioApp: Detecting Your Sociability Status with Your Smartphone*

SocioApp is a mobile application created for tracking a user's sociability and giving the user feedback. This is important, as studies show that a student's performance in school has a correlation with their mental health. Taking part in social settings has a positive impact on a student's mental health. Audio data collected from participants were converted into flac format and built into "features" that a machine learning algorithm can understand. We then took the feature data of each participant and fed it to the machine learning algorithm. Given data, the machine learning algorithm attempts to distinguish each participant. The results were that the machine learning algorithm had an accuracy of just ~50%, meaning the machine learning algorithm was making guesses on who the speaker was. In the future, we plan on continuously collecting more data and continuing to train the neural network to get better accuracy in distinguishing speakers.

## 2. Morgan Aitchison (UNI)

Hometown – Elk Run Heights, IA

Major – Accounting/Finance: Financial Management

Mentor – Christine Schrage

### *New Policy Opens Trade with India for Pork Producers in the US*

This presentation will cover the new Trade Policy between India and the United States that recently opened up agricultural trade. Specifically, the research is looking into how the demand for pork has changed in India, and what factors have led to this rise in demand that will also benefit pork

producers in the US. The research involves surveys conducted within a few cities in India, which I will be visiting personally. The main survey groups are general consumers, culinary students and professors, and local restaurant owners. They will all be asked basic demographic questions like age, income, education, and religious views. The presentation will provide a consensus as to why there was existing aversion to pork and pig products, how that viewpoint is changing, and what pork producers in the US can do to raise their interest in pork and meet their demand.

### **3. Emily Allen (ISU)**

Hometown – Ankeny, IA  
Major – Statistics  
Mentor – Danica Ommen

#### *Forgery Detection Using Statistical Analysis*

Can we tell whether a digitally-captured signature is authentic or forged? To address this question, data is obtained with a software called MovAlyzeR® to capture aspects of a signature as it is written. The signatures are decomposed into strokes, and each stroke's qualities are analyzed, including size, duration, velocity, jerk, and pressure. The statistical Hotelling's T-Squared Test is used to compute test statistics for pairs of genuine and forged signature exemplars. The corresponding test statistics for the known genuine comparisons are used to approximate the known-match score distribution via kernel density estimation and similarly for the non-known-match distribution. For each new comparison, the test statistic is computed and compared to both reference distributions. The ratio of these values is the score-based likelihood ratio, a statistically based objective method for assessing the value of evidence towards forgery. This forgery-detecting method is critical as more signatures are written electronically over time.

### **4. Andrew Behrens (UofI)**

Hometown – Polk City, Iowa  
Major – Biomedical Engineering  
Mentor – Cesar Netto

#### *Assessment of Metatarsal Joint Structure in Patients With Bunions Deformity*

Hallux valgus (colloquially known as bunion) is a complex, 3D deformity that involves a variety of different rotational and translational displacements of the bones of the big toe. Our aim in this study was to create an objective method to assess changes in foot structure in patients with bunions. Weight-bearing CT places the bones of the foot in a loaded, functional position. We used the data from these CT images to create three-dimensional models of each patient's foot. These models were generated using an automated method with a runtime of 20 minutes, previous methods to accomplish this required over four hours per patient. These 3D models were used to assess changes in foot structure. Patients afflicted with bunions had significant widening in the 1st-2nd intermetatarsal space. Reporting the occurrence and determining the mechanisms behind these changes will help influence the development of future surgical techniques.

## **5. Lydia Berns-Schweingruber (UNI)**

Hometown – Ames, IA

Major – Elementary Education/Sociology

Mentor – Kristin Mack & Marybeth Stalp

### *The Effect of K-12 Public Education Spending on Student Academic Achievement in Iowa*

Student academic achievement in Iowa is poor and on the decline. Some politicians propose increasing public education spending in order to address worrisome trends in academic achievement. Prior research has examined the effect of K-12 public education spending on student academic achievement; researchers disagree about whether increasing public education spending improves academic achievement. The purpose of this study is to determine if K-12 public education spending has a positive effect on student academic achievement in Iowa. This project will use a secondary analysis of data from the past twenty years to examine the relationship between K-12 public education spending in Iowa and student academic achievement in Iowa. The findings of this research can be used to inform policymakers and citizens about whether increasing K-12 public education spending will positively affect student academic achievement in Iowa.

## **6. Kelly Biscoglia (UNI)**

Hometown – Waukee, IA

Major – Biochemistry/Env Science: Env Earth Science

Mentor – William Harwood & Anthony Melton

### *Analysis of Cytokinin Response Factors in Artemisia tridentata*

For my contribution to the research on *Artemisia tridentata*, I identified and analyzed Cytokinin Response Factors (CRFs) from the recent reference genome<sup>3</sup>. CRFs have been found to potentially be regulators of the developmental processes within vascular tissues and they also play an important role in environmental stress response. This makes CRFs essential in the regulation of plant development and have impacts on a plant's drought stress tolerance. The understanding of these pathways can lead in many directions including more sustainable, drought resistant species. I hypothesized that due to an evolutionary history with whole genome duplications, CRFs in the *Artemisia tridentata* genome may be duplicated. To test this hypothesis, I identified *A. tridentata* cytokinin response factor proteins and reconstructed the phylogeny of CRFs. The finding of only twelve CRFs indicates there is no retention of duplicated CRFs in the *A. tridentata* genome.

## **7. Josie Bliss (UofI)**

Hometown – Ely, IA

Major – Integrative Biology

### *Sanibel Captiva Ecology*

## **8. Hannah Blumhoefer (ISU)**

Hometown – New Ulm, MN

Major – Aerospace Engineering

Mentor – Ossama Abdelkhalik

### *An Analysis of Variable-Shape Wave Energy Converter Modifications*

A Variable-Shape Buoy Wave Energy Converter (VSB WEC) analysis to reduce reactive power requirements is presented. An original VSB WEC

power take-off (PTO) unit with a middle connection was previously explored. An improved PTO connection enhances energy harvesting. The flexible buoy shell and PTO connection integration increases the continuous volume available for deformation. A numerical simulation contrasts the improved VSB WEC with the original VSB WEC and conventional Fixed-Shape Buoy energy harvesting capabilities. A previously developed ANSYS Computational Fluid Dynamics Numerical Wave Tank simulates the three WEC behaviors and ocean wave conditions. Irregular ocean wave conditions are consistent across all simulations to accurately compare energy harvesting. The three WEC velocities, displacements, damping forces, and power production are compared. Results indicate that the improved VSB WEC energy harvesting shows significant increases in both transient and steady-state behavior. Future work in model development, simulation time extension, and cost minimization is discussed.

## **9. Denisse Camarena (ISU)**

Hometown – Le Mars, IA

Major – Animal Ecology

Mentor – Amy Toth

### *Taking a Closer Look at the Hair of a Bumble Bee*

Up to half of all bumble bee species may be in population decline; this is of major concern as bumble bees are key pollinators of crops and native plants. One key question is why some bumble bee species populations are declining, while others are stable or even increasing. Differences in their basic biology may explain this, including differences in traits related to foraging efficiency and temperature tolerance, both of which may be relevant due to habitat loss and climate change. Hair could be the major biological difference separating declining species populations from stable and increasing populations, but there isn't enough current information about bumble bee hair to know for sure. In an effort to improve our understanding of bumble bee hair, specifically its structure and function, my research will take a closer look at hair structures and define hair types to be compared between common Iowa bumble bee species.

## **10. Alison Carr (ISU)**

Hometown – Ames, IA

Major – Kinesiology and Health

Mentor – Gregory Welk



## *Risks and Fear of Falling in Older Adults*

Reducing risk of falling in older adults is an important public health priority. The ISU Translational Research Network (U-TuRN) manages the statewide dissemination of an evidence-based program called Walk with Ease (WWE) that may help reduce risks of falls in this population. This study utilizes baseline data from the WWE intervention to examine associations between indicators of fall risk and fear of falling (FOF) in older adults. Data on fall risk were obtained from the CDC-endorsed STEADI fall risk screening tool which includes a survey and three functional tests. Data on FOF was obtained from the Falls Efficacy Scale (FES-I). Correlations between FOF and three key functional tests ranged from  $r=0.61$  to  $r=0.67$ ; however, a larger correlation was observed using a composite continuous risk score that includes all of the assessments ( $r=0.86$ ). The data provide important insights into identifying possible risks for falls in older adults.

### **11. Karlee Colby (UNI)**

Hometown – Cedar Rapids, IA

Major – English/Philosophy

Mentor – Yasemin Sari

### *Her Story, Her Right: Narrative as a Basic Human Right*

This research is an investigation of narrative as a basic human right. Specifically, it looks into what exactly it means for a person to be able to have an accurate life story or account of an event without fear of manipulation and non-consensual distortion. The narratives being analyzed are narratives of violence against women. In this analysis, multiple factors are examined. The first is the idea of narrative as a whole and the specific uniqueness that surrounds narratives of violence against women. The second is a dive into the legal system and its impact on both the definition of what exactly a “basic human right” is considered to be, as well as the ways in which the legal system acts as a top perpetrator of stripping narrative as a right. The third deals with weaving in identity and intersectionality, while the fourth is a collation of new, unheard narratives.

## **12. Emmet Cummings (UNI)**

Hometown – Center Point, IA

Major – History

Mentor – Thomas Connors

### *Underground lowans*

Underground lowans is a project undertaken by myself and two other undergraduate students (under Prof. Thomas Connors's guidance) to catalog the graves of notable people buried around the state. This geodatabase will be developed as an app allowing lowans and tourists to locate the graves and learn more about those who contributed to Iowa's history. Individuals cataloged include political leaders, writers, actors, musicians, Medal of Honor recipients, and Tuskegee airmen, among many others. This free app identifies hundreds of mainly unknown historic sites found in every part of the state.

## **13. Anthony David (ISU)**

Hometown – Maple Grove, MN

Major – Mechanical Engineering

Mentors – Pranav Shrotriya and Todd Kingston

### *Fabricating Biosensor Platforms for Real-Time Biothreat Detection*

Real-time biothreat detection is needed to safeguard populations from biothreats and rapidly deploy countermeasures if necessary. Rapidly detecting biothreats requires biosensors with specific characteristics, such as high throughput and selectivity. Our current research efforts to develop these biosensors focus on growing nanoporous anodized aluminum oxide films with a large concentration of uniform and straight pores. These films are ideally suited for real-time biosensors due to their unique geometric properties and ability to be reliably mass-produced. This research will directly and positively impact society through its applications in healthcare, defense, agriculture, environmental monitoring, and national security. Moreover, it has the potential to advance the Bioscience and Advanced Manufacturing sectors outlined by the Iowa Economic Development Authority.

## **14. Makayla Dove, Mckenzie Sanden (ISU)**

Hometown – Carol Stream, IL, Plymouth, MN

Major – Bioinformatics, Genetics

Mentor – Qian Wang

### *Gene Editing of Human Cells for Alzheimer's Disease Research*

The mitochondria are responsible for many important functions in the cells such as producing ATP and maintaining a balance between the production and disposal of reactive oxygen species. The health and function of the mitochondria naturally decline as people age. However, for people with Alzheimer's disease this decline is much more drastic and leads to impairment of brain functions. This project focuses on genetic risk factors of Alzheimer's disease which are also closely related to mitochondrial function. HEK 293 cells will be edited using CRISPR technologies via transfection of CRISPR cas9 protein and homology directed repair plasmids containing desired alleles. Once the cells are transfected, their overall and mitochondrial health will be evaluated and compared to those of healthy cells. This project uses the cell lines with homogenous genetic background. It will provide reliable measurement on the direct impact and interaction between APOE  $\epsilon$ 4 and TOMM40 rs2075650.

## **15. Hugh Duffy (ISU)**

Hometown – Cedar Rapids, IA

Major – Architecture

Mentor – Chengde Wu

### *Lowering Carbon Footprint with 3D Printed Concrete Buildings*

3D printing concrete has emerged as a revolutionary technology primarily used in the fabrication of buildings. Cement manufacturing accounts for approximately 5% of anthropogenic CO<sub>2</sub> emissions worldwide. In our research, we are testing mixes of concrete containing shredded wind turbine fibers, recycled glass powder, corn stover, and biochar. These materials were chosen as they provided a balance of strength, workability with the 3D concrete printer, and lower carbon emissions. To test our mixtures we developed the following workflow: mix, cure, test, and evaluate.

After curing, we tested the compressive strength on a hydraulic press and analyzed measurements of load and stress. We then calculated the carbon footprint of the concrete mix with each alternative material. The new concrete mixes showed varying levels of compressive strength and a reduction in carbon footprint. The technology of 3D concrete printing and eco-friendly concrete will lay the foundation for a sustainable future for housing.

## **16. Harper Dunne (Uofl)**

Hometown – Fort Worth, Texas

Major – Spanish, Global Health Studies

Mentor – Laura Frey Law

### *We Looked at 6,795 Articles So You Didn't Have To: A Scoping Review of Studies Investigating MSS (Multisensory Sensitivity) in Pain Populations*

Chronic pain is a debilitating health problem that affects 20 million Americans each year and can result in devastating emotional and financial stress. Although the causes of chronic pain remain elusive, there is a recent interest in multisensory sensitivity (MSS) as an indirect marker of pain-related central nervous system sensitization. MSS is a trait in which a person experiences increased sensitivity to normally non-painful stimuli (e.g, sensitivity to bright lights or rough clothing textures). Understanding if MSS is a predictor of chronic pain would be a huge breakthrough in its treatment, but because there is a lack of a common vocabulary to describe MSS, it is difficult to find and summarize discoveries. Our review contributes to a solution by comprehensively cataloguing all peer-reviewed studies to date in the MSS-pain field. We also make a recommendation for a standardized vocabulary to aid in the future sharing of knowledge.

## **17. William Fekkether (ISU)**

Hometown – Dunkerton, IA

Major – Materials Engineering

Mentor – Steve Martin

### *Using Glass to Develop the Next Generation of Solid-State Batteries*

In our ever-growing state, the need for energy in Iowa has regularly increased. As this demand for power grows, new and original sources of energy are required. Even more so, methods of storing this energy are critical, especially for usage with Iowa's myriad wind farms, solar arrays, and growing electric vehicle market. To address these concerns, our research has worked towards developing solid-state battery technology, the next generation of energy storage. By substituting the flammable liquid within a traditional lithium-ion battery with a solid electrolyte, safer and highly energy-dense batteries are being created. Specifically, this project creates new solid-state batteries by first drawing a sulfur-based glass into a micron-scale thin film. To fabricate a full battery, this glassy thin-film is used as the solid electrolyte separator between a lithium metal anode and metal-phosphate cathode. With these novel materials, new battery technology to power Iowa's future is being developed.

### **18. Daniel Fu – (UofI)**

Hometown – Johnston, Iowa  
Major – Biomedical Sciences  
Mentor – Rory Fisher

#### ***RGS6 mediates exercise-induced rescue of impaired cognition and hippocampal neurogenesis in mice with Alzheimer's disease***

Hippocampal neuronal loss in Alzheimer's disease (AD) is responsible for cognitive dysfunction in AD patients. Adult hippocampal neurogenesis (AHN) is critical for hippocampal-dependent learning and memory and protects against cognitive loss in AD. AHN is stimulated by exercise and is reduced in humans with AD and A $\beta$  mouse models of AD. Thus, there is a critical need to understand the AHN mechanisms that contribute to improved hippocampal function in AD. Here, we show that voluntary wheel running in AD mice completely restored their impairments in hippocampal learning and memory to that of control mice along with a robust increase in immature neurons in the hippocampus. This rescue of cognitive function in AD mice by running was abolished by RGS6 deletion in the hippocampus. Our findings identify RGS6 as a therapeutic target to combat hippocampal neuron loss and cognitive dysfunction in AD.

## **19. Noah Gilkes (UofI)**

Hometown – Robins, Iowa

Major – Neuroscience, Philosophy

Mentor – Elizabeth Newell

### *Traumatic brain injury is associated with neurological deficits and leads to activation of the type I interferon pathway*

Our research is focused on the variety of pathways involved with traumatic brain injury (TBI). TBI is a leading cause of death and impacts over 3 million people annually. Survivors often experience many neurological deficits that can persist throughout life. The underlying pathological mechanisms contributing to these deficits remain understudied and result in a lack of neuroprotective therapies available. We are focused on the type I interferon pathway, one specific immune system pathway that becomes activated after TBI. In our study, adult male mice were subject to either fluid percussion injury (a form of TBI) or sham injury. We evaluated the neuroimmune response and behavioral outcomes after injury. We demonstrated a robust inflammatory response in the brain after TBI which we believe contributes to the negative immunological outcomes after injury. Our current studies are further investigating possible mechanisms of neuroprotection that can be used to protect against TBI for victims.

## **20. Grace Hagedorn (ISU)**

Hometown – Ankeny, IA

Major – Biology

Mentor – Mohan Gupta

### *Creating effective G418 antibiotic plates for yeast transformation*

G418 is an antibiotic that is effective on yeast. The gene *kanr* from *Escherichia coli* encodes for G418 resistance and can be inserted into yeast cells, allowing them to grow on media supplemented with the drug. G418 plates have been showing inconsistencies causing non-resistant yeast strains to successfully grow. My research involves testing culture plates created using different water sources, G418 concentrations, and temperatures. This has resulted in varying degrees of growth for non-resistant strains, with certain water sources and higher G418 concentrations

resulting in lower false positive colonies. The plates were then tested with newly transformed yeast strains that have the DNA fragments of both the resistance gene, and a protein tag, Myc-13. This protein tag allows for that specific protein to be located and isolated. Working G418 plates can ensure the efficacy of the transformation process, along with confidence of the new strains generated by the process.

## **21. Jenna Heinen (UNI)**

Hometown – Algona, IA

Major – Biochemistry/Physics: Data Science

Mentor – Joshua Sebree

### *Spectroscopic Characterization of Wind Cave National Park*

My research focuses on studying Wind Cave National Park as a model for extraterrestrial environments, especially the icy moons of Saturn and Jupiter. One caveat of studying this cave is the crystalline features being studied cannot be removed or contaminated. Because of this, spectroscopic studies about light fluorescence and mineral composition are used to gain an understanding about the cave's makeup. Through this, insights about certain extraterrestrial environments and models for studying them can be formulated.

## **22. Dela Houssou, Erik Dralle (ISU)**

Hometown – Iowa City, IA, Oswego, IL

Major – Civil Engineering

Mentor – Alice Alipour

### *Resiliency of Electric Power Network under Wind Event*

The changing climate is leading to increased extreme weather events that cause damage to the electric power network (EPN). This creates outages with serious consequences, especially to rural utilities with limited resources. To alleviate such adverse impacts, this project will introduce a new digital infrastructure that transforms the resilience of the EPNs serving rural communities, allowing appropriate preventive and corrective actions with a focus on climate adaptation. There is a high priority among underserved utilities to address the absence of high-fidelity platforms capable of representing real power system performance during natural

hazards and connecting current and future hazard data to the measures of risk and resilience at the community level. Thus, the overarching goal of the project's tasks and activities is to introduce, test, and establish a novel digital infrastructure that will enable utilities in rural communities to plan for changing climate, minimize the consequences of natural disasters, and recover from them as fast as possible.

### **23. Karly Jans (ISU)**

Hometown – Clutier, IA

Major – Biology and Animal Ecology

Mentor – Mike Rentz

#### *Mental Health Issues within Iowa Veterinary Clinics*

A veterinary medicine career has many stressors, including low wages, long hours, client complaints, management responsibilities, euthanasia procedures, educational debt, and poor work-life balance. With these stressors, veterinary professionals are at high risk for burnout, compassion fatigue, depression, and suicidal ideations. Our aim with this study was to investigate the prevalence of these conditions within Iowa veterinary clinics. We sent a survey to over 400 clinics to collect information using three widely used, standardized survey tools: the ProQOL 5, PHQ-9, and SBQ-R. We received and analyzed a total of 94 responses. We found no support to indicate different levels of burnout, compassion satisfaction, or secondary traumatic stress between veterinarians and support staff, but support staff had increased levels of depression and suicidal ideations compared to veterinarians. We believe that both veterinarians and support staff have elevated levels of burnout, depression, and suicidal ideations, but support staff suffers from higher levels.

### **24. Vesha Jayswal (UNI)**

Hometown – Independence, IA

Major – Accounting/Economics: Business Economics

Mentor – Joe Ugrin

#### *The Power of Homeownership*

The purpose of this study is to examine the impact of John Deere's recent donation of \$1.0 Million to Iowa Habitat for Humanity for neighborhood redevelopment in the Church Row neighborhood of Waterloo. This study will



examine evidence of how such investments can impact the lives of the recipients and the broader community. There are three key factors of interest in measuring impact of the donation. First key factor is the financial benefit derived from homeownership through Habitat for Humanity. The second factor is the improvement well-being, both physical and psychological, and life satisfaction. Another key consideration is the impact on the community as a result of the redevelopment. The vision behind this research is to provide foundation for reporting the impact of corporate philanthropic initiatives and to highlight the significance of the work done by Iowa Habitat for Humanity.

## **25. Elle Jones (UNI)**

Hometown – Burlington, IA

Major – Political Science/Pre-Prof: Law

Mentor – Yasemin Sari

### *Government and Institutional Changes regarding Human Rights that affect Citizen Involvement*

Over centuries, one party has been unhappy, whereas the other has power. But what about the population as a whole? Government policy constantly changes, forcing citizens to change their relationship with it. An activist's involvement can include protests or changing voter turnout. Recent midterm elections are a perfect example. Voter turnout for Democrats led to underperformance in several red states. This is due to those who based their vote on the Dobbs decision when the Supreme Court overturned *Roe v. Wade* the summer before, despite Democratic approval ratings being 50% and Republican approval ratings leading by 3%. With many more examples like COVID-19, the Market Crash, and so much more, the definition of democracy is able to be enforced. People are able to react and act in order to pursue the rights they are entitled to. Democracies have their ups and downs.

## **26. Emmeline Kraus (UofI)**

Hometown – Iowa City, IA

Major – Environmental Sciences; Geography

Mentors - Matt Dannenberg and Susan Meerdink

*Seasonal effects of the fungal pathogen *Tubakia iowensis* (bur oak blight) on the photosynthetic capacity of infected *Quercus macrocarpa* (bur oak).*

Bur oak blight, a late-season leaf disease of *Quercus macrocarpa* (bur oak), has increased in prevalence in Iowa, Minnesota, and Nebraska since the 1990s. The disease, caused by the fungus *Tubakia iowensis*, causes vein necrosis and leaf death in afflicted trees. To prevent further spread of bur oak blight and protect native bur oak populations, more research is needed on the progression of the disease, its seasonal physiological effects, and its detection and management. To understand how blight progression influences bur oak photosynthetic capacity, we measured changes in the maximum rate of carboxylation ( $V_{cmax}$ ) and the maximum rate of electron transport ( $J_{max}$ ) of 20 mature bur oak trees experiencing *Tubakia* infections of varying severity for 10 weeks (June 1 - August 5, 2022). We assessed the physiological effects of blight using mixed-effects models and found that blight does reduce  $V_{cmax}$  and  $J_{max}$  in affected trees.

## **27. Victoria Kyveryga (ISU)**

Hometown – Ames, IA

Major – Chemical Engineering and Chemistry

Mentor – Kirill Kovnir

*Structure and Energy-Related Properties of Novel Barium-Arsenide Materials*

Materials science can provide solutions to many challenges in our society, including those related to our energy consumption, generation, and storage. The discovery and industrialization of these types of materials are critical as the global population increases and our energy demand explodes. However, predicting the stability and even mere existence of these desirable materials can be an enormous hurdle, which is further frustrated by industry standards of utilizing cheap, non-toxic, and abundant elements. To engineer materials that meet these standards, it is necessary first to

thoroughly understand the structures, properties, and chemistries of candidate materials. In this project, the structures and properties of three barium-arsenide materials are studied. These materials exhibit interesting structural motifs and fascinating physical phenomena, and their exploration will further contribute to the fundamental understanding of materials for energy applications.

## **28. Trevor Larkin (UofI)**

Hometown – Dubuque, Iowa

Major – Chemistry

Mentor – Johna Leddy

### *Preparation and Evaluation of Lanthanide Catalysts for Oxygen Reduction*

Oxygen reduction reactions are essential for fuel cells and energy production. Oxygen reduction reactions are catalyzed by platinum which is expensive and not as readily available as other possible catalysts. Catalysts play an important role in chemical reactions, such as speeding up a chemical reaction, or lowering the temperature or pressure needed to start one, without itself being consumed during the reaction. Many lanthanides have catalytic properties, and are cheaper than platinum, which would allow for a cheaper and more cost-effective route to perform an oxygen reduction reaction. The research being conducted investigates the catalytic properties of different lanthanide species, in hopes of finding a cheaper and equally as effective substitute for platinum as a catalyst.

## **29. Priscilla Lee (ISU)**

Hometown – Schaumburg, IL

Major – Kinesiology

Mentor – Ji-Young Choi

### *Differences in Working Memory Between Monolingual and Bilingual Learners*

The literature point to bilingual benefits in cognition. We wanted to test whether such bilingual benefit is observed in short-term memory skills by comparing bilingual children's and monolingual children's performance. In

order to assess the the short-term working memory of children, we conducted the digit spanning assessment for children between the ages of 36 to 48 months. I will analyze data obtained from a mix of monolingual and bilingual learners, all healthy, and random mix of gender. The digit spanning assessment will allow us to see how many digit sequences children are able to repeat, with the more digits being repeated, the bigger their short-term memory capacity is.

### **30. Haley Lightfoot (Uofl)**

Hometown – Lake Zurich, IL

Major – Chemistry

Mentor – Tori Forbes

#### *Novel Green Solventless Synthesis of Uranium Metal Organic Frameworks via Temperature Dependent Flux Reactions*

Uranium, a naturally occurring radioactive element, can form metal organic frameworks (UMOFs) that are of interest due to their tailorable properties and range of applications. The uranyl cation ( $\text{UO}_2^{2+}$ ) is a positively charged triatomic molecule formed when two terminal oxygen atoms bond to a central uranium (VI) atom. Further coordination occurs to the uranium center as ligands bind in the perpendicular plane to the linear oxygens, forming one- and two-dimensional materials. Our project explores the optimization of a new method of UMOF preparation by adjusting various procedural parameters such as reaction time and temperature. This novel method looks at how an organic ligand reaches its melting point and proceeds to act as a solvent to react with uranyl nitrate hexahydrate. Solid yellow powders containing multiple phases were observed for each flux reaction. Solventless synthetic methods aid in green chemistry, reduce liquid waste, and may provide access to unusual structures.

### **31. Kobie Long (Uofl)**

Hometown – Des Moines, IA

Major – Environmental Science

Mentor – Ben Swanson

#### *Identifying Areas of Groundwater-Surface Water Exchange along Camp Cardinal Creek at Ashton Prairie Living Laboratory*

Groundwater-Surface water interactions are an important component of aquatic ecosystems. Groundwater provides temperature refugia and nutrients to stream systems. I aimed to locate areas where groundwater is entering Camp Cardinal Creek in order to inform future aquatic habitat and groundwater studies, including ongoing, repeated aquatic macro-invertebrate surveys. I measured water temperatures every 3-5m with a digital thermometer set approximately 2 cm above the streambed. The thermometer was attached to a GPS survey rod, and the GPS was used to locate each measurement point along a longitudinal profile of the stream channel. The macroinvertebrate surveys were conducted twice at six different sites, along 50m stream reaches for 1 hour. The temperature survey identified three reaches of the stream that are strongly influenced by incoming groundwater, and initial macroinvertebrate sampling indicate these areas also harbor macroinvertebrates which are indicative of relatively good water quality. Future work will compare water quality sampling results to an IBI index which will be calculated using the macroinvertebrates survey data. Additionally, work in the future will include identifying groundwater input locations and volumes with more detailed analysis.

### **32. Julie Matta (UNI)**

Hometown – Marshalltown, IA

Major – Theatre: Performance/ Theatre: Theatre Yth Community

Mentor – Katherine Hahn

#### *Hidden in Plain Sight: The Influence of Indigenous and Latin Theatre*

The purpose of this research is to see how ritualistic and storytelling aspects of theatre have affected the story of what we consider modern theatre to be. The research will provide a living archive to students who want to further their career in the arts and have the opportunity to see for themselves how the evolution of theatre has made it to what it is today. The exploration of different methods of storytelling such as dance, music, ritual, and heritage is seen in many traditions of various indigenous tribes all involving the metaphorical sacrifice of the body in order to create the art of storytelling. This archive will be one that is interactive through first-hand accounts of Latin people today. This will provide students an educational tool as they move forward in their knowledge, so they have a better understanding of how art styles have been created.

### **33. Rowan McCarthy (UNI)**

Hometown – Windsor Heights, IA

Major – The Study of Religion/ Env Science: Env Earth Science

Mentor – Mohammad Iqbal

#### **Development of a Water Quality Index Calculation Tool using Excel**

Water Quality Indices (WQI) are vital to the decision making process. They summarize reams of data into a single value. When used in aggregate, WQI values provide a general sense of how a body of water changes holistically over a given period. The problem is that analog WQI calculations (as well as pre-existing online calculators) are onerous and time-consuming. Using my calculator, I was able to complete approximately 88 hours of work in 38 minutes. This calculator has already been used internationally to expedite the WQI calculation process; allowing for lawmakers, businesses, and citizens alike to understand more about the general quality of their water.

### **34. Tamara McConnell, Mia Riddley (ISU)**

Hometown – Kansas City, KS, Byram, MS

Major – Geology, Environmental Engineering

Mentor – Elizabeth Swanner

#### **Biological and Geochemical Controls on Iron Deposition in an Intermittent Stream**

In Clear Creek, on Iowa State University's campus, we have observed iron mineralization within stagnant pools and slow-moving water. Iron cycling relates to the amount of dissolved oxygen, which indicates water quality. We are investigating the pools' iron sources, as either groundwater-bearing iron or a sedimentary iron source. Accumulating mineralized iron can provide reactive surfaces for the absorption and immobilization of contaminants, and degrade with close proximity to organic contaminants. Our observations show several mineralization patterns that recur within specific pools. To study these patterns, sediments taken from Clear Creek are put through chemical extractions to determine the chemical form of iron. Iron concentrations are then measured. The presence of microorganisms near such sediment is being assessed to determine the variance of iron-oxidizing and iron-reducing microorganisms. Researching the iron source in

these pools can lead to a better understanding of their ecological and environmental roles.

### **35. James McMillan (UofI)**

Hometown – Iowa City, IA

Major – Public Health, Ethics and Public Policy

Mentor – Stephanie DiPietro

#### *Impact of Violence over the Life Course*

I am using grounded theory qualitative coding to examine case study interviews conducted by Dr. DiPietro in Bosnia. These interviews are examining what impact experiencing violence has on behavior in the life course of individuals who lived through the Bosnian civil war/genocide in the 1990s. And within the coding process, my goal is to find common threads and themes that help explain and illustrate behavioral trends. That in turn helps us have a better understanding of how a person reacts and what options they have whether they are perceived or not to these very intense situations like what happened with the genocide in Bosnia in the 1990s. And the very real impacts can even be seen now over 25 years later.

### **36. Jesse Miller (UofI)**

Hometown—Solon Iowa

Major—History, Social Studies Education

Mentor—Alyssa Park and Nick Yablon

#### *"License to do Evil in the Name of Good": Political Radicalization and Rhetorical Adaptation During the Wilmington Coup*

This paper seeks to analyze the impact of local political actors on the development of the Wilmington coup of 1898, an event that stands out in American history due to the violent overthrow of a sitting city government. The event has been studied more in recent decades by Prather, Gilmore, and the state of North Carolina, and they tend to focus on the aspects of race and gender that pervaded the buildup to the coup against a government with African-American civic participation. I build on the existing scholarship to argue that, while white supremacy and gender hierarchy in the South were important to understand in why the participants were convinced to

engage in political violence more broadly, the influence that a group of dedicated conspiracists had on the events in Wilmington shows that it took the proper urging and coordination for the coup to unfold and succeed at all. Through comprehensive military planning and the nimble adaptation of rhetoric, Wilmington succeeded where other insurrections failed. I will also argue that the conditions and tactics that allowed Wilmington to succeed can be found in modern acts of political violence, such as the Capitol Insurrection.

### **37. Aracely Miron-Ocampo (Uofl)**

Hometown – Des Moines, IA

Major – Microbiology, Global Health Studies Certificate

Mentor – Damian Krysan and Sarah Beattie

#### *Searching for Novel Antifungal Treatments and Regulatory Pathways via the Characterization of a Fluphenazine Derivative Against C. albicans*

The *Candida* spp. are commensal yeast, however, under certain host conditions involving immunosuppression, *Candida* can cause life-threatening infections. Previously, the phenothiazine class of drugs including fluphenazine were found to have antifungal activity, however these drugs are associated with unwanted side effects. A structural analog of fluphenazine, (974), was identified as having improved antifungal activity and reduced human receptor binding affinity. Using drug interaction assays with wildtype *C. albicans*, we observed that subinhibitory concentrations of 974 reduced *C. albicans* susceptibility to fluconazole, an interaction described as antagonism. To understand this antagonistic interaction, we measured the gene expression of the drug efflux pump CDR1, after treating the yeast cells with fluphenazine, 974, or vehicle (DMSO). As previously described, fluphenazine induced CDR1 expression. However, we also observed that 974 induced CDR1 expression to an even greater extent than fluphenazine. To investigate the CDR1 expression we generated mutant strains using CRISPR-Cas9 of the transcription factors TAC1 and MRR2 which are known to regulate the CDR1 pump. Expression of CDR1 in these mutant strains revealed that induction of CDR1 in response to fluphenazine is regulated in part by TAC1 but not by MRR2 while induction by 974 is regulated by both TAC1 and MRR2.



### **38. Ryleigh Mulcahey (UofI)**

Hometown – North Liberty, IA

Major – Chemistry, Environmental Science

#### *Sanibel Capitva Ecology*

### **39. Diana Mulder (ISU)**

Hometown – Parkersburg, IA

Major – Microbiology, International Agriculture

Mentor – Leonor Leandro

#### *Verification of a qPCR Assay for Detection of Phialophora gregata in varied Soybean Tissue and Brown stem rot suspect samples*

Phialophora gregata is a fungal pathogen that causes Brown Stem Rot disease in soybean. As a common disease found in fields across Iowa, it is important that university extension services, like the Plant & Insect Diagnostic Clinic at Iowa State University, have effective methods of detecting and diagnosing the disease so farmers may implement proper management practices. A published academic paper, Malvick et al. 2007, presents a promising detection strategy that uses quantitative polymerase chain reaction (qPCR) to detect and quantify P. gregata within a plant. This article is the first qPCR assay for P. gregata ever published, which demands the need to evaluate the materials and methods used in the assay to verify the procedure. The reproducibility of the detection method was tested to examine its effectiveness as a diagnostic tool by determining whether the method could detect the pathogen at various concentrations within soybean plants of varying conditions.

### **40. Stephanie Orellana (UofI)**

Hometown – Muscatine, Iowa

Major – Psychology

Mentor – Emily Thomas

#### *We are listening: Educator experiences during COVID-19*

The COVID-19 pandemic has negatively impacted physical, mental, social, and occupational health. Essential workers, for whom in-person work was

necessary, were at heightened risk for exposure and infection. Research has primarily investigated health care workers, yet educators' essential work occurred in a unique and often changing context. The American Psychological Association published technical and policy reports detailing concerning rates of psychiatric symptoms, violence against educators, and desire for career transitions during the pandemic. The current study examined educator health during the COVID-19 pandemic in the United States. Presented herein are qualitative data that provide important context regarding consequences of the pandemic on physical, mental, social, and occupational health in educators. The results provide insights into preparedness for future collective stressors and targets for intervention. Given that educators are one of the backbones of communities and important facilitators of child development, this study provides the foundation for future educator research.

#### **41. Zach Palmer (UofI)**

Hometown – Huxley, IA, Iowa City, IA, Waterloo, IA

Major – English & Creative Writing, Criminology & Social Justice, Japanese and Spanish

Mentor – Heather Erwin

#### ***Captive Labor Market: Addressing Iowa's school-to-prison pipeline***

The 13th amendment abolished slavery, however, it included a lesser-known clause. Section 1 states: "Neither slavery nor involuntary servitude, except as punishment for crime... shall exist within the United States." Iowa Prison Industries (IPI) is a \$25 million enterprise employing 80 IPI staff members and more than 800 inmates as the work arm of the Iowa Department of Corrections. Incarcerated workers are paid anywhere from 28 cents to \$1.92 per hour working in manufacturing, farming, canteen, and other labor sectors. IPI claims being paid in pennies lowers recidivism rates by 8% upon release—despite 347 policies and sanctions targeting employment for prior convictions in Iowa. The 13th amendment exception allows enterprises interconnected with the prison-industrial complex to capitalize on low-wage prison labor. Our data outlines Iowa higher institutions' private reliance on prison labor. We argue that prison labor is modern-day slavery; Reducing dependency on prison labor is transformative justice.

## **42. Jacob Parker (UNI)**

Hometown – Bettendorf, IA

Major – Biochemistry/ Psychology

Mentor – Martin Chin

### *Using an Aminimide Functional Group to Selectively Uptake Lithium*

The increased demand for lithium in recent years has called for new innovative methods of isolating lithium quickly. The goal of this project was to use the size and charge of the aminimide functional group to block other species in a brine solution, such as potassium, while selectively binding lithium. An aminimide is a functional group that consists of two consecutive nitrogen atoms, one with a negative charge, the other with a positive charge. Three different aminimide groups were tested, a trimethylaminimide, aminopyridiniumaminimide, and a triethylaminimide. Modified beads were introduced to a realistic brine solution which contained 10,000 ppm K, and 200 ppm Li. The aminopyridiniumaminimide and the triethylaminimide exhibited lithium selectivity compared to the control. The aminopyridiniumaminimide took up 43.9 ppm Li, while triethyl-aminimide took up 59.35 ppm Li both were better than the 29.5 ppm by the control.

## **43. Jeanetta Plotzke (ISU)**

Hometown – Osage, IA

Major – Environmental Science and Global Resource Systems,

Mentor – Matthew Helmer

### *Drainage District Main Improvements in Iowa*

Iowa agriculture within the Des Moines Lobe (West/Central Iowa) is dependent upon drainage systems to keep the corn and soybean fields producing year after year due to previous glaciation. In the early 1900s, drainage systems became a popular and feasible way for farmers to remove the excess water from these fields. There is a concern that there are drainage systems that are currently in place across the Des Moines Lobe that are under-capacity, and that the fields will not be drained properly to keep productivity up. This research has examined recent drainage main improvement projects to evaluate the percent of projects that move forward, the cost of these projects, and the old and new drainage coefficient. The work has found most drainage main

improvement projects have moved forward and the average cost per acre is \$800.

#### **44. Olivia Poppen, Tatum Englund, Madison Bemis (ISU)**

Hometown – West Branch, Marshalltown, Fairfield, IA

Major – Industrial Engineering, Industrial Engineering

Mentors – Kathryn Liefbrig, Stephen Gilbert

##### *Ergonomic Assessments via Virtual Reality: Is it Possible?*

Manufacturing facilities perform ergonomic assessments to reduce injuries among employees. Ergonomic assessments may encompass shutting down a manufacturing line to complete procedures, which could lead to delays in production and high costs. A Portable Ergonomic Assessment Tool (PEAT) was developed to test the feasibility of conducting ergonomic assessments in virtual settings. A virtual testing procedure may allow for a faster and more remote solution for ergonomic assessments. 50 participants participated in this study by assembling PEAT physically on a workbench and then again in a virtual environment using a VR headset and controllers. This research uses data-collecting tools that measure body position, muscle stimulation, and video recordings to collect data such as cycle times and extreme movements. Data from the virtual trial and the physical assembly trial will be compared to determine if it is feasible to make ergonomic assessments in virtual reality.

#### **45. Tristen Prouse (UNI)**

Hometown – Buckingham, IA

Major – Economics: General Economics/Pre-Prof:Law

Mentor – Lisa Jepsen

##### *How to Not Save the World From COVID-19: The Dire Consequences of Giving Away the Vaccine Formula*

The debate over giving away the COVID-19 vaccine formula is a political hot topic. Violating intellectual property law (patents) to give away the vaccine is a tempting option for aiding other countries in the current global health crisis. In actuality, many problems exist with this proposed solution, including violating intellectual property law, disincentivizing innovation, undermining confidence in vaccine safety, harming America's geopolitical

objectives, and inefficiencies. The United States can and should aid the world in obtaining vaccines, but it should not do so by waiving patent law and giving away the vaccine formulas.

#### **46. Tanzeel Ur Rehman (UNI)**

Hometown – Lahore, Pakistan

Major – Computer Science

Mentor – Dheryta Jaisinghani

#### *IoT in the Air: Thread-enabled Flying IoT Network for Indoor Environments*

In this work, we address the problem of connecting an Internet of Flying Things (IoFT) network in a robust, reliable, and resilient manner. Such a network is apt for the indoor use cases where not only we need fast network establishment but, the network should also be able to seamlessly adapt to frequent topology changes and power-efficient as well. We build an indoor IoFT prototype with CrazyFlie 2.1 drones that are specially equipped with NRF52840 chips capable of operating with the latest IoT standard – Thread. We evaluate the prototype for networking metrics such as, latency and throughput. Our initial evaluation reveals that this novel flying multihop mesh architecture can support up to 50 Kbps of throughput with the average latency 30 ms. We quantify network resilience with the time taken for a new route to take effect in the event of losing the previous connection. Our experiments reveal that the network restores within a minimum of 5 seconds in case of a partial node failure to a maximum of 30 seconds in case of a complete failure.

#### **47. Matthew Shafer (ISU)**

Hometown – Solon, IA

Major – Biology

Mentor – Jeanne Serb

#### *Creating Curriculum to Inspire Young Scientists*

As science proficiency scores fall across the nation, science, technology, engineering, and mathematics (STEM) learning demands innovation. The vast majority of impactful STEM curriculum is designed for middle and high school learners. This project addressed the learning gap by developing a

meaningful STEM curriculum for elementary students and a workshop to bolster teachers' confidence in STEM education. Based on a thorough educational literature review, I defined six tenets for effective STEM learning: social sensitivity, collaboration, teacher empowerment, central phenomena, process emphasis, and adaptability. My curriculum was adapted from existing high school curriculum with these tenets and Next Generation Science Standards in mind. Research on woodchip bioreactors from the Soupier Laboratory at Iowa State University informed the central phenomenon and surrounding activities. Both the curriculum and workshop were designed as a framework to guide the development of future scientific experiences for educators and curriculum developers alike.

#### **48. Megan Smith (ISU)**

Hometown – Cedar Falls, IA

Major – Biochemistry

Mentor – Amy Andreotti

#### ***Structural Analysis of a Tyrosine Kinase-Substrate Complex - a Target of Cancer Drugs***

Bruton's tyrosine kinase (Btk) is the enzyme responsible for activating phospholipase C gamma (PLC) that leads to the production of diacylglycerol (DAG). DAG is involved in the Ras signaling pathway that controls cell functions like division and survival. Ras pathway malfunctions can lead to cancer, and as the Ras pathway itself is difficult to regulate pharmacologically, Btk is a common target of cancer drugs. However, Btk often mutates where the drugs bind, rendering them ineffective. Understanding how Btk and PLC interact provides more opportunities for future drugs to interrupt this interaction and disrupt the Ras pathway in rapidly growing cancer cells. My research aims to obtain structural data of the Btk-PLC complex by synthesizing the two domains involved in the binding plus a linker domain that will facilitate their binding. This structural information will allow us to develop drugs that more effectively disrupt the binding interactions between Btk and PLC.

#### **49. Grayson Talaski (UofI)**

Hometown – Bloomington, IL

Major – Biomedical Engineering

Mentor – Cesar de Cesar Netto

## *The Impact of 3D Foot Alignment on Detection of Distal Tibiofibular Syndesmotoc Widening after Injury using Comparative Contralateral Distance Mapping*

Previous studies identified a link between increased hindfoot valgus and distal tibiofibular syndesmosis (DTFS) widening in patients with flatfoot deformity using foot-ankle offset (FAO). FAO is a weight-bearing CT (WBCT) based three-dimensional assessment of the relationship between the weightbearing foot tripod, and the center of the ankle joint and is frequently used as a 3D surrogate for hindfoot alignment. However, it is not known what the impact of 3D foot alignment is on the DTFS in the presence of a known syndesmotoc injury, particularly in varus. The objective of this cadaveric study was to determine the relationship between hindfoot alignment, measured by FAO, and DTFS widening in specimens with complete DTFS ligamentous injury, under simulated weight-bearing. We found that DTFS widening was significantly greater in specimens with increased hindfoot valgus (flat feet) and conversely diminished in specimens with hindfoot varus (high arching feet).

### **50. Eric Thomas (UofI)**

Hometown – Iowa City, IA

Major – Environmental Sciences

Mentor – Benjamin Swanson

## *Comparison of Intentionally Planted Species to Observed Population: Survey of plant biodiversity at Ashton Prairie Living Laboratory Prairie Restoration*

The Ashton Prairie plant distribution study included identifying and differentiating plant species within the original 1 acre prairie plot at Ashton Prairie for comparison with the restoration seed list to see what seeded plants had established and what additional species had “invaded.” The research group sited 10 by 10 meter plots within the 1 acre prairie, and within these plots, we surveyed presence and absence of plants within a 1m x 2m quadrat divided into 6 sections of sequentially larger sizes. We then used Microsoft Excel to compare existing plants with the original plant list for the site. We also compared existing plants between plots to see if hillslope position or wetness determined where certain plants grew. Initial data suggests that few of the seeded plants have established yet, and the

dominant plant remains the invasive reed canarygrass. The data provide a baseline for monitoring plant distributions at APLL over time and after treatments such as the burn conducted in November 2022.

## **51. Abigail Tibben, Megan McGuire (ISU)**

Hometown – Marshalltown, Ankeny, IA

Major – Genetics, Criminal Justice

Mentor – Stacy Renfro

### *Producing Mock Crime Scene Footwear Impressions Dataset*

One of the problems in forensic science is a lack of data. Creating datasets representative of casework is challenging, because it is difficult to obtain images collected under controlled conditions. Though, data collected in this way is useful for researchers and training within forensic science disciplines. This project's main objective is to create an open-source database containing a sizeable number of high-quality images of shoe impressions. The team at CSAFE worked to collect images that could represent those found at crime scenes and made publicly available to the broader forensic and research communities. With mixed impression types, flooring, lift techniques, and digital file types, the complete dataset will include nearly 800 shoeprint images contained in more than 1,700 digital files. Our presentation will focus on the process of developing data collection projects, writing protocols and publishing open-source datasets, with intentional reproducibility and details on how/why the project is important.

## **52. Zach Vig (UofI)**

Hometown – Mount Vernon, IA

Major – Geoscience, Physics

Mentor – David Miles

### *Detecting Iowa's CO<sub>2</sub> in the Stratosphere using the High Altitude Near Infrared Spectroscopy Experiment (HA-NICSE)*

Atmospheric CO<sub>2</sub> concentration measurements are crucial in determining the effects and processes behind climate change. Although many surface-level CO<sub>2</sub> studies have been performed, there is a distinct absence of vertically profiled CO<sub>2</sub> data. By measuring the CO<sub>2</sub> concentration using Near Infrared Spectroscopy on Iowa State University's High Altitude Balloon



Experiments in Technology (HABET) aircraft, we plan to characterize Iowa's atmospheric boundary layer, provide evidence of locally sourced CO<sub>2</sub> in the stratosphere and detect small-scale discrepancies in global CO<sub>2</sub> concentration models. Our instrument includes the use of a K30 FR CO<sub>2</sub> sensor in conjunction with Dynaflo 2000 series pumps to provide a calibrated, high resolution vertical profile of CO<sub>2</sub> concentration above Iowa. The experiment will be flown to 30km mainly above Iowa's farmland alongside two other scientific instruments from the University of Iowa. Once our data is collected, we plan to compare our measurements to theoretically derived and experimentally measured values to put Iowa's unique atmospheric environment into a global context.

### **53. Morgan Wickman (UNI)**

Hometown – Winterset, IA

Major – Psychology

Mentor – Elizabeth Lefler

#### *Secondary Traumatic Stress: Therapists' Past Trauma and Workplace Intervention*

Secondary traumatic stress is a type of indirect trauma wherein a person listens to the traumatic experiences of another and has a stress reaction. It can lead to symptoms that look similar to PTSD and can develop after only one instance. Secondary traumatic stress affects therapists more than the general population because therapists are exposed to trauma at a greater rate. So, I explore ways to decrease therapists' secondary traumatic stress by improving their work environment. I also identify how a personal history of trauma may impact the secondary traumatic stress in the therapist. Finally, I provide recommendations that may lead to the lowering of secondary traumatic stress rates specifically focusing on therapists' personal history of trauma and their work environment.

### **54. Raquel Wilhelm (UNI)**

Hometown – Cedar Rapids, IA

Major – Chemistry

Mentor – Shoshanna Coon

#### *Investigation of Unexpected Purple Substance Extracted from Newsprint Paper*

In an attempt to extract a green dye from newsprint advertisements, it was serendipitously discovered that a purple substance can be extracted from newsprint paper using methanol or acetic acid. Further investigations involving blank newsprint paper showed that the purple substance was a part of the paper itself rather than a component of the ink in the advertisements. Soxhlet extraction was used on the blank newspaper print to obtain the compound. Using different analytical instruments, characteristics of the compound can be determined such as the elemental composition, molar mass, and structure. The ultimate goal is to determine the compound and its structure.

## **55. Mackenzie Wisneski (UNI)**

Hometown – Le Claire, IA

Major – Tchg Eng to Spkrs of Othr Lang

Mentor – Hilal Ergül

### *Using Color with Care: An Exploration of the Application of Psychological Color Theory within Language Classrooms*

This study is a qualitative analysis of the instructional uses of color for social-emotional and academic assistance within language classrooms. Learners' environment in relation to information acquisition and retention matters (Krashen, 1982; Maslow, 1970; Perry, 2006), and developing practices connecting color and emotion is beneficial for the psychological regulation of those within any environment (Güneş & Olguntürk, 2020). This is especially important for emergent bilingual students, as these learners are disproportionately exposed to additional academic, emotional, socio-economic, and cultural challenges (Benesch, 2012; Beyer, 2017; Heineke & Vera, 2021). Data comprise surveys and interviews of three K-12 public school teachers of emergent bilingual students. Findings indicate that these educators work to curate the ideal mood within their classroom using colorful materials and furniture whilst implementing color-based strategies for organization and coding of academic information. Additional findings reveal teachers' intention to foster a holistic classroom that is exciting but not overwhelming to learners.



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