POSTER AND ORAL PRESENTATIONS • CREATIVE EXHIBITS • PANELS • KEY NOTE PRESENTATIONS

26TH ANNUAL UNDERGRADUATE RESEARCH SYMPOSIUM

Centennial Student Union

Thursday, April 18, 2024

MINNESOTA STATE UNIVERSITY MANKATO

Greetings from the President

It is my distinct honor to welcome you to the 26th Annual Undergraduate Research Symposium at Minnesota State University, Mankato. This year has been an exciting, challenging, and inspiring year of learning for our students and faculty. Earlier this month, 48 students shared that work at the National Conference of Undergraduate Research in Long Beach, California.

This year's symposium is a celebration of intellectual exploration, creativity, and collaboration by students, faculty, and staff. Enjoy your time as you listen to oral presentations, engage in meaningful discussions with students at posters, and view presentations of visual and performing arts. It is, in part, because of these sorts of scholarly showcases that Minnesota State Mankato has come to be known for its Big Ideas, Real-World Thinking, and Inspired Action.

I want to express my appreciation for the efforts of the Undergraduate Research Center staff, the Undergraduate Research Council, and the many volunteers who have made this event possible. I also want to recognize the many contributions of our faculty and staff for their work creating opportunities for and encouraging participation in research and creative exploration for our students. Your contributions to the intellectual development of these young scholars and their pursuit of excellence will last a lifetime.

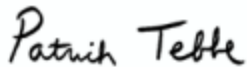I'm sure today will be inspiring. I hope you enjoy it.

Edward S. Inch
President
Minnesota State University, Mankato

A Message from the Undergraduate Research Center

Welcome to the 26th Annual Undergraduate Research Symposium at Minnesota State University, Mankato. The event features research, scholarly, and creative works from undergraduate students representing majors and disciplines from across campus. The symposium allowed undergraduates the opportunity to engage in the process of conducting and presenting research in an academic setting. This opportunity fosters collaboration between student presenters and an audience of faculty, administrators, peers, and family.

We congratulate these student presenters for their accomplishments and hard work throughout this year. We wish them the best of luck on their future academic and professional journeys.

Patrick Tebbe

Patrick Tebbe, Ph.D, P.E.
Director of the Undergraduate Research Center
Professor, Mechanical & Civil Engineering

Mission Statement of the URC

The Undergraduate Research Center (URC) nurtures and supports mentored research, scholarly, or creative activities for all undergraduate students. The URC promotes research as an opportunity to engage in a community of scholars to enhance students' academic experience and readiness to succeed in the future.

Visit the Undergraduate Research Center's website for more information on our programs: https://research.mnsu.edu/undergraduate-research-center/

URS Inclusion Statement

We consider the Undergraduate Research Symposium to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All presenters and attendees are expected to contribute to a respectful, welcoming, and inclusive environment for every other participant.

Accessing the URS Online

The URS is hosted digitally on the Symposium by ForagerOne system. The URS Welcome page can be accessed through the following link after the in-person URS concludes:

https://symposium.foragerone.com/2024-undergraduate-research-symposium

Thank you for the Minnesota State University, Mankato Foundation

The Undergraduate Research Center wishes to thank the Minnesota State University, Mankato Foundation for their support of undergraduate research, scholarly, and creative work through funding for grants and student programming.

Thank you to the Office of University Fellowships, Honors Program, and Undergraduate Research Center Staff

The Undergraduate Research Center wishes to thank the staff from the Office of University Fellowships, the Honors Program, and our administrative assistant, Destiny Lee. This event would not be possible without your time and support!

Thank You to the 2023-2024

Undergraduate Research Council

The Undergraduate Research Council includes staff, administration, and faculty representatives from every college and several offices on campus. Council members actively serve on a variety of URC initiatives and committees that support student success. Council members also act as the voice of our faculty. Thank you, 2023-2024 council members!

Kristi Oeding	Başak Bektaş
DeQuindre Spencer	Keenan Hartert
Kerri Mahoney	Samantha Katner
Rachel Cohen	Matt Connolly
Shawna Petersen-Brown	Chris Corley
Kelly Moreland	Leah White
Aaron Hoy	Erik Youngs
Corey Selland	Kristel Seth
Amal Sharafkhodjaeva	

Minnesota State Mankato Foundation Grant Recipients

Lydia Schrempp	Jake Lohn	Chayton Schmidt
Riley Ahrendt	Emma Dennison	Lauren Bondhus
Gionna Parsa	Austen Bayne	Selvin Hernandez
Aidan Forberg	Keone Anderson	Natalie Dodson
Matthew Jensen	Jessica Heinsch	Marissa Muller
D'Aaliyah Johnson	Victoria Greene	Kylie Hensch
Rachel Fischer	Kayla Szafraniec	Sean Sheets
Halen Tsegaye	Marielle Calanza	Mary Olageji
Ya Faatou Sowe	Ellie Schindle	Cody Dayton
Lensa Tsagaye	Leah Hed	Oltjona Muca
Justin Kjorness	Randi Libin-Straub	Omar Ghandour
Kaylyn Batchelor	Casey Schneider	Alison Brunmeier
Meklit Naizgi	August Thomas-Best	Kaitlyn Sizer
Amal Sharafkhodjaeva	Logan Montgomery	
Rohit Paruchuri	Haley Schaefer	

Undergraduate Research Center Grant Recipients

Solomon Kendall	James Hawco	Sophia Lee
Jenna Eklund	Allison Alshouse	Jeremy Derhaag
Katelyn Walz	Koleman Lund	Lucas Rohl
Ella Schulz	Tara Lovas	Samarth Shah
Emma Dennison	Teanna Horn	Chanpitou Um
Bernadette Igo	Karlie Mathias	Sumaya Khan
Brooke Andel	Hamede Abdulgafur	Ariana Jacobs
Jessica Stelton	Dagmawi Abera	Huzaifa Muhammad
David Rezac	Noah Awol	Ashley Cridlebaugh
Eli Koboski	Jordan Ausen	Ali Rashid
Ainslee Hemmen	Hedaya Abdulgefar	

National Conference on Undergraduate Research Presenters

Akrem Ahmed	Rohit Paruchuri
Brooke Andel	Zoe Porter
Kaylyn Batchelor	Cade Predmore
Alison Brunmeier	Mirza Rashid
Marielle Calanza	Emma Rieper
Maija Carriveau	Ellie Schindle
Mia Collazo	Nomin Senadheera
Ashley Cridlebaugh	Dilasha Shakya
Demaris De La Torre	Amal Sharafkhodjaeva
Georgia Deml	Meklit Shiferaw
Saumya Gautam	Rikin Shrestha
Tinsay Gerbremariam	Kaitlyn Sizer
Omar Ghandour	Ya Faatou Sowe
Francesa Goma	Kayla Szafraniec
Leah Hed	Shamsi Taghiyev
Muhammad Huzaifa	Amlake Tamrat
Ariana Jacobs	Megan Tobias
Madisyn Jarvey	Derek Utecht
Matthew Jensen	Kaylee Voigt
D'Aaliyah Johnson	Koleman Lund
Niftalem Kassa	Aryee McCabe
Yodahe Kebede	Barkot Menkir
Kory Kyro	Oltjona Muca
Araya Lemma	
Jasmine Ortuno Jimenez	

Congratulations on presenting at the 26th Annual Undergraduate Research Symposium at Minnesota State University, Mankato. Now that you have finished all your hard work and your poster, creative work, or presentation is ready for the Undergraduate Research Symposium, did you know that you can also submit a copy of your work to Cornerstone?

Cornerstone highlights the intellectual productivity and creativity of Minnesota State University, Mankato's faculty, staff, and students by preserving their work in this online repository and presenting them to the world to view. After the 2024 Undergraduate Research Symposium ends, Library Services will be adding the abstract booklet and proceedings to the repository as well. You can view the collection at https://cornerstone.lib.mnsu.edu/urs/.

The proceedings include your name and the abstract of what you presented, but there is no full or complete text of your presentation, no view of your poster, or no images of your creative work. If you would like, you can submit a full-text version of your work to Cornerstone which will be added to the proceeding record. Each item submitted to Cornerstone receives a permanent URL, which you can add to your resume to provide evidence of your hard work to prospective employers or graduate schools. You will also be able to see statistics on the number of times people have downloaded or viewed your work.

If you are interested in, we encourage you to talk to your faculty mentor or contact Heidi Southworth, Digital Initiatives Librarian, at heidi.southworth@mnsu.edu with questions.

Did your project result in a research paper? Consider submitting it to the Journal of Undergraduate Research, which is also archived in Cornerstone.

Aims & Scope

The Journal of Undergraduate Research (JUR) at Minnesota State University, Mankato is an interdisciplinary peer-reviewed online journal. The JUR is committed to the dissemination and celebration of undergraduate students' research, scholarly, and creative activities. The JUR accepts submissions from students within the Minnesota State system. Submissions from all fields and disciplines are welcomed.

9:00 a.m. – 10:00 a.m.
Oral Session 1 (CSU 201), Oral Session 2 (CSU 204)

10:00 a.m. – 11:30 a.m.
Poster Session 1 (CSU 245 and CSU 253/254/255)

10:30 a.m. – 11:30 a.m.
Oral Session 3 (CSU 201), Oral Session 4 (CSU 204)

12:00 p.m. – 1:00 p.m.
"Promoting Research as a Career Readiness Tool"
Faculty/Staff Workshop (CSU 203)

12:00 p.m. – 1:00 p.m.
"Developing Your URC Grant Application"
Student Workshop (CSU 202)

1:30 p.m. – 2:30 p.m.
Oral Session 5 (CSU 201)

2:00 p.m. – 3:30 p.m.
Poster Session 2 (CSU 245 and CSU 253/254/255)

4:00 p.m. - 5:00 p.m.
"Unveiling the Secrets of Extraterrestrial Materials: Studying Meteorites with
Undergraduate Students"
Keynote Address by Dr. Analía Dall'Asén (Department of Physics & Astronomy),
2023 Recipient of the Outstanding Undergraduate Research Mentor Award
(CSU 201)

Immediately followed by a panel discussion with Puteri Megat Hamari and Elizabeth
Sandell, 2023 Recipients of the Certificate of Recognition for Outstanding
Mentorship.

6:00 p.m. – 8:00 p.m.
"Undergraduate Research Symposium Exhibition"
CSU Gallery

Barriers To Dental Care Among International Students
Yonung Rai
Sonika Masih

Introduction
Oral health refers to the condition of the mouth, teeth, and orofacial structures, allowing individuals to carry out fundamental activities like eating, breathing, speaking, and encompasses psychosocial aspects (Oral Health, 2019). Having good oral health is of utmost importance as it can prevent various dental issues and systemic diseases. The access to dental care is important for everyone including international students who have come to the United States (U.S.) for their studies. Even though dental health is critical to overall health there are barriers to it for international students. The barriers include affordability, communication difficulties, insufficient interpretation, limited knowledge of the healthcare systems and healthcare rights and negative encounters with the healthcare teams (Paisi et al., 2020). Being in a foreign country, international students may encounter unfamiliar healthcare systems and may also lack awareness about oral health. Hill's research studies the connection between health insurance and dental care utilization among university students. University students, who may engage in inadequate oral health practices, face the risk of not having health insurance. This situation is similar to that of international students who are enrolled in university and do not have health (dental) insurance coverage (Hill et al., 2023). Neglecting dental care can lead to various oral health issues, which can affect their overall health and their academic performance. Regular dental care visits are important for preventing dental issues, detecting problems earlier, and preventing tooth loss and decay. These barriers are relevant with international students who are in the U.S. The main purpose of this research is to evaluate the barriers that prevent international students from accessing dental care.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61173

A Comprehensive Review of DeepFake Detection Methods Using Machine Learning
Sonia Sherif, Hawi Atinafu, Bethel Zegeye
Rushit Dave

Deepfakes are synthetic media created using deep learning techniques, typically involving the manipulation of audio, video, or images to depict fabricated events or scenarios. While initially used for entertainment purposes, deepfakes pose significant risks in various domains, including politics, cybersecurity, and social media. With the proliferation of deepfake technology, the potential for misinformation and fraudulent activities has become a significant concern. In response, numerous research efforts have been devoted to developing effective deepfake detection methods. This paper presents a comprehensive review of deepfake detection techniques utilizing machine learning algorithms over several datasets. We analyze and compare a diverse range of Machine-Learning approaches. By synthesizing insights from a wide array of research contributions, this review aims to provide a comprehensive understanding of the current state of deepfake detection using machine learning and to guide future research directions in mitigating the threats posed by deepfakes. Despite significant advancements, current state-of-the-art approaches exhibit limitations, such as sample size dependence, misclassification risks, reliance on specific data types, or inefficiency in handling complex architectures. To address these limitations and enhance detection accuracy, future research could explore the integration and fusion of multiple detection models.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61002

A Geochemical Investigation of the Weathering Characteristics of Old Glacial Tills
Kayla Szafraniec
Chad Wittkop

I analyzed the geochemical characteristics of samples sourced from two different locations featuring old glacial tills. I prepped the samples by sieving each sample to <63 micron of sediment and ran it through the X-ray Fluorescence (XRF). Compared the CIA and major element geochemistry of tills derived from these sources to confirm whether early Pleistocene glaciers scoured an extensive regolith, or whether relatively young igneous rocks were a constant influence on Labrador sector tills. The CIA was determined from an analysis of the bulk

geochemistry on sieved (<63 micron) glacial till using X-ray Fluorescence (XRF). The geochemical characteristics of early- and middle-Pleistocene tills were influenced by both changes in evolving rock weathering characteristics, and changes in glacier flow direction which incorporate contrasting rock sources.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/60326

A Thematic Analysis of Transgender Young Adults' Attitudes Towards Marriage
Maddie Kowalczyk
Aaron Hoy

Research on transgender people's experiences with marriage remains extremely limited. Although a handful of studies have addressed this important topic (e.g., Lagos, 2018; London, 2022; Meyer et al., 2017), only preliminary answers can be found for even basic questions about how many transgender people marry, who they marry, and why. It is unsurprising, then, that despite a robust research literature on young adults' marital aspirations (e.g., Allred, 2019; Manning et al., 2007; Manning et al., 2019), research has yet to explore the marital aspirations of transgender young adults specifically, which is especially significant now that all transgender people in the US have the legal right to marry regardless of their sexual identity. To address this, in this presentation, I draw upon qualitative survey data from a convenience sample of 48 transgender sexual minority young adults collected as part of a larger study on the marital attitudes and aspirations of sexual minority young adults (including those who are cisgender). I conducted a reflexive thematic analysis of this data (see Morgan, 2022), and preliminary results show that transgender young adults are largely disinterested in marriage for a plethora of reasons. A majority of the indifferent respondents perceive the institution of marriage to be "unnecessary" due to their belief that marriage is not meaningfully different from other committed relationships as well as its association with cis-heteronormativity and sexism. Most participants would, however, marry for external reasons, such as its legal benefits or familial pressure.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61294

Aerodynamic Core Material Testing
August Thomas-Best, Logan Montgomery
Sam Ertl

Aerodynamic devices are typically made of composite materials and a core material, referred to as a "sandwich panel". Sandwich panels are a common lighter alternative to metal panels; items from billboards, to buildings, and automotive bodies are made from sandwich panels. One of the most common and readily available composite material used in sandwich panels is fiberglass; fiberglass is comprised of woven glass strands that can be formed into sheets. Another composite material is carbon fiber; carbon fiber is akin to fiberglass, but instead of woven strands of glass, carbon strands are woven into sheets. Both sheets can be bonded to a core material which can be anything that the manufacturer desires, from balsa wood, to foam, to metal, these materials range significantly in terms of strength and density. Core materials help sandwich panels retain their shape and increase their rigidity. The core materials tested in the study were various types of foam and extruded Nomex.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61218

Age Related Microaggressions: The Gender Disparity
Sachita Pokhrel
Jeff Buchanan

Microaggressions are defined as everyday forms of discrimination and stereotyping faced by marginalized groups of people in society. Similarly, ageism is the stereotyping and discrimination against people because of their age. This study focused on examining gender differences in the experience of age-related microaggressions in individuals over the age of 65. Participants (n= 303) were asked a variety of questions about their experiences with age-related microaggressions in their daily lives. Gender differences were examined in terms of the types of microaggressions experienced, their frequency of occurrence, where

microaggressions occurred, who delivered microaggressions, as well as emotional and behavioral responses to microaggressions. Data are still being analyzed at this time. However, results may provide important information regarding how age-related microaggressions affect older men and women differently. In addition, based on findings from previous studies, results may have implications for training employees in service-related industries (e.g., retail, hospitality, restaurants) or healthcare settings where age-related microaggressions frequently occur.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/60931

Age, Ethnicity, and Microaggressions.
Stella Neophytou
Jeff Buchanan

Older people of color belong to two marginalized groups; therefore, they may be particularly susceptible to experiencing intentional or unintentional discrimination in the form of microaggression. The purpose of this study was to complete an exploratory qualitative analysis of age-related microaggressions reported by older adults identifying as non-white/Caucasian. Participants in this study included 26 adults over the age of sixty-five who identified as belonging to a minority ethnic group such as Native Hawaiian/Pacific Islanders, Black/African American, Asian, Hispanic/Latin, or American Indian/Alaskan Native. These participants were recruited as part of a larger study on age-related microaggressions. Participants completed a survey that asked a series of questions about their personal experiences with age-related microaggressions. Qualitative analysis of the data revealed several common themes in participant responses, which include microaggressions related to technology, acts of intended benevolence, impatience, and having one's abilities underestimated. The majority of participants reported experiencing microaggressions at least 1-2 times per month and having negative emotional reactions to microaggressions. The results point to the need for further research on the topic of everyday ageism as experienced by individuals belonging to minority racial and ethnic populations.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61287

An Ultrasonic-Based Approach to Environment Mapping
Connor Best
Vincent Winstead

An effective approach to environment mapping through the use of low-cost sensors and a physics-based path generation system, along with a map generation tool that utilizes custom clustering algorithms.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61358

Antibiotic Resistance in the Common Human Gut Microbe *Eggerthella lenta*
Gionna Parsa
Cecilia Noecker

Eggerthella lenta is a microorganism commonly found in the guts of healthy people, especially in North America and Europe. These regions are also areas with high rates of antibiotic use and growing concerns about antibiotic resistance. Interestingly, *E. lenta* can occasionally cause sepsis and other infections outside the gut, with high mortality rates. Despite this infection risk, little is known about the distribution of antibiotic resistance genes in *E. lenta* across human demographics. The prevalence of different types of antibiotic resistance in this species and their association with geography, demographics, and recent antibiotic use may help us understand this organism's role in the gut. In this study, we are analyzing data from the 318 *E. lenta* genomes previously compiled by Dr. Noecker. This database includes genomes from publicly available human microbiome studies from 19 countries and new *E. lenta* strains and genome data from a cohort study of healthy human adults previously conducted in San Francisco. We are using a bioinformatic system known as CARD, The Comprehensive Antibiotic Resistance Database, to identify antibiotic resistance gene clusters in these genomes, finding many antibiotic gene clusters in different strains of *E. lenta*. The three drug classes that

correspond to the majority of antibiotic resistant gene clusters found in *E. lenta* strains include aminoglycoside (5% of genomes), glycopeptide (59.9% of genomes), and tetracycline (29.3% of genomes) antibiotics. We are preparing to test the antibiotic susceptibility and role of the most prevalent antibiotic resistance gene clusters in *E. lenta* strains in the laboratory. Overall, the results may help doctors understand the relationship between diseases, such as sepsis, and this microorganism. As antibiotic resistance is an emerging topic of concern, these results may help address the spread antibiotic resistance genes in individuals considering that the majority of healthy people carry *E. lenta.*

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61325

Are Retinal Opsins Sensitive Biomarkers of Thyroid Hormone Disruption?
Ainslee Hemmen, James Hawco
David Sharlin

Thyroid hormone is not only essential in regulating metabolic function, but also an important factor in the development of the nervous and sensory systems (Bernal 2005). For example, mice with hypothyroidism or inhibited thyroid hormone quantities have also shown signs of retarded developmental expression of retinal cone opsins; proteins that are light activated and underlie vision (Baumann, 2019). Moreover, alterations in opsin sensitivity have been reported in children born with a mutation in the gene for a thyroid hormone receptor (Weiss, 2012). Considering the importance of thyroid hormone in sensory (visual) system development, it is important to understand whether these developmental events can be influenced by environmental factors. Many human-made chemicals released into the environment may disrupt thyroid hormone dependent development and cause permanent neurological or sensory deficits. Concerningly, thyroid hormone disrupting chemicals (THDCs) have been reported to cause permeant visual damage in zebra fish (Baumann, 2019). However, limited work exists that investigates THDCs and opsins in mammalian models. Furthermore, most of the existing research only considers severe developmental hypothyroidism. Therefore, the sensitivity of developing systems to perturbations in thyroid hormone, as well as the degree to which circulating levels of thyroid hormone must be reduced to observe an adverse outcome, are largely unknown. **We hypothesize that retinal opsins may serve as a sensitive marker of thyroid disruption *in vivo.*** Understanding the threshold at which altered development takes place in association with low levels of thyroid hormone is still unknown.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/60337

Assembling and testing an atomic force microscope to examine carbonaceous meteoritic fragments.
Meklit Shiferaw
Analía Dall'Asén

Atomic force microscopy (AFM) is a technique that can be used to analyze several properties of a sample's surface (e.g., optical, topographical, mechanical, chemical, magnetic and electrical properties) through non-destructive and accurate measurements with very high resolution at the nano- and micro-scales. In this work, we assemble and test an educational AFM system with different AFM tips and appropriate samples with the final goal of characterizing fragments of carbonaceous chondritic meteorites by examining their topography and mechanical properties, such as adhesion and hardness. These properties allow us to investigate what structures are on the surfaces of the samples and how they have stuck together. Our findings can provide novel valuable evidence about how planets formed in our Solar System since carbonaceous chondritic meteorites are relics that date back to the origin of the planets. In addition, from a pedagogical point of view, this study was conceived as an undergraduate research project to expose students, in particular physics majors, to all the stages of an experimental scientific work.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61277

Assessment of Student Safety Concerns
Madeline Charbonneau, Mackenzie Rich, Alysha Kruger
Joseph Visker

 The purpose of this study is to assess students' safety concerns, awareness and use of safety resources, and safety-related education needs at MNSU. According to the Greater Mankato Inclusivity Study (ICEdge, 2023), when respondents were asked about their top safety concerns, the most frequent response was "safety of students at school and university settings" (p. 29) Approximately 22% of respondents selected Agree or Strongly agree in response to the statement "safety of students at school and university settings". To identify specific safety concerns of students, awareness and use of resources, and safety-related education needs, participants have been asked to complete a survey through Qualtrics or traditional paper/pencil. Analysis will include a combination of descriptive and inferential analyses. Data collection will conclude within the next week. Implications for health professionals will be discussed.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61388

Attitudes Toward the Influenza Vaccine
Maggie O'Connell
Joseph Visker

The purpose of this research is to assess Minnesota State University, Mankato students' attitudes/opinions about the Influenza Vaccine, Influenza, and the Student Health Services. Vaccination rates affect the percentage of students that develop influenza; because Mayo Clinic (2023) reviewed past studies and found that the flu vaccine lowers the risk of flu illness by 40% to 60% when the vaccine matches the spreading flu viruses. Assessing influencing factors on whether to receive the vaccine can help increase the percentage of students receiving the influenza vaccine. IBR was submitted, pending approval. The survey was developed from Sandler et al. (2019), Waghmare et al. (2021), and Zou et al (2023) and assessed previous vaccination status, influences on decision to receive the vaccine, attitudes and opinions toward influenza and the vaccine, and selected demographics. Professors from select courses will be contacted for permission to distribute the survey and the survey will be distributed to students via the use of Qualtrics(r). Data from the surveys will be entered in the statistical program SPSS®. Results are currently pending but will be shared at the Undergraduate Research Symposium.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61312

Bear Spray Characterization Device for the Development of a Re-Usable Training Unit
Tate Putman, Heidi Roeschli, Grace Klucas, Jack Lee
Jacob Swanson

Our team of student engineers is designing a durable testing apparatus to support the future development of a reusable bear spray trainer. This apparatus will measure the spray force exerted by both inert and live* bear spray canisters. Measurements of distance traveled by the fluid, the changes in force, and the distance as the canister empties will be recorded. The automated trigger mechanism will measure the trigger force necessary to discharge a bear spray canister and how this force evolves as the canister empties. The collected measurement data will undergo analysis and be presented as treated data and raw data sets to the client. These tests will shape the design of a refillable inert spray capable of replicating the force and spray profile of bear spray. The project will contribute value to the public by facilitating proper training on bear spray, ultimately enhancing safety for individuals in bear-inhabited areas.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61272

Bilingualism and Stuttering: A Link or a Misconception?
Kayla Polanco
Eric Strong

This literature review explores the relationship between bilingualism and stuttering as seen through research in past years to now. In a study conducted in 2016, it is found that 20% of speech-language pathologists (SLPs) inaccurately classify bilingualism as a risk factor for the onset and persistence of stuttering (Byrd, et. al., 2016). This literature review will focus on how a stutter manifests in monolingual versus bilingual children, why SLPs believe this misconception, and what can be done to provide better understanding and treatment for bilingual children who stutter. Current research has found that there is little training for SLPs to work with bilingual individuals. It has also been found that SLP comfort level with diagnosis of stuttering is very low in comparison to other diagnoses. This makes it difficult for children to be receiving the accurate diagnosis and care needed (Byrd & Johnson, 2020). It has also been found that many bilingual children are being administered tests with monolingual guidelines which is the leading cause for misdiagnosis. In reality, what has been found is that there are more disfluencies in bilingual children due to the navigation of two languages and not because they have a stutter (Gkalitsiou, et. al., 2017). In the future, the field of communication disorders should further the development of multilingual guidelines for diagnosis and create experiences for future SLPs to cultivate cultural awareness, cultural humility, and overall comfort working with multilingual individuals.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61291

Calmodulinopathy Disease Mutations and their Effect on Structure and Thermal Stability
Katelyn Walz
Rebecca Moen

Calmodulinopathies are life-threatening syndromes that affect various parts of the heart rhythm that occur when there's a genetic mutation in various genes that code for protein calmodulin. The protein involved in these diseases, calmodulin, is a calcium binding protein that interacts with many other proteins and serves as the major intracellular calcium regulator in eukaryotic species. My research project focuses on a genetic mutation that changes an aspartic acid amino acid residue in calmodulin to a glutamic acid (mutation D132E). This mutation is shown to cause the cardiac arrhythmias including Long QT Syndrome (LQTS) and Catecholaminergic polymorphic ventricular tachycardia (CPVT) in patients. Previous data has shown that this mutation has an effect on calcium binding affinity in calmodulin. Results of my research indicated that this mutation, both with and without calcium being present, affects the thermal stability and refolding capabilities of calmodulin, which could help explain at the molecular level why these disease mutations lead various different cardiac arrhythmias.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61286

Capitalizing on Engagement and Senses for Individuals with Dementia
Kaitlyn Sizer, Jasmine Ortuno Jimenez, Emily Rowbotham, Hailey Eibes, Corena Powell
Jeff Buchanan, H Sheen Chiou

The stigma against dementia persists while few dementia-friendly programs currently exist. Montessori-based activities are designed to offer active and meaningful engagement and provide socialization and enjoyment for individuals with dementia despite their cognitive deficits (Hindt, Morris, Sohre, & Buchanan, 2018; Jarrot, Gozali, & Gigliotti, 2008). Research participants in this study comprised of eight college students who completed specialized dementia-friends training. Student participants conducted two 30-minute activities with a small group of residents with dementia twice a week for ten weeks. This study aims to examine meaningful engagement by comparing two Montessori-based activities addressing verbal modality vs. multiple senses. Two Montessori activities, Memory Bingo and a Sensory Station have been created to facilitate among individuals with dementia. The Sensory station allows individuals with dementia to explore a variety of theme-based objects (e.g., flowers, pots, watering cans, etc.) along with a theme-based scent. This activity promotes individuals with dementia to engage with student volunteers while capitalizing on their five senses encouraging them to reminisce and engage in theme-based conversation without requiring demand on their

impaired short-term memory. Memory Bingo is similar to Bingo but replaces the numbers on the bingo cards with theme-based sounds that may be familiar to the individual. This activity allows individuals with dementia to recognize sounds and relate the corresponding sound to a memory they may potentially have. Qualitative and quantitative measures prior to and after completing the program will be conducted to measure student perceptions on ageism, dementia, and meaningful engagement. The expected outcome of this programming is for student volunteers to develop and facilitate purposeful engagement activities by maximizing the abilities of individuals with dementia.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/60620

Career Success in Students Majoring in Psychology
Megan Hagel, Carmel Gezahegne
Emily Stark

Majoring in psychology creates opportunities for students to develop certain skills that are beneficial in the workplace. This study explores if psychology majors can recognize and articulate the skills they have developed through their coursework when they are seeking a job. Regardless of these students having a broad set of skills that are acceptable for several positions, these students may experience challenges to secure a job if they can't apply their skills to different workplace scenarios. For the students who are psychology majors and go into the workforce, it's important for them to acquire and use knowledge, qualities, skills and abilities that will open a door to different job opportunities in today's competitive job market. (Landrum & Harrold, 2003) In this study we examined students who are currently psychology majors and had them complete an online survey that included self-ratings of specific skills related to a psychology major. We also examined their confidence level in these specific career skills along with their confidence in crafting a fit resume, preparing for job interviews and using resources to social network and find job openings. Understanding these skills and communicating their educational experiences is important for their future career. This research aims to measure psychology students' confidence in their skills and provides recommendations to help psychology departments enhance how well students understand and recognize their developing skills.

Changes in English Language Learning Strategies in US Education K-8.
Marielle Calanza, Linden Anthony
Elizabeth Sandell

Historically, monolingual America was the socially acceptable norm for school children in America. Multilingual education was frowned upon. As early as the 1900s, assimilation to the English language and American culture has been ingrained in the U.S. education system. Non-English-speaking students were most likely to be channeled into speech therapy and English as a Second Language (ESL). "This is America, we speak English here" was the welcoming slogan to newcomers. Since 2000, there has been a shift from monolingual conformity to multilingual celebration in educational programs. Dual-language programs, such as the Mandarin-English or Spanish-English, show advancement in cognitive skills for their students. This research project examined changes in cultural learning strategies in the U.S. education system K-8 grade. The investigator found common themes among one-on-one interviews with students and teachers. Results suggested a significant connection between the newer cultural learning strategies and growing diversity in American demographics. For example, education programs such as ESL were rebranded as English Language Learners (ELL). The results shed light on a centuries-long, derogatory system. Investigators comment on improvements to better diversity, equity, inclusion, intercultural competence, and multicultural awareness.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/60395

Changes to *Kryptolebias marmoratus* morphology and jumping behavior in transitioning from aquatic to terrestrial environments
Alison Crandell
Michael Minicozzi

Much is unknown about how organisms adapt when transitioning environments. In water, organisms are kept afloat by buoyancy while on land they must overcome gravity to move. Amphibious fishes are defined as fishes that voluntarily emerge onto land. They have evolved a stereotyped tail-flip-jump, where they curl their body into a C-shape and transfer force through the caudal peduncle to launch into ballistic flight. The goal of this project is to elucidate the physical changes that allow organisms to go from an aquatic to a terrestrial environment. Mangrove rivulus (*Kryptolebias marmoratus*) were used, as they exhibit the tail-flip-jump and can remain out of water for prolonged excursions. Three treatment groups were used: a terrestrially exercised group, an air exposed group, and a control that remained in water. Treatments were done every other day, 4 times total. The exercised group were placed in a 90 cm wide arena and prompted to jump by prodding anteriorly with a pipette tip for 3 minutes. The air exposed group were placed in small containers and covered with wet paper towels to immobilize the fish and prevent them from jumping for 3 minutes. Before and after the treatments, the fish were exercised for 3 minutes and recorded at 30 frames per second. Additionally, two jumps for each fish were filmed at 600 framer per second, and the longer jump was used for kinematic analysis. Dorsal and lateral pictures of the fish were taken before, after, and halfway through the experiment to determine mass distributions for each individual fish. We hypothesize that fish exercised on land will improve their jumping behavior because their muscle mass is shifted more posteriorly.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61200

Characterization of actin capping protein dynamics during metastatic epithelial cell propagation
Ephrata Bezuayene, Nitee Rai
Marilyn Hart

Cervical epithelial cells line the cervix, maintain structural integrity, and limit the passage of molecular and cellular substances into the cervix. Carcinogenic cervical epithelial cells lose structural integrity and proliferate indefinitely. Hela cells are an immortalized malignant line of cervix adenocarcinoma epithelial. Malignant cancer cells are characterized by their increased motility and capacity to pervade healthy tissues and generate metastatic colonies. Cell motility is primarily mediated by actin cytoskeleton reorganization. Changes in cellular propagation occur in tandem with actin polymerization and depolymerization. Actin subunit nucleation and filament elongation at free barbed ends are required for the polymerization of actin filaments. Nucleation factors add actin subunits to the slower-growing pointed ends and the faster-growing barbed ends of filaments, stabilizing small actin oligomers. Because subunits add and remove filaments at the barbed endpoints of actin filaments, these ends serve important roles in filament dynamics at cellular structures. Actin filament barbed ends are bound by heterodimeric capping protein (CP), which prevents further polymerization. Consequently, it is believed that CP plays a crucial part in facilitating net migration and leading-edge protrusion of cells. Lamellipodial actin filament development is speculated to be inhibited by CP activity, resulting in short, stiff filaments that can effectively push the membrane forward. I hypothesize that actin caping protein activity would be directly proportional to actin filament reorganization during the initial stages of propagation. The concentrations of primary antibodies (3F2 (CP label), β-catenin (adherens junction label), and secondary antibodies (donkey anti-mouse IgG and donkey anti-rabbit IgG, phalloidin (actin label) were experimentally optimized by preliminary studies. Variables linked to cell fluorescence labeling, particularly incubation time, blocking agent, and mounting medium, were also experimentally determined. Qualitative data will be presented.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61372

Characterizing Carbonaceous Meteorites with Fourier-Transform Infrared Spectroscopy.
Colby Hastings
Analía Dall'Asén

Meteorites can help to answer the major question of how planets formed. In particular, carbonaceous chondritic meteorites are considered some of the most primitive surviving materials of our solar system and are accessible on Earth. These relics are composed of ancient inclusions and their surrounding matrix that can provide important information about the processes (condensation, shock, etc.) and conditions (thermal, barometric, etc.) of the formation of their parent bodies (asteroids and comets) and the planets in our solar system. This information can be obtained through the physical properties of these meteorites which can be studied using different characterization techniques, such as microscopy and spectroscopy. In particular, Fourier transform infrared (FTIR) spectroscopy in attenuated total reflectance (ATR) mode is a technique that has been used to study meteorites since it is a powerful tool for the analysis of the local structure (e.g., carbon, silicon, oxygen and hydrogen bonds). In this work, we use ATR-FTIR spectroscopy to analyze the molecular structure of several carbonaceous meteoritic fragments: Aguas Zarcas, Allende, Moss, Murray, Nogoyá, NWA 3118, and NWA 6603. We compare these results among these samples and correlate them with the findings obtained using other characterization techniques.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61281

College Outcomes for Commuter and Residential Students at MNSU
Michelle Aouga
Felix Pambuccian

The goal of this research is to assess aspects of the college experience such as involvement in activities/organizations, sense of belonging, and academic success in commuter and residential student populations at MNSU. We aim to compare the two populations to assess similarities and differences between commuter and residential students. Responses will be assessed via t-tests or ANOVA and qualitative analysis.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/60935

College Students Attitudes about Vaping
Maggie O'Connell, Madeline Charbonneau, Mackenzie Rich, Alysha Kruger, Cait Jacobson, Zoe Lomenda, Ava Novcaek
Wendy Schuh

The goal of this survey is to understand what college students think about vaping and to understand how vaping affects them. Students apart of Eta Sigma Gamma, a national health honorary society, administered IRB approved qualitative research through informal structured interviews. There were 54 students interviewed. Descriptive data is being analyzed. Qualitative themes are being identified and will be shared. Specific quotes will be taken from interviews.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/60752

Comparative Analysis of Machine Learning Models for Sentiment Analysis on Amazon Reviews
Tinsay Gebremariam, Collin Dahlback, Boubacary Bocoum, Tucker MacCallum
Rushit Dave

This research investigates the comparative performance of various machine learning models for sentiment analysis on Amazon product reviews. Sentiment analysis, the process of extracting opinions and attitudes from text, plays a crucial role in understanding customer perception. By leveraging Natural Language Processing (NLP) techniques, sentiment analysis helps businesses improve products and target advertising effectively. This research delves into the methodology of sentiment analysis using machine learning, comparing and evaluating

different models to understand their strengths and weaknesses. Additionally, the research explores the limitations associated with sentiment analysis with those different models, paving the way for future exploration in this domain.

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Comparative metagenomic analysis of primate gut microbes.
David Okanta
Cecilia Noecker

The gut microbiota, consisting of trillions of microbes, plays a crucial role in health and disease among different host species including humans and other primates. For example, different strains and close relatives of the bacterium *Eggerthella lenta* differ in metabolic pathways that can impact health. However, it is unclear how traits of *E.lenta* and its relatives in the family *Eggerthellaceae* are distributed in their host species or how they have evolved, since metagenomic sequencing is often not effective in capturing this low-abundance species. To address this problem, we are using public whole genome and metagenome datasets from NCBI together to identify the presence and characteristics of these microbes. We are gathering public data from primates including gorillas, chimpanzees, and humans. We are using the KBase platform to compare and analyze the genome sequences of *E.lenta* (found in humans) with its relatives in other host species. Specifically, we will perform evolutionary phylogenetic analysis of the relationships between these genomes and compare their metabolic traits with host species diet. This resource will help us understand what differences exist between *Eggerthellaceae* in these host organisms and whether they are due to diet and evolution.

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Continuous User Authentication Using Touch Dynamics
Akrem Ahmed
Rushit Dave

As the world increasingly relies on the internet for exchanging and storing sensitive data, the demand for a highly secure system becomes paramount. Traditional authentication methods, like PINs and passwords, are insufficient due to susceptibility to breaches and difficult usability. In response, there's a rising interest in biometrics, specifically in touch dynamics, as a means of continuous user authentication, especially for mobile and computer devices. This approach is interesting because it encapsulates both user-friendliness while also ensuring strong security. It actively monitors various aspects of how the user interacts with the device, such as their typing patterns, swiping gestures, or touch pressure. By analyzing this diverse range of actions, the system builds a fairly accurate profile of the user's unique patterns. For example, when a person swipes around their phone, the system considers multiple factors like touch coordinates, duration of the swipes, and touch pressures. By evaluating these broad user's behavior, the system is able to create an authentic profile. The system then uses this profile to verify the user's identity over time.
Essentially, this system does not rely on one source of data for verification but rather stores a wide spectrum of features and uses those behaviors to make the authentication process efficient.

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Contrasting Oak Responses to Water Stress - Osmolyte Profiling Across Species
Aryee McCabe
Matthew Kaproth

Water represents an essential environmental factor, as it impacts plant growth, development, and structure. Drought stress induces plant acclimation to avoid tissue loss or death. Plants must adjust their physiology in response to low water conditions. One way plants acclimate to drought is by synthesizing or storing more

osmolyte such as sugars, sugar-alcohols, or proline. Osmolytes are known to increase drought tolerance in plants by increasing the uptake of water by plant tissues. Oak species are well-adapted to a range of dry and well-watered environments. The objective of our research is to investigate the amount of osmolytes, specifically proline, produced by various oaks species using a common garden. This research is important because it gives us a greater understanding of how oaks and plants acclimate and are adapted to drought stress. Ultimately, this will be useful as climate change and water scarcity become more of an issue. We found that proline accounted for less than 0.05% of the total osmolyte concentration for leaf tissue. (In relative amounts, some species produce 100 times more proline than others.) The reason for this low concentration is that oaks synthesize other osmolytes and use proline in other functions (e.g., as an antioxidant). Our results motivated us to gain a greater understanding of how oaks naturally respond to drought. To serve this end, a future direction would be to research if osmolytes are dependent on soil factors (topsoil pH and organic content) that may influence nutrient availability. For example, studying the native environmental conditions of each oak will give us a greater understanding of the natural drought strategies of these oaks.

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Cooperative Networks between MYC and XPO1 Associated with Decreased T-Cell Presence and a Depleted Tumor Microenvironment May be Addressed By the Synergistic Combination of AZD4573 and Selinexor
Aidan Forberg
Keenan Hartert

Background: Genomically-targeted Diffuse Large B-cell (DLBCL) treatments for refractory or relapsing patients remain a clinical need alongside the growing success of Chimeric Antigen T-cells (CAR-T), which have ushered in durable responses in 40-70% of patients. However, recent studies have identified factors indicative of an inferior CAR-T response. Recent tumor Ecotype studies from Kotlov and Steen reveal that a Depleted or Cold tumor microenvironment (TME) is associated with poor CAR-T response. Notable features of these environments include a decreased presence of native T-cells alongside oncogenic alterations associated with their exhaustion, namely MYC and XPO1. Few precision treatments exist given the difficulty targeting MYC, but two avenues have shown recent success: inhibition of the downstream oncogene CDK9 via AZD4573 and upstream inhibition of a MYC propagator, the nuclear exportin XPO1 via Selinexor. Herein, we report the first observations of synergy between AZD4573 and Selinexor within DLBCL cell lines and data supporting that these genes may serve as accessible markers for inferior tumor immune microenvironments.
Methods: We combined progression vs. response results from four previous CAR-T genomics studies, noting MYC status (Jaeger 2020, Jain 2021, Sworder
2021, and Shouval 2022). We next analyzed a 418-patient de-novo DLBCL patient cohort (Xu-Monette 2020) and 48-patient TCGA cohort after GEDIT immune deconvolution for differential expression and component enrichment between patients expressing high levels of MYC and XPO1 (+1 Standard Deviation) compared to normal counterparts. Significantly expressed genes were evaluated via gene set enrichment analyses. We next assayed AZD4573 and Selinexor vs. 7 DLBCL cell lines, 5 of which harbor MYC alterations, across a series of 9 concentrations (78nM-20μM) across 3-9 replicates. We followed these results by combining treatments in the *MYC*-altered Ly3, DHL6, and DHL4 cell lines, analyzing results using the BLISS synergy model.
Results: Integrative analyses support that MYC alterations are associated with significantly reduced CAR-T outcomes. Of the 93 MYC-altered patients within the total 246-patient cohort, 65.59% of them experienced progression during CAR-T treatment compared to just 50.33% of WT CAR-T patients ($p = 0.0242$). Differential gene expression analyses between de-novo patients expressing high MYC or XPO1 revealed losses in Cytokine Signaling pathways (FDR = 6.96E-18) and gains in Cell Cycle modulators (FDR = 2.525E-20). Importantly, CD8A expression was significantly lower in these patients (FDR
Conclusions: Our results support that the cooperation between MYC and XPO1 is associated with T-cell reductions characteristic of a Depleted or Cold TME, a key issue for CAR-T success. We applied the targeted therapies AZD4573 and Selinexor vs. cell line models to address this pathway, with both displaying anti-tumor effects as single agents. Most importantly, we observed synergistic activity in the MYC-harboring Ly3 and DHL6 cell lines, and in the WT DHL4 cell line when these molecules were combined. These results are supported by integrative analyses that highlight the importance of targeting aberrant MYC signaling via CDK9 and XPO1 inhibition, revealing a potential avenue to address inferior response rates faced by patients harboring MYC-positive, Depleted tumor microenvironments that would otherwise face an inferior CAR-T prognosis.

Cultural Learning Strategies in Elementary Education: A Comparative Study of Practices in the United States and Ecuador
Damaris De La Torre
Elizabeth Sandell

The intersection of culture and education in elementary classrooms is a pressing concern for teachers, parents, and policymakers. The need is driven by evolving demographics and the need for culturally responsive teaching practices. This study investigated how schoolteachers in these two diverse countries incorporate cultural learning strategies to respond to unique student populations. The problem statement underscored the necessity of addressing cultural diversity in educational settings to provide equitable and effective learning experiences for all students. As demographics shift, understanding pedagogical responses to cultural diversity is imperative. The significance of this research extends beyond the classroom. In today's multicultural world, educating students from diverse backgrounds is crucial for our society. Incorporating cultural learning strategies carries profound implications for social inclusivity, peace, heritage preservation, and more. The study's potential to inform policies, curriculum, and teacher training programs emphasizes its broader societal impact. Methodologically, this research interviewed Elementary School teachers from the United States and Ecuador to investigate unique culturally responsive teaching and cultural learning strategies in both countries. The predicted result was that educators in Ecuador will exhibit teaching strategies focusing on the nation's internal cultural diversity, while US educators will adopt strategies influenced by the international and multicultural nature of their student body. These insights will foster more inclusive and culturally aware teaching practices, benefiting students and society. This project's implication is clear: it has the potential to transform how we approach multicultural education. By comparing practices in these two diverse nations, we can adapt and refine strategies to better suit today's students and the future of our society. This research is a step towards a more inclusive, harmonious, and culturally enriched world.

Cultural Learning Strategies in Ethiopia and the United States Experienced by International Students at a Mid-size Midwestern University
Yodahe Kebede
Elizabeth Sandell

Cultural learning strategies refer to the methods and processes by which individuals acquire knowledge, skills, beliefs, and behaviors that are specific to a particular culture or social group. This research responded to an interest in how cultural learning strategies in Ethiopia compare to those in the United States. Ethiopian students experience cognitive dissonance, because their previous educational experiences were so different from the United States. This research will provide suggestions for current and future Ethiopians who are adapting to college in the United States. The university's international faculty interviewed current students from Ethiopia who were studying computer sciences. Open-ended interview questions will generate understandings of differences in cultural learning and how university students overcame those challenges. The outcomes of this project will guide educational policies, curricula for international student orientation, and faculty professional development.

Cyber Bullying Detection using machine learning.
Rikin Shrestha
Rushit Dave

Internet use, particularly digital/social media and video games is growing daily. Everyone is becoming dependent on them from all ages and with many positive aspects, there are drawbacks as well, one of which is cyberbullying. Cyberbullying has effects on victims mentally, emotionally and physically. It includes low self-

esteem, acting violently, despair, increased stress/anxiety, depression, self-harming/suicide, etc. Findings from this research study justify that it affects young people more which impacts their emotional development and overall safety. Real-time cyberbullying detection identifies and protects the target from further abuse and its effects. This study aids in determining the seriousness of the issue, and vulnerabilities that individuals can take advantage of to bully others. Additionally, understanding how various features for cyberbullying detection function assists in developing a strong and trustworthy system, making a healthy online community. Natural Language Processing (NLP) models assess the textual content, analyzing hashtags, and analyzing comments. Similarly, context in photographs is analyzed using Optical Character Recognition (OCR), which converts them into a machine-readable format for further examination. Deep Neural Network models, such as Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), and Bidirectional LSTM (BLSTM). CNN is utilized for text/picture classification, LSTM is utilized for long-term dependency learning, and BLSTM expands the network's input by encoding data in both forward and backward directions. Classifiers like Support Vector Machine (SVM) and Naïve Bayes help in the detection of cyberbullying. A working cyberbullying detection system can detect cyberbullying on multiple platforms. With models being developed for different attributes providing results with high accuracy, the cyberbullying detection system contributes by leading us to a healthier online community.

Deciphering APOBEC3 Protein Regulation: Exploring miRNA-Mediated Downregulation for Cancer Mutagenesis Control
Jake Lohn
Allison Land

The APOBEC3 family of proteins are an essential part of our immune systems, which aid in defending against viruses. The proteins accomplish this by deaminating cytosine (C) to produce uracil (U) in viral DNA, thereby inducing a multitude of damaging mutations. However, APOBEC proteins also have the potential to mutate our DNA when unregulated. These APOBEC-induced mutations are so frequent that they are now considered one of the major drivers of mutation in cancer. While there are some potential solutions for dealing with these proteins, none are currently in use. As such, our research focuses on combating ABOBEC proteins by downregulating their production through the use of miRNAs. To achieve our goal more effectively, we used multiple miRNA-producing genes in this study from erroneously produced plasmids made previously in the lab that have been repaired to a functional state. By using a wide variety of promising genes, we aim to find commonalities between the produced miRNAs based on their interactions with APOBEC protein production to provide further insight into a potentially viable regulator. By identifying one, or even multiple, regulatory miRNAs, the mutagenicity of varying cancers can be drastically reduced, which can help make cancer treatments more effective.

Differences in hearing screening results using steady, pulsed, and warbled pure-tones in a quiet and noisy environment
Hedaya Abdulgefar, Jordan Ausen, Sophia Lee
Kristi Oeding

Hearing screenings are commonly conducted in schools each year to determine if a child has a temporary hearing loss due to an ear infection or a permanent hearing loss that could impact the child's learning long-term. We have encountered many different ways to test a child's hearing. Some schools prefer a steady pure-tone that just sounds like a continuous beep sound. Some schools have requested a pulsed beep which sounds like "beep beep beep", while others have wanted a warbled and pulsed pure-tone, which sounds like a ghost saying "*beep beep beep*". In addition to using different pure-tones, some schools have more background noise than others, making our ability to test a child's hearing challenging. Some schools have been adamant that we only use one type of pure-tone as this could impact the results of the hearing screening. However, there is no evidence proving that this concern is true. The purpose of this research study is to determine which pure-tone for testing hearing is the best for listening in a quiet and in a noisy environment.

Diverse Perspectives on Disability: Exploring Cultural Perceptions, Stigmas, and Barriers Affecting College Students with Disabilities
Emily Dittrich
Jess Schomberg

Disabilities, both visible and invisible, can pose significant barriers for college students that can impact their success at school. At Minnesota State University, Mankato several of the resources available to students with disabilities do not collect or track relevant data about the participants of their programs such as race, gender identity, other LGBT affiliations, or differentiate domestic from international students. Without these statistics it is impossible to know how students' intersectionality may be impacting their use of resources, and potentially allowing various identity groups to be underserved by these integral resources. I created a survey using google forms that was open for submissions for a month. It emphasized four on-campus resources that serve students with disabilities. Question topics included demographic data, basic knowledge of available resources, respondents' disability status, what resources respondents have used, what barriers have prevented use of resources, and the dispositions regarding disabilities students experienced in their family home, community, culture, and friend groups. All survey submissions were anonymous and voluntary, and included the opportunity to win a prize for survey completion. Methods for collecting responses included: emailing links to students, in-person tabling, appearing in several newsletters, and The Reporter, posters featuring a QR code were placed across campus, promotions at Student Government Senate meetings, on Student Events Team's social media and during their events.

Documenting the diversity and physical features of moss species collected from Rasmussen Woods in Mankato, MN.
Jenna Eklund
Matthew Kaproth

This research project provides a comprehensive documentation, identification, and description of mosses (Bryophyta) within Rasmussen Woods, a local woodland ecosystem, with the goal of compiling a monograph. Mosses, fundamental to terrestrial ecosystems, play critical roles in soil stabilization, nutrient cycling, and microhabitat creation. Despite their ecological significance, thorough studies on local moss flora are often lacking. Over 30 moss specimens were collected from various microhabitats, including fallen logs, rock faces, soil surfaces, and others. These specimens underwent meticulous morphological examination using microscopy and taxonomic keys for identification in the laboratory. Species descriptions, detailing morphological characteristics and habitat preferences, were compiled to create a valuable monograph resource. Furthermore, a subset of specimens were preserved in the campus herbarium, archiving the scientific resources for future plant biology research. This study enhances understanding and appreciation of local moss biodiversity, supporting conservation efforts and serving as a reference for scientists, conservationists, and educators.

Domestic partnership: A comparative systematic review
Emily Hodge
Dan Moen

This comparative systematic review investigated domestic partnership policies across the United States. The aim of this study was to advocate for awareness into domestic partnership laws in Minnesota, and other states across the U.S. Historical perspectives and recent trends are discussed with a functional comparison across

states. Peer-reviewed journal articles and government documents were sourced. Suggestions for future studies and advocacy efforts are provided.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61166

Early Detection of Type 2 Diabetes using Machine Learning Classification Models
Xiao Fang, Nafissatou Bahadio
Deepak Sanjel

Early detection of diabetes is essential to prevent serious complications in patients. In this study we will use Machine Learning Classification models to identify type 2 diabetic patients based on the known explanatory variables such as age, weight, blood pressure, diabetes in the family. Methods such as Logistic Regression (LR), Decision Tree (DT), Linear discriminant analysis (LDA), Quadratic discriminant analysis (QDA) and support vector machine (SVM) are used and accuracy of the methods are calculated for comparisons.
 A case study analysis is performed on Diabetes database of 10,000 people which is sourced from UCI machine learning repository.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61186

Effect of Forskolin on Vitamin A Synthesis in Brown Adipose Tissue
Allison Alshouse
Charles Krois

Brown adipose tissue (BAT) is found in mammals to specifically maintain body temperature through thermogenesis. When body temperature lowers, a cascade of enzymes including the adrenergic receptor, adenylyl cyclase (AC) and protein kinase A (PKA) are activated. This cascade in turn increases UCP1 proteins found in BAT to increase body temperature. UCP1 expression is also regulated by all-trans-retinoic acid (atRA), which signals through retinoic acid receptors (RAR), creating binding interactions with retinoic acid response elements (RARE). Given their shared role in regulating UCP1, we hypothesize that activation of the adrenergic receptor also leads to increased atRA via increasing expression of the retinol and retinal dehydrogenases that make atRA. Previous experiments showed that isoproterenol, which activates the adrenergic receptor, and 3-isobutyl-1-methylxanthine, which prevents cAMP degradation, increase expression of retinol dehydrogenase 10 levels while decreasing levels of retinaldehyde dehydrogenase 1. Both treatments increased UCP1 levels, as expected. To further investigate the adrenergic pathway, we have treated cells with forskolin, an activator of adenylyl cyclase, the protein that makes cAMP. Treatments will be analyzed using western blots to determine the relative protein amounts of *Dhrs9* and *Raldh1.* We expect protein levels of *Dhrs9* and *Raldh1* to decrease when compared to the total proteins quantified in the control sample, providing additional evidence that retinoic acid is an important regulator of the metabolism of fatty acids and non-shivering thermogenesis in brown adipose tissue.

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Effects of BPA on Planarian regeneration
Eli Koboski
Michael Minicozzi and Bhushan Dharmadhikari

Bisphenol-A (BPA) is an Endocrine Disrupting Chemical (EDC) that can be found in many aquatic environments as a result of pollution stemming from the manufacturing of plastics and resins. Planarians, such as *Dugesia dorotocephela*, are a commonly used model organism due to their regenerative capabilities. The aim of this study was to see if planarian regeneration is negatively affected by environmentally relevant concentration of BPA. To do this, 30 worms were cut pre and post pharyngeally and corresponding head and tail fragments were placed into one of three treatments, control (0µM), 1µM, or 10µM BPA. Each fragment was photographed using a Leica stereoscope every day for 14 days. To quantify regeneration, the images were

used to measure the growth of new tissues (area of the blastema) and the total area of the fragment using Image J. A ratio was created to of the new tissue over the total tissue and assessed over the 14 days. We found that regeneration in the 10µM treatment showed no sign of regeneration, while worms in 1µM showed inhibited regeneration when compared to the control. We also saw higher rates of mortality in the 10µM and deformities in the 1µM treatments. As a follow-up, we would like to investigate possible methods of bioremediation of BPA that is effective and safe for the worms.

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Effects of Perchlorate on Behavior and Stress Levels in Mice
Carly Abelson
Michael Minicozzi

Perchlorate is a common pollutant found in explosives, fireworks, road flares, and rockets which can easily get into and stay for long periods of time in surface and ground water. Nearly all humans of industrialized countries are exposed to this chemical. This chemical inhibits the body's ability to make thyroid hormone which could lead to deficient levels; insignificant amount of thyroid hormone can lead to hyperthyroidism. Hyperthyroidism is associated with developmental, behavioral, and metabolic abnormalities. In my research, I aimed to study the effect perchlorate has on behavior and stress levels of mice on an elevated plus-maze. This maze has two arms enclosed by walls and two open tracks. Mice were contained in a room with constant day and night cycles with light. Within a 50-day cycle, every five days the water consumed was measured and recorded. Perchlorate was administered via drinking water by adding 100 parts per million of perchlorate to test subjects and zero parts per million to the control. At the end of the trial cycle, the mice were moved to the recording room which included the maze and a camera set-up above. Each subject was given a 30 minute acclimation period then picked up by the tail and placed in the middle of the maze. After the researcher exited the room, the mouse was given ten minutes to explore without external stimuli. These recordings were put into EthoVision to collect data for the time spent in each arm, how far they traveled in the open arms as well as the latency to the open arms. I expect the perchlorate mice to have higher stress levels by spending more time in the enclosed arms.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61280

Enhancing CNN Models for Facial Recognition
Aaron Bottner
Rushit Dave

From phones to smart doorbells, facial recognition has become ubiquitous in certain areas of technology. However, the software powering these technologies lags in sophistication behind the technology itself. Many potential applications of facial recognition are in their infancy. Many more have yet to be pursued by either research or industry. These applications, if well developed, can potentially lead to a smoother end user experience. They have the potential to save the consumer time and frustration when compared with devices that rely on traditional password security models. This project documents how facial recognition can be used to implement better security practices in fields like unmanned delivery, home security notification system and file organization systems.

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Evaluating Not Interaction with Glypican-3 in Hepatocellular carcinoma
Megan Tobias, Kendall Young
Samantha Katner

Hepatocellular carcinoma (HCC) is the third most common cause of cancer related death. Typically, HCC arises in patients having a previous liver condition such as cirrhosis or inflammation. There are few treatment options that exist for HCC but they are only curative if the HCC diagnosis occurs in the early stages. Therefore, current

therapy explorations involve identifying molecular targets for a personalized medicine approach. Uniquely, Glypican-3 is only overexpressed HCC tumor cells making it an attractive target for potential therapies. Glypican-3 on the surface of the cells has been known to play a role in growth factor signaling to aid in tumor progression. Like glypican-3, notum is overexpressed in HCC cells and minimally expressed in normal healthy tissues. Here, we investigate notum interaction with glypican-3 using an ELISA assay by comparing CRISPR-edited notum knockout HCC cells with wild-type HCC cells. We propose further exploration on notum and glypican-3 relationship for developing HCC-targeted therapy approaches.

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Evaluating the effectiveness of a brochure on hearing accessible venues in the Mankato area
Alexis Kubesh
Kristi Oeding

Hearing loss can have a significant impact on a person's quality of life. Research has reported an increase in social isolation and depression for person's that have hearing loss. One way to decrease social isolation is to make people with hearing loss aware of hearing accessible places in the community. A clinic in another state had previously created a brochure that listed local venues that had hearing accommodations such as assistive listening devices and captioning. This project sought to use this model to create a similar resource that can be provided to the community and other clinics to share with persons with hearing loss. A previous study collected information on accessible venues in the Mankato area. The goal of this project was to make a brochure and evaluate its ease of use and helpfulness in raising awareness of the hearing options available to improve and encourage participation in social activities. Future goals are to encourage more venues to consider adding hearing accessibility options.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61351

Evaluating the effects of perennial cover crops on the soil chemical properties in a wide row corn production system in southern Minnesota
Rachel Fischer
Mriganka De

Cover crop integration has been proposed to eliminate the extended periods of bare soil in intensive corn (*Zea mays*) production systems and can help reduce the degradation of soil health by decreasing erosion and surface runoff and helping reduce the loss of nutrients. Annual cover crops must be replanted every year in the fall and then killed in the spring to allow land preparation for planting the cash crop (e.g., corn), thus leading to high management costs due to labor and materials. However, perennial cover crops (PCCs) have the potential to increase continuous soil surface cover without needing to be replanted or terminated each year, thus requiring minimal management. There is a lack of research on the effects of PCCs on soil chemical properties. Hence, this study investigated the impacts of PCCs on the soil chemical health indicators in a wide-row (i.e., 60" rows) corn production system in southern Minnesota. The experimental site is a randomized complete block design with four different treatments (three PCCs + one control): i) a control with no PCCs, ii) grass + corn, iii) legume + corn, and iv) grass-legume mix + corn. Each plot has four replications, totaling 16 plots. Soil samples were collected in the spring and fall of 2023 and analyzed after collecting them from 0 to 6" (0-15 cm) depth. Here we present the effect of PCCs on several soil chemical health indicators – potentially mineralizable nitrogen (PMN), inorganic nitrogen content, soil organic matter content (SOM), pH, and the soil macro- and micro-nutrients – and how these indicators vary with time (Spring vs Fall). Analysis of PMN and inorganic nitrogen content is still in progress. Only boron has shown significant differences between the different PCC treatments among all the micro and macro-nutrients. Based on these results we can conclude that PCCs cause very minimal or no short-term changes to the SOM, pH, macro and micronutrient contents of the soil in all the PCC + corn treatments compared to the control treatment and did not support our hypothesis. Patience is needed to observe changes in soil chemical health, even in response to a drastic management change like integration of PCCs to a wide-row corn production system.

Examining the relationship between athletic participation and academic success in athletes and non-athletes
Ashley Cridlebaugh
Joe Wohkittel

The purpose of this study is to examine the relationship between sports participation and academic success among athletes and non-athletes. Participants will be collected through a convenience sample. Results will help clarify the relationship between the variables sports participation and academic success among athletes and non-athletes.In the year 2022, over 500,000 students were members of the NCAA (Statista, 2023). This doesn't include the athletes apart of NAIA, Junior College, or intermural and club athletics.
Regarding the effect of sports participation on college students, the results are mixed. For boys who participated in rowing, their Leaving Certificate Score appeared to be higher than non-sport members. However, boys who participated in rugby and soccer showed no significant difference in their Leaving Score Certificate compared to non-sport members (Bradly et al., 2012). Another study conducted by Maloney & McCormick (1993), further confirms how athletics negatively affects academic performance at the college level. However, there were studies conducted that did show academic improvement for student-athletes at the college level. A study conducted by Deere et alt., concluded that students who participated in a club or intermural sport reported a higher grade point average than students who didn't participate in a club or intermural sport. Overall, the data appears to be inconclusive in determining if sports participation affects academic success. For this study, an online survey through Qualtrics will be conducted to examine the relationship between athletic participation and academic success. The Subjective Academic Achievement Scale will be used to assess the correlation level between academic success and athletic participation among college students. Additionally, factors outside of sports participation that can affect academic success will be discussed. This topic was previously explored in a classroom project. Results indicated that athletes performed better academically than non-athletes. However, the sample size was insufficient to draw definitive conclusions. I predict that a larger sample size will yield both statistically significant and meaningful results.

Examining the role of heparan sulfate modifying enzymes in hepatocellular carcinoma
Maija Carriveau
Samantha Katner

Hepatocellular carcinoma (HCC) obtains the third highest cancer-related mortality rate in the world particularly due its high level of metastasis. HCC accounts for 80 percent of all liver cancer cases and is difficult to treat as it does not respond to chemotherapy drugs. A recent discovery in HCC structure is the overabundance of glypican-3 (GPC3) on the surface of the cell compared to that of healthy liver cells. GPC3 belongs to the heparan sulfate proteoglycan family as it consists of heparan sulfate chains that come off the core protein. The heparan sulfate chains can be cleaved by an enzyme, heparanase (HPSE) that is known to promote the progression of several cancer types. This cleavage degrades the heparan sulfate chains which causes the release of growth factors that can induce proliferation, angiogenesis, and invasion. Here, we utilized CRISPR technology to create a functional HPSE knock out HCC cell line for comparison to the wild-type cell line. We measured the effects of HPSE cleavage of heparan sulfate chains using an ELISA assay. This comparison data allows us to better understand the role heparan sulfate modifying enzymes perform in HCC progression.

Examining Undergraduate Students' Perceptions of School Resource Officers
Haley Schaefer
Chip Panahon

The implementation of school resource officers (SROs) has become increasingly prevalent in response to growing concerns regarding school safety, particularly in the wake of tragic events such as mass school shootings. SROs are sworn law enforcement officers assigned to work in schools (Theriot, 2009). The implementation of school resource officers has sparked controversy, particularly following the resurgence of the Black Lives Matter Movement. Thus, it is important to examine stakeholders' perceptions of these officers. The objective of this study is to examine undergraduate students' perceptions of SROs. Specifically, the perspectives of students majoring in criminal justice or law enforcement and education will be sought. In addition, students enrolled in psychology courses will be invited to participate to provide a more comprehensive perspective. An online survey consisting of four sections will be distributed to students. These sections consist of demographics, perceptions of school climate and safety, perceptions of SROs, and interactions with SROs. With the primary focus on the participants' high school experiences, the survey aims to gather insight into the perceived influence of SROs on school climate and safety. Given the growing controversy surrounding the employment of SROs, gathering student perceptions of these officers may be vital in more ways than one. The differing majors and interests among participants may provide a range of diverse viewpoints. In addition, these findings may enlighten school administrators and law enforcement officials on effectively utilizing SROs to cultivate a positive school environment and promote school safety.

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Explorations of the Sun in the Radio Spectrum
Jeremy Derhaag, Lucas Rohl
Michael Rutkowski

Observing the Sun in the radio spectrum allows for a unique perspective of the workings of the sun that cannot be obtained in the visual light spectrum. Using the radio spectrum, we can get a better sense of the suns magnetic field outputs as it moves into its cyclical maxima output. This also allows us to see the effect that sun spots have on the suns magnetic output.

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Exploring Communication Behaviors of a Resident with Dementia using Montessori-Based Activities
Alison Brunmeier, Zoe Porter, Alyssa Bartholow, Morgan Ellis
Jeff Buchanan and H Sheen Chiou

The purpose of the study was to explore how implementation of a Montessori-based group activity promotes more active engagement for individuals with dementia. The study explored activity implementation with a progressive complexity influencing engagement amongst individuals with dementia. Activity modification includes simplifying task demands (downward) and challenging cognitive and motor skills (upward) (Jarrott, Gozali, & Gigliotti., 2008). This treasure hunt activity required an individual with dementia to use their senses of vision, hearing, touch, and verbal skills along with motor movements to help identify objects in the themed tray. The goal of this activity is to stimulate long-term memories and discussion to enforce a meaningful engagement. Individuals with dementia were invited to participate, prompted to engage, identify different objects in the bin and share their thoughts. Pre-set questions were developed to support conversation based on the individuals' abilities and their intact senses. For example, "this looks like a spoon to me. Let's look at this together" for the downward version. "What would you like to say about this? What does this remind you of?" for the upward version. The research participants were eight college students who completed dementia-friends training and were mentored by a faculty member who specialized in dementia. Research participants conducted the activity with a small group of residents with dementia twice a week for ten weeks. Each participant interacted one on one with an individual with dementia on the activity and engaged in a personal conversation. Research participants followed a protocol to identify the preferred complexity version (upward/downward) based on engagement level and conduct the activity with modifications as needed for

individuals with dementia. Data will be obtained with a five-point rating scale on targeted communication engagement. Specific measures will be used to document their perception of ageism, dementia, and engagement of individuals with dementia. The expected outcome is for college students to create appropriate meaningful engagement activities by capitalizing on the abilities of individuals with dementia.

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Exploring Professional Development as a Barrier to Teaching STEM in an Elementary Classroom.
Malorie Wyman
Patricia Arnold

With increasing needs in STEM (Science, Technology, Engineering, and Mathematics) education, there is more need for effective professional development opportunities for elementary school teachers in STEM subjects. The research project sheds light on a significant gap; many teachers lack access to relevant and ongoing professional development opportunities in STEM. As a result, teachers express reduced confidence in their ability to effectively teach STEM concepts and employ innovative teaching strategies. The limited availability of professional development for elementary school teachers serves as a substantial barrier to hands-on and inquiry-based STEM instruction. This research underscores the critical need for increased investment in targeted professional development programs, enabling educators to enhance their STEM teaching skills and cultivate a generation of STEM-literate students.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/62225

Exploring Teacher Efficacy as a Barrier to Teaching STEM in the Elementary Classroom
Ari Nguyen, Amber Murphy
Patricia Arnold

Over the years, the importance of STEM (Science, Technology, Engineering, and Mathematics) education for children at an early age has been evident. Teacher efficacy, often defined as teachers' belief in their ability to positively impact student learning outcomes, is a significant factor in determining the quality of STEM education in elementary schools. This study explores the impact of teacher efficacy on STEM education in elementary schools. Through critical analysis of recent research, we find that teachers' confidence, growth mindset, resource access, and societal perceptions significantly affect their ability to effectively teach STEM subjects. Inadequate confidence and resources hinder STEM instruction. Fostering growth mindsets and combating biases can enhance the effectiveness of STEM instruction. Recommendations include targeted professional development, resource allocation, and efforts to promote diversity in classrooms to break down this barrier and improve STEM education.

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Exploring the meteoric fragments with microscopy and spectroscopy techniques.
Oltjona Muca, Omar Ghandour, Ryan Druce
Analía Dall'Asén

Carbonaceous chondritic meteorites are ancient materials from the earliest times of our Solar System, and thus, these objects can provide valuable information about how planets formed. These meteorites are composed of micro/millimeter-sized inclusions surrounded by a matrix of microparticles. The study of the physical properties (e.g., structure, composition and morphology) of these constituents can give evidence of the conditions (e.g., thermal, temporal and barometric) in which the materials found in the meteoritic samples developed in our Solar System. These physical properties can be studied using different experimental and analytical methods. In this work, we use microscopy and spectroscopy techniques, such as Raman spectroscopy and optical microscopy, to study several properties of carbonaceous meteorites (e.g., mineralogical composition and topography at the micro and nanoscale). In particular, we analyze two meteoritic fragments: Northwest Africa (NWA) 7184 and Aguas Zarcas. We explore numerous regions of

individual inclusions, surrounding matrix and inclusion-matrix interface. We correlate our results to look for clues about the origin of these extraterrestrial materials.

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Expression of myoneurin in the green anole lizard (*Anolis carolinensis*)
Madisyn Jarvey
Rachel Cohen

The green anole lizard (*Anolis carolinensis*) is seasonally breeding such that this lizard displays major differences in physiology, morphology, and behavior between the breeding and non-breeding seasons. During the non-breeding season, the lizard will have smaller gonads, lower sex hormone levels, and a decrease in reproductive behaviors compared to breeding lizards. In this study, we are examining myoneurin (*MYNN*) mRNA expression to determine whether this gene is involved in mediating seasonal changes in the green anole. MYNN is known to regulate transcription and control the expression of genes; our group predicted that MYNN will be more present in the non-breeding season. To do this, we first designed several primers sets that amplify the anole MYNN gene and used PCR and gel electrophoresis to confirm the quality of our primers. We verified that only one of our primers sets amplified MYNN through DNA sequencing. We then isolated mRNA from the hypothalamus of breeding and non-breeding male and female lizards (n = 6), performed cDNA synthesis, and set up standard curves. Our group ran standard curves for the *MYNN* gene and received inadequate results. The efficiency value equated to zero for each of these runs. We think it is likely that our primers may have been contaminated, resulting in the failed standard curve. Finally, we were able to perform a full run on our control gene, Beta-actin, and we found no differences between sex and season (p 0.377). Future research will involve continuing to trouble shoot our qPCR conditions to successfully amplify MYNN. This work will help us determine if MYNN is involved in regulating seasonal changes in the brain that correspond to reproduction.

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Fluid Powered Vehicle Challenge
Jack Rhodes, Jonathan Curillo, Stephan McGruder
Jake Swanson

this project is to physically assemble a fluid powered vehicle that is manually operated by a rider, for a national competition. A hydraulic and control circuit was designed and have been verified by industry and program mentors. A frame was chosen that would benefit component mounting when it comes to assembly. The components designated for fabrication and testing in preparation for the upcoming sprint race in the Power Fluid Bike Challenge have been meticulously chosen. The team's initial challenge centers around assembling the parts onto the bike frame for initial testing of the hydraulic system. The team will focus on completing the assembly of the various components and once completed, the optimization process will start for better performance.

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From Clicks to Security: Investigating Continuous Authentication via Mouse Dynamics
Ali Rashid
Rushit Dave

In the realm of computer security, the importance of efficient and reliable user authentication methods has become increasingly critical. This paper examines the potential of mouse movement dynamics as a consistent metric for continuous authentication. By analyzing user mouse movement patterns in two contrasting gaming scenarios, "Team Fortress 2" and "Poly Bridge," we investigate the distinctive behavioral patterns inherent in

high-intensity and low-intensity UI interactions. The study extends beyond conventional methodologies by employing various machine learning models. These models are carefully selected to assess their effectiveness in capturing and interpreting the subtleties of user behavior as reflected in their mouse movements. This multifaceted approach allows for a more nuanced and comprehensive understanding of user interaction patterns. Our findings reveal that mouse movement dynamics can be a reliable indicator for continuous user authentication. The diverse machine learning models employed in this study demonstrate competent performance in user verification, marking an improvement over previous methods used in this field. This research contributes to the ongoing efforts to enhance computer security and highlights the potential of leveraging user behavior, specifically mouse dynamics, in developing robust authentication systems.

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Gender Differences in the Experience of Age-Related Microaggressions
Crystal Hecht
Jeff Buchanan

Age-related microaggressions occur daily and are often unrecognized. Understanding experiences in how these are experienced between genders is important for society, as it holds a gendered view on aging. This study aims to investigate gender differences in the experiences of age-related microaggressions. This current study utilized existing survey data from a previous study (Lewis et al., 2023). The aforementioned study collected information from older adults regarding their experiences with twenty examples of age-related microaggressions. Participants were asked about their experiences including emotional reactions, perceived cause, location, relationship context, and behavioral response. Frequency analyses will be utilized to determine gender differences in these areas. A threshold of >20% will be used to identify meaningful differences between genders. Data analysis is ongoing. It is hoped that these findings will contribute to a deeper understanding of how gender influences the perception and response to age-related microaggressions among older adults. Further research should develop focus groups to create a taxonomy of age-related microaggressions. Providing teaching applications between male and female microaggressions could further enhance understanding and awareness in older adults.

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Heart Disease Risk Prediction using Classification Methods.
Akinahom Wabella
Deepak Sanjel

Heart disease is one of the leading causes of death and affects millions of people worldwide. Early detection can aid people in making lifestyle changes and, if necessary, ensuring effective medical care.
In this research, we build and compare several classification models using the patient information dataset from the UCI Machine Learning repository.
Classification models such as logistic Regression (LR), Linear Discriminant Analysis (LDA), Quadratic Discriminant Analysis (QDA), and K-nearest neighborhood (KNN) methods have been employed for developing heart disease risk prediction model and we obtained the accuracy of each of the methods for comparisons.

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Heated Concrete Pavement
Eduard Stasyuk
Fatih Bektas

The aim of this project was to determine the feasibility and efficiency of heating concrete instead of using a snowblower for snow removal. The study involved two different methods of heating: electric and hydronic.

The heating elements were also placed at different pour depths to determine heating efficiency. The concrete was designed to replicate typical retail dry concrete mix.

Herpes Simplex Virus 1 and its Interactions with Pro-Cancerous Human Immune Proteins
David Rezac
Allison Land

APOBEC3B (A3B) is a human immune protein that protects our cells from viral infection. It does this by localizing to the host nucleus and damaging the genome of double-stranded DNA viruses as they attempt to replicate. Herpes Simplex Virus (HSV-1) is a DNA virus, but manages to avoid A3B by encoding a protein, UL39, that forces A3B out of the nucleus and into the cytoplasm. This functionally disables A3B by preventing it from interacting with its viral genome substrate, allowing HSV-1 to productively replicate in the cell. Like many viruses, the human genome is also made up of DNA; A3B can easily confuse the two, damaging our own genome causing pro-cancerous mutations.
A3B normally resides in the nucleus of cells because of a nuclear localization sequence (NLS), which is a part of the protein that tells the cell to move the whole protein into the nucleus. To test the extent of UL39's ability to delocalize A3B from the nucleus to the cytoplasm of cells an additional NLS will be added to A3B, to see if its molecular strength is sufficient to counteract UL39's effects. Additionally, an NES (nuclear export signal) will be added onto A3B to observe maximal cytoplasmic localization of this protein. I hypothesize that the molecular forces of UL39 will succeed in pulling A3B-NLS out of the nucleus and into the cytoplasm. I will test this hypothesis by engineering plasmids to include A3B and the extra NLS or NES that can be transfected into HeLa cells. Using immunofluorescence and confocal microscopy, I will image these cells and quantify A3B localization. The results of this project will help to shed light on the behaviors of APOBEC3 proteins and the potential for developing cancer treatments based on this viral component.

How Jobs Impact Critical Thinking Skills
Abby Heisinger, Paige Goodnight
Emily Stark

Critical thinking is a must-have skill in the workplace for tasks like problem-solving, evidence-gathering, and information evaluation (Noruzi & Hernandez, 2011). Having a job can affect many aspects of someone's life, their time, energy, and school schedule. Critical thinking in the workplace offers many benefits including improved decision-making, enhanced problem-solving, and increased adaptability to changing circumstances. Students in undergraduate programs at Minnesota State University, Mankato are the participants in this study. They are given twelve different scenarios regarding problems within a workplace environment and they are to record their answers on what they believe the problem(s) are within the scenarios. After recording their answers, the participants are asked to answer demographic questions as well as participants rating how accurately certain circumstances related to their insight to emotions, lastly, they are asked to take a personality test. These different tasks help us understand what may influence participants' level of critical thinking skills. Our goal is to learn if participants being employed and/or having work experience would influence their critical thinking skills in the workplace. We hypothesize that the participants who are employed will have higher scores on their critical thinking test than those who are unemployed.

Identifying Key Enzymes Responsible for Glypican-3 Shedding in Liver Cancer
Hunter Burgess
Samantha Katner

Hepatocellular carcinoma, a form of liver cancer, ranks as the fifth most prevalent cancer globally and significantly contributes to the cancer-related mortality as the third leading cause of death. With an alarming annual incidence of approximately 728,000 cases, the disease poses a formidable challenge in terms of treatment that leads to a mere 14 percent five-year survival rate post diagnosis. The intricacies of liver cancer progression hinder early detection and effective treatment with surgical intervention remaining the primary therapeutic recourse. Notably, 70% of liver cancers exhibit elevated glypican-3 expression, a proteoglycan linked to the cell surface that orchestrates crucial cellular pathways for growth and migration. Here, we focused on understanding the enzymes responsible for glypican-3 shedding in hepatocellular carcinoma cells. We examined several enzymes known to influence proteoglycan shedding in other cancers by employing an ELISA assay to quantify glypican-3 shedding levels in response to varying concentrations of such enzymes. Then we selectively knocked out the genes associated with the enzymes that increased glypican-3 shedding using CRISPR-Cas9 technology. Additionally, through bioinformatics, we were able to identify patient populations with elevated levels of the key enzymes involved in glypican-3 shedding. By unraveling the intricacies of glypican-3 shedding and its regulation, our research may pave the way for novel therapeutic strategies hepatocellular carcinoma.

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Identifying ZYG11A, HS6ST1, and DIO2 gene expression in green anole lizards (*Anolis carolinensis*)Emma M. Rieper, Anna R. Wilcox, Eleanor P. Malone, and Rachel E. Cohen
Emma Rieper, Anna Wilcox
Rachel Cohen

Green anole lizards (*Anolis carolinensis*) exemplify certain behavioral changes depending on whether they are in their breeding or non-breeding season. During the breeding season, these lizards display sexual behaviors such as head bobbing and flashing their dewlap and these behaviors do not occur during the non-breeding season. Our question is to determine at the gene level what might contribute to these behaviors being apparent in the breeding season and not the nonbreeding season. We are testing three candidate genes, ZYG11A, HS6ST1, and DIO2 for their expression during the breeding and non-breeding season in the anole brain. ZYG11A is both a promoter and enhancer gene and HS6ST1 plays a role in angiogenesis. DIO2 converts thyroid hormone T4 into the active version, T3, which plays a role in metabolism. Our research project is to evaluate whether the expression of these three genes is altered seasonally. We designed specific primers for our genes and tested them via PCR and gel electrophoresis. We obtained our results by performing a quantitative PCR (qPCR) test. This allowed us to analyze and determine if there is any significant difference in gene expression between breeding and non-breeding seasons in males and females. From these tests we will learn how these genes may play a role in behavior changes during the breeding and the non-breeding seasons.

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Identity in Art and Personal Relations
Kaden Bergsbaken
Elizabeth Sandell

In this artistic exploration, each work is primarily anchored in identity or a series of interconnected events. Proposing a chronological presentation for contextual clarity, the artist contends that a painting or ceramic completed months ago embodies a distinct meaning, skill level, and set of experiences compared to their most recent project. The artworks serve as a compound manifestation, blending both heightened skill and revelations of identity. Despite tackling new issues with each piece, the artist's evolving knowledge as an individual and creator is consistently compounded with an unwavering commitment to continuous learning. Embracing the role of a novice, particularly in terms of taking art studio seriously, the artist places significant emphasis on transparency in their creative process by presenting underlines and visible pentimento. The narrative extends beyond the canvas to explore personal experiences such as love, farming class, politics, place in the church, unseen differences, and the poignant theme of loss of identity. Additionally, the artist provides insight into works in progress, future compositions, and the developmental journey of skills, particularly in portraiture. The focus intensifies on the intricate relationship with portraiture; it explains the connection with

a face and presents a rational explanation accessible to those disinterested in art. Furthermore, there's a dive into the practical aspects of skills, studio resources, and careers, while simultaneously exploring profound philosophies, including a personal relationship with identity and the profound notion of destroying identity for progress. This introspective journey also delves into the artist's relationship with existentialism and the contemplation of these higher philosophical aspects by emphasizing that the inseparability of identity and artistry persists even in seemingly mundane projects.

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Immigration and Love
Landis Parham
Lori Lahlum

The Expatriation Act of 1907 stated women would take their husband's citizenship. This would include women born and raised in the United States and married to a non-citizen man. When the United States declared war on Germany in 1917, citizenship status became important. The federal government required "enemy aliens" to register, while Minnesota ordered all aliens to register with the state. The 1918 Minnesota Alien Registration provides insight into American-born women who lost their citizenship. A small number of Black women had to register, another limitation to deal with in addition to the color of their skin. Amidst this uncertainty, these Black women engaged with their communities and advocated for full participation in society. Their families purchased war bonds, and family members served in the American Army. Women like Ida Lealtad balanced family and community obligations as they and their families fought for social justice in the Twin Cities.

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Impact of Caffeine on Collegiate Pilot Performance
Jess Stelton, Laura Beinecke
Cheng Wang

Pilot fatigue is a major safety concern in aviation. Due to the increasing number of long-haul flights and worldwide pilot shortage, pilots have been experiencing sleep deprivation and circadian disruptions. Therefore, pilots use countermeasures to reduce fatigue and sustain flight performance. Researchers found that caffeine was the most common countermeasure used by pilots over the past 25 years (Amann et al., 2014; Ehlert & Wilson, 2021). Although large amounts of caffeine consumption have negative effects, caffeine could be helpful for improving alertness. It is essential to fully understand the contexts in which caffeine is used and how it affects our bodies and mind. However, very few studies explain the effects of caffeine on pilot performance. This study aims to determine the impact of caffeine on the performance of collegiate aviation students. The authors surveyed collegiate aviation students to examine their caffeine consumption and how they perceive the effects of caffeine.

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Impact of Perennial Cover Crops on Soil Biological Health in a Wide-Row Corn Production System in Southern Minnesota
Bibata Sore
Mriganka De

Annual cover crops (ACCs) have been proposed to minimize the impact of intensive corn (Zea mays) production systems on soil health. Unlike ACCs grown in a relay cropping system, perennial cover crops (PCCs) can be grown as companion crops with corn, do not need to be replanted or terminated every year, and has the potential to increase continuous soil surface cover while providing numerous soil health benefits (e.g., scavenge nutrients, reduce erosion, suppress weed germination and growth, and add soil organic matter). Hence, this study is focused on evaluating the impact of PCCs on soil biological health in a wide-row (i.e., 60"

rows) corn production system in Southern MN. We hypothesized that corn grown with PCCs will significantly improve soil biological health compared to conventionally grown corn (i.e., 30" row) without PCCs. The experiment was set on a 2.4-acre land in Faribault County, MN, subdivided into 16 plots to facilitate a detailed comparison across four distinct treatments: a control with no cover crops (i.e., 30" row) and three PCC treatments integrating grass, legume, and a grass-legume mix, respectively, within 60" corn rows. To assess the impact of PCCs on various soil biological health indicators, soil samples were collected in Spring and Fall 2023 and analyzed after collecting them from 0 to 6" (0-15 cm) depth. Here we present the effect of PCCs on several biological health indicators – soil respiration rates, and the microbial community structure and abundance through the Phospholipid Fatty Acids (PLFA) test – and how these indicators vary with time (Spring vs Fall). The study results will offer recommendations for farmers seeking to determine the best PCC species for improving soil biology. By choosing appropriate PCCs, farmers can significantly benefit soil health without sacrificing crop yield, thus supporting both environmental sustainability and agricultural productivity.

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Importance of a Single Amino Acid Residue in SIVmac239 Vpx Nuclear Import
Kylee Zytkovicz
Allison Land

Vpx is a Human Immunodeficiency Virus type 2 (HIV-2)/Simian Immunodeficiency Virus (SIV) protein whose activity permits successful viral infection of non-dividing cells. One of the roles of Vpx is to mediate nuclear import of the HIV-2/SIV reverse transcribed genome. Nuclear localization of Vpx is important for this function, however, the lab SIVmac239 strain has a Vpx that is largely cytoplasmic. A previous student in Doctor Land's Lab identified that when a specific amino acid residue in the SIVmac239 Vpx (Glutamate (E) at position 54) is mutated to an Arginine (R); the protein becomes more nuclear. We note that this is a change from an acid to a basic amino acid. We hypothesis that if the Glutamate at position 54 is mutated to another basic amino acid, such as Lysine, SIVmac239 Vpx will similarly demonstrate increased nuclear localization. In contrast, we hypothesize that mutating the Glutamate at position 54 of SIVmac239 Vpx to a polar or non-polar amino acid will not affect nuclear localization. We tested this hypothesis by creating these mutations in a plasmid that expresses SIVmac239Vpx fused to Cherry – a red fluorescent protein. These mutated plasmids were transfected into HeLa cells and visualized by confocal microscopy. The localization of mutated Vpx-Cherry in nuclear and cytoplasmic compartments was quantified and compared to the localization of wild type SIVmac239 Vpx and the described E54R mutant. These data can be used to understand the localization of Vpx and identify the host proteins that Vpx interacts with to gain access to the host nucleus. By providing greater insight into viral nuclear import, these data may contribute to the development of effective HIV-2/SIV therapeutics that target exploited host-cell nuclear entry pathways.

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In the Middle: Birth Order and Childhood Experiences
Kaylee Voigt
Dan Moen

This cross sectional mixed-methods study collected data from adults (n = 180) about their emotional and cognitive childhood experiences based on birth order. Comparative baseline scores of subjective well-being (emotional and cognitive) (Diener et al. 1985) using the satisfaction with life scale (SWLS) (Andrews & Withey, 1976) were used to see differences between groups. The SWL scale looks specifically at emotional and cognitive outcomes (Diener, 1984; Veenhoven, 1984) which are paramount in understanding childhood outcomes. No significant differences were found between birth orders. Additionally, linear regression was used to examine birth order and perceived relationship satisfaction with peers, siblings, and parents/caregivers. A significant ($p < 0.05$) negative correlation was found between middle children and sibling relationship satisfaction. This study also asked participants to share their most memorable childhood experience. Qualitative themes between groups (birth order) were found. Implications for educators, clinicians, and future research are discussed.

Increased Student Employment is Associated with Inferior Biology Exam and Course Performance
Gifty Jijo
Keenan Hartert

Rising tuition rates across American colleges and universities contribute to the mounting financial strain on students (Clark et al., 2019; Hossain et al., 2022). In response to rising costs, we suspected that students would seek to bolster their financial security by working additional hours per week, consequently leading to less available time (Lessky & Unger, 2022; Moores et al., 2019). Financial strains that lead to higher stress, distressed sleep schedules, and ultimately less time devoted to academics pose a troubling cycle for students that commit substantial portions of their time to employment. We observed this relationship within a 162-student cohort comprised of 2 200-level Genetics courses at Minnesota State University Mankato, a high-population state-subsidized institution. These results build upon an original archival observation from Spring 2021.Comparing students committed to 20+ hours per week (42.0% of students) vs. those faced with lesser commitments revealed significant differences in overall course/exam performance. Those working 20+ hours per week scored significantly fewer total class points ($p = 0.0008$), exam points across all 3 ($p = 0.0010$, $p = 0.0016$, $p = 0.0004$), and were more likely to incur a failed assignment sooner during the class than their counterparts ($p = 0.003$). Expanding data collection beyond hours working, we observed that over 29% of students had no financial support system should an emergency arise, 11.1% were working overnight shifts, and over 14.2% were commuting over 3 hours per week. We notably observed a significant negative correlation between hours working per week and final grade ($p = 0.0012$), Normal (90%+) vs. Low class attendance ($p = 0.0004$), and Normal (90%+) vs. Low learning platform (D2L) engagement ($p = 0.0028$). Unsurprisingly, higher financial and employment stress were Likert rankings were enriched in the 20+ hour group. Lastly, we observed that students working 20+ hours were significantly less likely to attend class ($p = 0.0232$), and this low attendance was significant determinant of success within the 20+ group itself. Our next steps include instituting "rescue" operations that target overcommitted students, seeking to rectify the gap. We also plan to collect more qualitative insights to supplement our quantitative data. These novel findings represent the first quantitative analysis of employment hours and their effects on numerical exam scores. Importantly, they grant us key insights into the working population students that did succeed despite their commitments, potentially shedding light on the key factors that we can target to support others. They are an important step towards identifying and treating the underlying factors associated with reduced student exam performance, retention, well-being, and may serve as an emerging benchmark for higher education to consider as institutions seek to retain and support underrepresented students and meet DEI goals.

Investigating Elderspeak: Perceptions and Emotional Impacts Among an Assisted Living Population
Cecelia Anderson
Jeff Buchanan

Elderspeak is a type of speech accommodation used when communicating with older adults that includes simplified language, slower speech, and tone akin to those used with children. Despite being relatively common in assisted living and healthcare settings, the use of elderspeak can be interpreted in many ways. This study aimed to explore perceptions of elderspeak from the perspective of older adults residing in an assisted living facility. Fifteen assisted living residents were shown two short videos depicting a caregiver assisting an older adult with personal care tasks. One video shows a caregiver using elderspeak and the other without. Participants were interviewed using a structured questionnaire about their experiences with and attitudes towards elderspeak. In addition, participants completed a questionnaire about their emotional responses to the videos and a questionnaire rating the nursing assistant depicted in the video. Data collection is expected to be completed by around March 15th. Interview data will be analyzed qualitatively, while quantitative questionnaire data will be analyzed statistically to determine differences between reactions to the two videos. Data from a secondary study that examined the validity of the two videos from the perspective of 15 nursing

assistants will also be presented. Implications of the results in relation to the care provided in assisted living facilities will be discussed.

Investigating sources of dental caries in humans/genomics/integrative analysis highlight emerging sources of dental caries in humans
Makiah Otto, Preston Mansfield, Sara Ihrke
Keenen Hartert

Pain, infections, and tooth loss are all effects of cavities and may go fatal if untreated. Over 90% of adults have at least one cavity. On average, individuals spend $1,000 on dental care each year without insurance. Even though you may brush your teeth twice a day and floss there may be other factors causing you to get a cavity, like the microbes in your mouth. This research examines the effects of twelve different microbes in the mouth on dental caries. Following that, the gene MUCB5 was looked into, which causes problems in the oral cavity, and found that it was in some of the various microbes. In addition, the results of this dataset were compared to a real life experiment conducted that involved swabbing a variety of individuals' mouths and seeing what microbes were prevalent along with their estimate of how many cavities they had.

Investigating the Factors Influencing Student Registration: An Exploratory Study on Rate My Professor
Tara Lovas, Teanna Horn, Karlie Mathias
Kevin Filter

In today's digitally driven world, higher education institutions rely on various types of technological resources to boost student outcomes. At its core are platforms like Rate My Professor, which have emerged as powerful tools that influence student decision making. Traditionally when registering for a class in college, students will meet with their advisor to select their courses and create the best plan of action to complete their degree. However, the use of technology has made it increasingly common for students to conduct background research on the potential courses and professors they may encounter during registration. This project concentrated on analyzing specific elements within existing Rate My Professor profiles to identify similarities of student preferences. We differentiated student preferences based on their class, or year enrolled in the university setting. The findings of this study indicate that students from different classes prioritize similar aspects of Rate My Professor profiles when looking to register. By understanding these variations across students, we can develop strategies to better cater to student preferences and improve overall enrollment outcomes.

Levels and Determinants of Cholesterol Among College Students
Riley Ahrendt, Lydia Schrempp
Jessica Albers

The purpose of this study is to examine the cholesterol levels of college students and assess possible determines for cholesterol. The goal is to increase college students' awareness of high cholesterol susceptibility and severity to promote early intervention of cholesterol reduction health behaviors, especially when determinants are present.Participants will have a finger prick blood sample analyzed with the Cholestech LDX Analyzer. The researchers will use a spring-loaded lancet to prick the participants' finger, fill the capillary tube with blood, use the capillary plunger to move the blood to the Cholestech lipid profile cassette, and insert the cassette into the analyzer. The lipid profile will give results for total cholesterol, high density lipoprotein cholesterol, triglycerides, glucose, and calculate non-HDL cholesterol and low-density lipoprotein cholesterol. The data will be analyzed using SPSS to describe rates of cholesterol among students. T-tests and ANOVAs will

be used to assess the difference between demographic groups and independent variables. Correlations will be completed for continuous independent variables and cholesterol levels. Regression will be used to create a prediction question for cholesterol.

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Link Between Relationship Satisfaction and Life Priorities
Amal Sharafkhodjaeva, Rohit Paruchuri
Bradley Arsznov

A strong sense of purpose in life (e.g., life goals) is shown to relate to increases in mental health, overall well-being, and cognitive functioning (Hooker and Masters, 2016). Purpose can be viewed in part as a set of relatively stable far-reaching goals that are meaningful to an individual (Damon, Menon, and Bronk, 2003). Life goals directly influence the behavioral actions and cognitions of the individual as they relate to obtaining the desired states they seek to obtain, maintain, or avoid (Nair, 2003). These life goals may include a promotion an employer (career), raising children (family), or improving sports performance (hobby) (Pervin, 2015). The extent to which an individual prioritizes these goals helps define their purpose and greatly impacts how they interact with their physical and social environments. While personal goals are important to individual well-being, shared goals are important for couples (e.g., marriage/significant partners). Previous research suggests a marriage is viewed as more satisfactory for people who share goals, while dissimilarity in goals is related to increases in divorce (Becker, 2013). Satisfaction in relationships is also related to value orientations (Caspi et al., 1992) and lifestyles (Becker & Lois, 2010). Additionally, perceived support for personal goals and collective efficacy for goals increases marital satisfaction (Kaplan and Maddux, 2002). This study investigates connections between life goals, individual well-being, and relationship satisfaction. This research will explore how both platonic and significant partners prioritize life goals across 7 domains: career, social life, immediate family values, hobbies and interests, religion and spirituality, healthy life choices, and forming personal romantic relationships. Additionally, we will examine relationship satisfaction and priority rankings between paired participants (platonic and significant) using the Couples Satisfaction Index (CSI) (Funk & Rogge, 2007). Additionally, participants will be asked to rank their life goals within and across the 7s domains. Comparisons will be made between paired couples to examine the extent of similarity in life-goal prioritization and their relationship satisfaction. In order to investigate the relationship satisfaction within a couple, individual responses will be paired with a unique identifier for their platonic or significant partner. For data analysis, this procedure will allow us to match a couple's responses and compare individual life goal ranking and relationship satisfaction level. We hypothesize that life goal priority will influence relationship satisfaction in both platonic and significant relationships. We predict that partners with similar life-goal rankings will have higher relationship satisfaction levels.

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Low-Resolution Imaging for Low-Speed Embedded Systems
Connor Best
Vincent Winstead

A brief explanation of the importance of imaging technology in the field of robotics, followed by a surface-level breakdown of a custom low-resolution camera that was developed in MSU's ECET department.

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Machine Learning for Human Activity Recognition using Wearable Devices
Koleman Lund, Tinsay Gebremariam
Rushit Dave

Human Activity Recognition (HAR) is a growing field in machine learning. With the growing popularity of wearable devices that enable data collection and quick analysis of that data, HAR will become increasingly

useful. Recognition of different activities has several beneficial applications in healthcare, security, and beyond. As the range of human activities is large and the activities complex, accurately categorizing the activity being performed is a difficult task. Machine learning is often applied to this problem to classify the data obtained. This research project aims to collect data from many participants using common wearable devices, such as an Apple Watch, and classify it properly into the activity being performed. This dataset will be obtained with participants performing a set range of abilities under observation, with time periods being measured. Different types of smart watches will be used, to provide further comparison between the effectiveness of popular devices. As this is a relatively new field, there is no standard dataset, and the addition of another publicly available dataset will help aid future research. Once this data is obtained, we will perform machine learning methods on them to properly classify the activity performed during this time period. Several different machine learning algorithms will be used to provide comparisons between the effectiveness of the individual algorithms. We expect at least one of the algorithms to have an acceptable level of activity recognition, however, depending on the activities performed, different algorithms will have different effectiveness. These differences will provide valuable insight on the machine learning algorithms, as well as the devices used to collect and analyze this data. Conclusions will be drawn about an effective algorithm and device combination regarding the different activities performed.

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Mapping Developmental Expression of a Potentially Novel Deafness Gene in the Cochlea
D'Aaliyah Johnson, Matthew Jensen
David Sharlin

Untreated congenital hypothyroidism (CH), a condition where a neonate is born with under-functioning thyroid gland, results in significant neurological deficits including hearing impairment. CH can result from an underdeveloped thyroid gland, the thyroid gland not being located the anatomically correct location, or a complete lack of a thyroid gland. It is proposed that the decreased levels of thyroid hormones disrupt the proper mechanisms for the development of the inner ear (cochlea, hearing organ) and ultimately auditory functionality (Andrade et al., 2021). Our lab has identified a pool of novel candidate thyroid hormone target genes that may contribute to the observed auditory deficits including – Fam107a – which is the focus of our project. Only a few reports are available for Fam107a, and none relate to cochlear development. Interestingly, in a database that curates in situ hybridization images (GXD, Jackson Laboratory; reports mRNA expression in tissues) Fam107a is observed in the embryonic mouse cochlea. Understanding how thyroid hormone works to direct hearing development by identifying genes that the hormone turns on and off is an important step in understanding thyroid hormone-linked deafness. Our gene, Fam107a, is not previously reported to be associated with cochlear development and offers a novel area of hearing research. Since mice and humans have similar anatomy, understanding Fam107a in mice may help understand human disease. Our working hypothesis is that Fam107a is a thyroid hormone-regulated gene, and its cochlear expression is disrupted following developmental hypothyroidism. To date, we have successful amplified Fam107a from a postnatal day 1 cochlear cDNA pool; confirming that Fam107a is expressed in the developing cochlea. Ongoing cloning work will lead to the production a labeled cRNA that will us to visualize Fam107a in cochlear tissue. Upon completion of this experiment, we hope to understand Fam107a mRNA levels between hypothyroid and euthyroid (normal) mice. Overall, our results can help define Fam107a mRNA expression in the cochlea and provide further understanding of deafness linked to congenital hypothyroidism.

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Metabolic Diversity of the Gut Microbial Genus *Slackia*
Kendall Solomon
Cecilia Noecker

The human gut microbiome plays critical roles in health and disease. Every individual has a unique microbial ecosystem shaped by genetics, geography, and lifestyle. Many organisms in the gut microbiome are relatively unknown, hard to culture in a laboratory setting, and/or have extremely specific growth requirements. *Slackia* is a prevalent bacterial genus in the human microbiome in the family *Eggerthellaceae*. *Slackia* is difficult to

culture and grow, and there is limited research on its biochemical properties and effects on its hosts. However, *Slackia* species are some of the only microbes that can transform the dietary chemical daidzein into equol, which is significant because equol has been found to be an effective phytoestrogen with potential effects on host endocrine signaling. I am analyzing a dataset of 176 *Slackia* genomes from 22 countries previously compiled by Dr. Noecker from public databases. We used the eggNOG database and RStudio to study the diversity and metabolic capacities of *Slackia*. Most of these genomes (79.5%) were classified as the species *Slackia isoflavoniconvertens*. Using BLAST, 14 genomes (0.08%) were found to contain at least one of the genes in the daidzein metabolism pathway. We are next using multiple sequence alignment to study the conservation of the genes in this pathway. Additionally, I explored other metabolic pathways in *Slackia isoflavoniconvertens* by creating a metabolic model using the KBase platform, allowing us to identify other novel metabolic pathways the genus may possess. Potential laboratory media to culture *Slackia* strains can also be determined using the model. These media formulations could allow for easier laboratory experiments with *Slackia* in the future. This research will allow for the formation of more focused questions to be asked on the biology of this important gut microbe and its role in health and disease.

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Modification of Extrusion Tooling to Allow Advanced Coating Techniques
Benjemin Redlin, Adham Razek
Jake Swanson

Uponor is currently engaged in developing an innovative application method for coating the inner diameter of ½-inch diameter machine tooling. Currently Uponor is using a Teflon coating that is no long viable, hence the switch to a lower coefficient of friction material called Aluminum Magnesium Boride. To coat this ceramic material, the team will try to use a process called Physical Vapor Deposition (PVD). A critical aspect of this project revolves around successfully applying the ceramic coating to the inner surface of the tooling, a task that hasn't been accomplished to our required scale.

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Narratives of Behind the Scenes Mental Health of College Athletes
Alayna Kunshier, Megan Narveson
Jessica Albers

This study presents stories of athletes pertaining to their mental health using the socioecological model of mental health. We conducted a survey where the athlete could choose an influence from the model that impacts their mental health the most. In the survey they could tell us why they chose the influence, a story behind the reasoning and what can be done to improve mental health awareness within the athletic environment.

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Navigating Contradictions: Exploring Attitudes Towards Marriage Among Bisexual Young Adults
Ashley Johnson, Dillion Daniels
Aaron Hoy

Even as the US marriage rate continues to decline and Americans increasingly delay entry into marriage until more advanced ages or life stages, research still shows that a significant majority of young adults hope and plan to get married someday (e.g., Allred, 2019; Manning et al., 2007; Manning et al., 2019). Furthermore, following the US Supreme Court's landmark decision in *Obergefell v. Hodges* (2015), all young adults have equal access to marriage regardless of their sexual identity. Although a few preliminary studies suggest that sexual minority young adults may aspire to marry as much as heterosexual young adults and for similar reasons (e.g., Bailey, 2022; Hoy, 2024), there has not yet been an empirical examination of bisexual young adults specifically. To address this, in this presentation, we draw upon qualitative survey data from a

convenience sample of 113 bisexual young adults (ages 18-35) collected as part of a larger study on sexual minority young adults' marital attitudes and aspirations. We conducted a reflexive thematic analysis (see Morgan, 2022) of these data to examine the meanings they attach to marriage and their motivations to marry, or not. The preliminary results indicate several predominant themes, including a) being indifferent toward marriage, b) marriage being unnecessary, and c) marriage as a symbol of love. Although a substantial portion of respondents view marriage as a symbol of love, many do not actively consider marriage a priority in their lives. Additionally, many respondents articulated that marriage holds no substantial difference from other forms of committed relationships, thereby questioning its significance and relevance in their lives.

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Opinions on aging before and after completing Montessori activities with older adults with dementia
Lauren Ziesmer, Jack Mullvain
Jeff Buchanan

Montessori-based activities were first developed to educate children. One hallmark of a Montessori-based approach to teaching is that learning activities can be adjusted and adapted for the individual learner. Over the past 25 years, research has examined whether a Montessori-based approach can provide an alternative method for planning activities in long-term care facilities for older adults with dementia given that activity planning for this population is a difficult process because residents have varied backgrounds and interests. This research has consistently demonstrated that Montessori-based activities can increase positive affect and engagement in activities in older adults with dementia. The current study had two purposes. One purpose was to create and implement several Montessori-based activities for residents living in a memory care unit within an assisted living facility in conjunction with students in the Minnesota State University, Mankato Communication Sciences and Disorders (CSD) program. Activities are currently being implemented with residents twice per week, which will continue through April. The second purpose of the study was to understand more about how participation in these activities impacted the CDS students involved in the project. For this part of the study, three students involved in creating and implementing the Montessori activities were interviewed prior to starting activity implementation and six weeks after it began. Interviews were designed to assess self-rated knowledge of dementia, changes in perceptions and attitudes about persons with dementia, and other reactions to the experience. In addition, the Dementia Attitudes Scale (DAS-20) was administered before starting the activity program and six weeks later. Data collection is still in progress and is planned to be completed by March 31. The results of this study may provide some insights into how college student views on Alzheimer's' disease and related disorders may change after doing Montessori based activities. Results may also inform how this Montessori-based activity program may be expanded to benefit facility residents as well as college students interested in careers related to aging.

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Overdose Prevention: Understanding Naloxone Training Efficacy
Mikhaila Malone
Roy Kammer

Working under Dr. Roy Kammer, I have done background research and developed a study on the efficacy of a Naloxone training done at Minnesota State University, Mankato in November of 2023. Over the next couple of weeks, we will collect and analyze data to understand the effectiveness of the training for the participants from the Mankato community. This presentation will highlight the importance of overdose prevention and Naloxone access. By sharing what we find through our research, I aim to educate and encourage the health and safety of our community.

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Re-examining Resiliency, Mindfulness, and Seasonal Affective Disorder Related to Stress
Ariana Jacobs, MacKenzie Berg, Jaylene Perez, Jack Mullvain, Sadie Williams, Ava Stier
Bradley Arsznov

Stress is a common experience for individuals of all demographic groups. College students experience stress in part from balancing demands of school and work along with managing daily-life stressors. College students experience stressors including: high tuition rates, outrageous academic standards, and worry for grades (Etherton et al., 2022). Hudd et al. (2000) suggests that this stress negatively impacts college students. Stress in college students has been shown to increase: low self-esteem, drinking, difficulty sleeping, lack of energy, and poor health (Hudd et al., 2000). Taken together, these negative effects of stress impact college students' ability to be successful individuals and academics. Given the increasing number and intensity of stressors in college, the present study examines the impact of stress on academic performance and well-being. Here we explore how aspects of positive psychology (resilience & mindfulness) moderate stress among college students. Further, we explore how seasonal affective disorder (SAD) may play a role in student success and stress levels. Previously, we found that students who reported lower levels of stress also reported increased resiliency and mindfulness behaviors. Further, we found a significant gender effect where women reported high levels of stress and lower levels of both resiliency and mindfulness compared to men. The present study further examines the variables of stress, mindfulness, and resilience, as well as including SAD and how it may impact students. This study aims to investigate how resilience, mindfulness, and SAD relates to perceived levels of stress in college students. Here we continue our survey on behaviors related to college students' academic and everyday lives with a goal of obtaining at least 100 new responses across different school levels and demographic characteristics. Original data was collected fall semester 2022-spring 2023. We intend to continue data collection through fall and spring semester 2023-2024. This continuation study will contribute to knowledge about the overall mental health impact of stress and the moderators of resiliency and mindfulness. We hypothesize that the college students who have higher levels of resilience and mindfulness will also report lower stress, seasonal affective disorder, and higher achievement in academics. The overall analysis will aid in better understanding the relationship between stress and resilience in current students at our university.

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Re-examining Social Media Use and Mental Health: Comparing Social Media Use Across Platforms
Ariana Jacobs
Joe Wohkittel

During the last decade, social media use has grown rampantly, and continues to do so. For example, 80% of adults in the United States report using social media, with 71% of 18–29-year-olds using Instagram, and 65% using Snapchat on a regular basis (Auxier & Anderson, 2021).
Previous studies on the topic of social media use and mental health outcomes have yielded mixed results. For example, one study reported that the individuals who use social media the most show, (a) more depressive symptoms, (b) decreased life satisfaction, and (c) increased social comparisons (Boer et al., 2021). Alternatively, other studies have found the opposite. For example, Hjetland et al. (2019) reported that social media helped in facilitating social connectedness and a sense of belonging. Further, a previous iteration of this study found that social media use had a negative impact on individuals (Jacobs & Wohkittel, 2023). Results indicated that: (a) anxiety and depression were positively associated with social media use, and (b) higher anxiety scores were shown from those who used TikTok, VSCO, and Snapchat. One area of importance to me is how specific social media platform use contributes to a person's mental health, specifically their anxiety and depression levels.
The purpose of this study was to better understand differences in how social media use affects peoples' anxiety and depression levels based on the social media platforms they use. Hypotheses for the study are; (1) there will be a positive correlation between social media use and an individual's anxiety and depression levels, and (2) there will be differences in an individual's anxiety and depression levels based on their specific social media platform use of: BeReal, Snapchat, Instagram, TikTok, and VSCO.
A Qualtrics survey was used to measure social media use, specific platform use, and behaviors associated with anxiety and depression levels. Specifically, items from the GAD-7, PHQ-9, and Social Networking Intensity Scale were included. Insight gained through this study will help individuals to further understand the pros and cons of social media use and to make healthy decisions when engaging with specific platforms. Additionally, the

findings may help mental health professionals encourage and discourage specific social media uses to their patients.

Remote-Controlled Vehicle for Mosquito Population Assessment and Control
Bella Henkel, Lukas Romann, Carol Ann Hanson, Jonathan Embree, Ben Zuehlke
Jake Swanson

In regions vulnerable to mosquito-borne diseases, effective monitoring and treatment are vital. To address this, a team of student engineers at Twin Cities Engineering is collaborating with an industry partner to develop a cost-effective robotic vehicle capable of collecting water and mosquito larvae samples from narrow sewer drains. This project aims to fill a crucial gap in existing solutions by providing both affordability and sufficient driving range for comprehensive monitoring and treatment efforts.

Sentimental Analysis using machine learning.
Dilasha Shakya
Rushit Dave

In this digital age where everyone is on social networking platforms like Facebook, Instagram, and Twitter, opinions, and emotions expressed in these sites have been crucial for different entities. The information extracted can be used for business ideas, marketing, getting updated with recent trends, and communication. The feedback and ideas that people express on social media are also important for companies to boost their products or improve on drawbacks. For all these purposes, sentimental analysis can be used to analyze and evaluate users' attitudes and opinions from subjective texts. Sentiment analysis utilizes machine learning techniques and natural language processing (NLP) to identify the emotions behind texts. This involves pre-processing data, extracting crucial features/words, and evaluating polarity through diverse machine-learning algorithms. The process of sentimental analysis starts from unstructured data from the internet that includes spelling errors, sentence repeats are analyzed and removed. Significant adjectives are then chosen to categorize the data's polarity. Some researchers use polarity markings for each word/emoticon, aiding overall emotion determination. Feature extraction methods encompass Bag of Words, word embedding, word count, and noun count. Classification methods categorize data based on its features. We measure the performance of the classifier in terms of recall, precision, and accuracy. Machine learning algorithms stand out in this research due to their proven accuracy in various models. Sentimental analysis is an advancing field that can be used in most systems in this technological age assisting in good customer-company relationships, healthcare systems, crisis management, political analysis, marketing, and trading. Machine learning approaches constitute an essential part of sentiment analysis tasks. Hence, using the right approach with increased model performance measurements is essential to help us enhance the efficiency of sentimental analysis systems.

Smart Mirror
Hamede Abdulgafur, Dagmawi Abera, Noah Awol
Puteri Megat-Hamari

This Smart Mirror project is an innovative initiative aimed at redefining the interaction between technology and users in everyday life. By incorporating advanced features such as real-time information display, personalized interfaces, and augmented reality, this mirror goes beyond simple reflection. It synergistically combines the Internet of Things (IoT), wearable computing, and user-centric design principles to create a dynamic and interactive tool that promises to streamline daily routines, ensure information accessibility, and provide a seamless technological experience. This interdisciplinary team's expertise ranges from hardware

assembly to software development and user interface design, all directed toward the successful realization of a Smart Mirror prototype that is anticipated to serve as a standard for future smart technology.

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Smart Mirror
Samarth Shah, Chanpitou Um, Sumaya Khan
Bhushan Dharmadhikari

The Smart Mirror project integrates a two-way mirror with a Raspberry Pi-4 powered monitor to transform a conventional mirror into a dynamic information hub. It displays essential data such as weather, time, and news in real time to create an immersive user experience. The team visions to add features like face and speech recognition to elevate user experience by introducing personalized GUI (Graphical User Interface). Simultaneously a proposed website will allow users to control their data sources and widget arrangement that will enhance their personalized experience. The project is a step forward to convert the dream of a smart home into a reality and pave way for a lot more improvements on the product. By demonstrating integration of technology into everyday spaces, it will explore the potential of creating interactive and intelligent surroundings.

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Speciation of Vanadium in Sulfidic and Polysulfidic Waters
Randi Libin-Straub
Trenton Vorlicek

Because V concentrations in black shales are often elevated relative to crustal abundances, V has the potential to be a useful proxy of Earth's redox history. Developing this proxy will assist in understanding the oxygenation history of Earth. Unfortunately, realizing this potential is hindered by a lack of knowledge of the chemical mechanisms leading to V deposition. Recent spectroscopy evidence suggests V in a Scandinavian shale is predominantly present as a V^{IV}-S solid(s). Curiously, A V^{III}-O solid(s) becomes a significant component under less sulfidic conditions. Possibly, ligand-induced reduction of V by polysulfides (S_x^{2-} with x = 2-6) accounts for the counterintuitive presence of the lower V oxidation state in less reducing environments. To begin unravelling the chemistry controlling V speciation, slightly alkaline (pH 7 to 9) sulfidic test solutions were prepared with or without elemental sulfur (referred to as S^0 hereafter) added initially. When $V^VO_4^{3-}$ (0.0025 to 0.0500 mM) is added to test solutions without S^0 added initially, polysulfides are rapidly produced at amounts implying exclusive reduction to V^{IV} products. Spectroscopic analyses of filtered test solutions indicate >30 % of initial V remains soluble. Preliminary analyses of precipitates from several (N = 8) test solutions without S^0 added initially showed the formation of $V^{IV}S_2$, regardless of initial pH, total S^{2-} (0.5 to 3 mM), or initially added V salt ($Na_3V^VO_4$ vs. $V^{IV}OSO^4$). Similar sulfidic test solutions with $V^VO_4^{3-}$ added initially but saturated in S^0 throughout the reaction yielded precipitates with mixed V^{III} and V^{IV} valences which is contrary to the results of earlier publications. Further analyses of similar test solutions and precipitates over a range of sulfidic and polysulfidic conditions are forthcoming.

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Statistical Analysis of Renewable Energy (Solar and Wind)
Deepshikha Sanjel, Jared Anderson
Mezbahur Rahman

Forecasting for wind and solar renewable energy is becoming more important as the amount of energy generated from these sources increases. In this project we studied forecasting methodologies for solar and wind energy production across the United States. We utilized advanced statistical techniques, including Multiple Linear Regression (MLR), Nonlinear Regression (NLR), Autoregressive Integrated Moving Average

(ARIMA), and Seasonal Autoregressive Integrated Moving Average (SARIMA) to identify the most precise models for energy prediction.

Steroid Hormone Influence on Neurogenesis in Breeding and Non-Breeding Green Anole Lizards (Anolis carolinensis)
Kadin Larsson
Rachel Cohen

The process of adult neurogenesis, the creation of new neurons, has been extensively studied, particularly in the hippocampus and olfactory bulb of mammalian species and the HVC in avian species. However, knowledge about neurogenesis in other vertebrate groups or brain regions remains limited. This study aims to investigate the broader impact of steroid hormones on neurogenesis in the amygdala of seasonally breeding green anole lizards (Anolis carolinensis). Previous research indicates a higher neuron count in the non-breeding season compared to the breeding season in the green anole lizard amygdala, suggesting a seasonal variation in neurogenesis regulation. We hypothesize that fluctuating hormone levels may play a role, due to anole seasonal hormonal differences in anoles. To explore this hypothesis, breeding male lizards were administered testosterone (T), estradiol (E2), dihydrotestosterone (DHT), or blank capsules and were injected with bromodeoxyuridine (BrdU), a compound labeling dividing cells. After three weeks, immunohistochemistry for BrdU and NeuN (a neuronal marker) was conducted on brain sections, and double-labeled neurons in the amygdala were counted. We have found that neurogenesis is occurring within the amygdala of the anole, and further analysis of the tissues is ongoing to identify any potential effects of steroid hormones. Investigating the effects of how steroid hormones impact neurogenesis can lead to a broader understanding of neural plasticity across different species.

Study on the effects of prescribed fire regimes on soil physical properties in Minnesota tallgrass prairies.
Justin Kjorness
Matthew Kaproth

Tallgrass prairie ecosystems, characterized by grass and forb communities, are increasingly rare and threatened areas of biodiversity that require management to maintain and conserve ecological structure, biodiversity, and soil health. One such management practice is the use of prescribed fire to minimize thatch cover and prevent woody encroachment in the goal of improving habitat. These ground cover fires also have the potential to change soil properties through chemical alterations, recycling of nutrients, and the encouragement of plant growth. There was, however, limited knowledge on the effects of prescribed fires done at different intervals and restoration types in tallgrass prairie ecosystems. Therefore, an analysis of soil properties with respect to fire frequency in tallgrass prairie was needed. Soil from 28 prairie sites was collected near Kensington, Minnesota for analyses of soil properties and comparisons to the burn frequency and restoration status (remnant or restored). For this study, chosen physical properties included bulk density, maximum water holding capacity, porosity, and aggregate stability. Additional analysis of chemical properties, nitrogen, carbon, and pH are also being conducted. It was hypothesized that fire frequency is negatively correlated with bulk density, pH, and nitrogen and positively correlated with maximum water holding capacity, aggregate stability, and carbon. Upon analysis, bulk density was positively associated with burn frequency and was lower in remnant sites. Maximum water holding capacity was negatively associated with burn frequency and was higher in remnant sites. These results indicate healthier soils in remnant sites with less burn frequency. Aggregate stability, nitrogen, carbon, and pH measurements are currently being collected. Results of this study have implications for management strategies and for work done by the Echinacea Project. This data provides a foundation for studies on biodiversity, pollinator and plant populations, and how tallgrass prairie soils can change given restoration status and fire prescribed fire frequency.

The Correlation of Political Beliefs, Religious Beliefs, and and Pseudoscientific Beliefs
Leah Hed, Ellie Schindle
Emily Stark

Many types of medicine or medical treatments are considered pseudoscience, meaning that their effectiveness is not supported by scientific findings, although they may claim to influence mental and physical health. It is a common and controversial topic of conversation. Belief in pseudoscience can have a massive impact on society, leading people to endorse treatments that have no basis in science. It is our goal in the current study to analyze the correlation between political beliefs, religious beliefs, and pseudoscientific beliefs. Previous research shows Republicans as more likely to listen to top political authorities as well as showing a decline in adherence to the COVID-19 guidelines and increased belief in false information about COVID-19, which was associated with their pseudoscientific beliefs. Similarly, previous research suggests that people associated with right-wing beliefs support conspiracy theories more than their left-wing counterparts, in particular that younger right-wing males and those less satisfied in life show a high correlation in their belief of conspiracy theories. In our current study, we measure participants' pseudoscientific beliefs about various alternative and complementary medical approaches, as well as their political affiliation and religious beliefs. To collect data necessary to test our hypothesis, participants are given an online survey to complete via Qualtrics. Preliminary analyses of the data collected so far (N = 91 college student participants) suggest positive correlations between religiosity, endorsement of conservative political views, and belief in some types of medical pseudoscience. We will continue to collect data and in spring 2024 and prepare a poster presentation. We hypothesize that those who are religiously affiliated will also show stronger pseudoscientific beliefs and have a right-wing political perspective.

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The Devil's in the Details: How the Christian Devil Impacted the Witch Craze of the 16th and 17th Centuries in Southern Germany
Maddie Heiser
Nadja Kramer

The topic of witchcraft is one which has remained within human imagination for centuries. Whether it be the evil, old crone in children's fairy tales or something more corporeal and real, witches have infiltrated a variety of cultures and mediums. Though these mystical women have made their presence known all across the globe, the witches of Europe have been the subject of a substantial amount of intrigue. One region in particular is quite infamous for its relation to witches: Germany. Many of the most prominent witch hunts and proceeding witch trials happened within German-speaking territories, most notably those in the south, and the very concept of what a witch was and how much power they had would shift throughout the Middle Ages and Early Modern period. Why did such a connection between Germany and witches exist? The answer lies in an unexpected figure: The Devil. Beginning with Saint Augustine of the Roman Empire and ending with the onset of Enlightenment, Christianity's most notorious malefactor continuously appeared time and again to wreak havoc on the faith. His most devoted servants were the witches. This project centers around a discussion and analysis of witches in southern Germany during the witch craze of the 16th and 17th centuries from a lens of Christianity and its relationship to the Devil, and it will provide explanations for why southern Germany specifically experienced the most intense manifestation of this event.

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The effect of Calmodulin cardiac arrhythmia mutations on calcium-binding
Halen Tsegaye, Lensa Tsegaye
Rebecca Moen

Heart disease, a leading cause of mortality, encompasses various conditions, including genetic disorders like calmodulinopathies. Calmodulin (CaM), a pivotal protein in calcium signaling, is crucial in regulating cardiac

calcium channels and, consequently, myocardial function. This study delves into the effects of specific mutations (D129G, D129V, D134H, and Q136P,) within the C-lobe EF-hand motif of CaM on calcium binding. Site-directed mutagenesis introduces these mutations into the CaM gene, followed by confirmation through sequencing. The mutated CaM genes are expressed using recombinant protein technology, and the resulting CaM proteins are purified through hydrophobic interaction chromatography. A comprehensive calcium binding assay was conducted, utilizing a fluorescent microplate reader to assess changes in calcium binding affinity induced by the mutations. The study hypothesizes that mutations in the calcium-binding sites of CaM may disrupt its regulatory role, affecting downstream signaling pathways. We anticipate that these mutations will alter the protein's ability to bind calcium, providing valuable insights into the molecular mechanisms of calmodulinopathies. The findings may contribute to a deeper understanding of the genetic basis of cardiac arrhythmias and inform targeted therapeutic strategies for individuals with these mutations.

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The Effect of Mechanical Clipping Control on *Myriophyllum aquaticum* Biomass Under Laboratory Conditions
Pearl Jensen
Ryan Wersal

Myriophyllum aquaticum, also known as parrotfeather, is an aquatic invasive plant that has been found in the United States since the late 1800's. Native to South America, it grows quickly and can clog waterways, causing detrimental effects to invaded lakes, rivers, and wetlands. While primarily located in the Southern United States, it has the capability of invading Minnesota. Despite its extended presence in the United States, a formal analysis of mechanical control methods on *M. aquaticum* has not been published.
Following a two-month growing period, three treatment groups were clipped either once, twice, or four times over the course of eight weeks before being harvested four weeks after their last clipping treatment. Dry biomass measurements were used to observe the effects of the treatments. One clipping treatment removed 70% of the original biomass while subsequent treatments removed less than 3%. The final biomass was reduced by nearly 50% with one clipping treatment. This preliminary study will provide insight into how *M. aquaticum* biomass is affected by mechanical control methods and whether this method has the potential to be an effective management technique.

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The Effects of Polypropylene and Polyethylene Microplastics on the Soil Microbiome
Hope Turner
Cecilia Noecker

The soil microbiome plays an important role in plant responses to a changing environment including climate changes. Alterations to microbial communities within this biome may have long term harmful effects. These alterations can be a result of agricultural practices, harmful environments, or the location in which the soil is located. One common agricultural practice is the use of plastic mulch to increase crop yield. Multiple types of microplastic residues are unable to breakdown and tend to accumulate within the soil. The effects of these microplastics on the soil microbiome are not fully understood. To further understand these effects, we chose to study how the microbial composition and function differs between soil samples treated with microplastics under different conditions: treated with small and large polypropylene and polyethylene plastics at two different temperatures. We are extracting DNA from multiple soil samples and amplifying the 16s rRNA gene and will use DNA sequencing to determine the composition of bacteria in each sample. Thus far, we have constructed a method for extracting high-quality DNA from these samples and confirmed the bacterial 16S rRNA can be amplified by PCR. We are continuing to work on extracting the DNA from all samples and preparing them for gene sequencing. These results will help us understand the effect that microplastics have on the function and health of the soil microbiome.

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The Efficacy of Temozolomide in the Presence of Glypicans
Victoria Greene, Jessica Heinsch, Keone Anderson, Austen Bayne
Samantha Katner

Temozolomide (TMZ), belongs to the family of antineoplastics, which are specifically used to treat diseases that undergo neoplasia. TMZ is specifically used to treat cancer through the addition of methyl groups to purine bases, adenine, and guanine, which will cause a disruption in cell replication and transcription. leading to ptosis/cell death if not repaired. TMZ is the standard of care for brain cancers due to its size, which enhances its ability to cross the blood-brain barrier. However, it can be counteracted if the cancerous cell is able to express methyl-guanine methyltransferase (MGMT) which grants the ability to remove methyl groups from DNA. The expression of MGMT is controlled by the Wnt pathway, which is regulated by glypicans. Glypicans consist of a terminal protein core bonded to the cell membrane via a glycosylphosphatidylinositol (GPI) anchor and heparin sulfate chains that allow the interaction with its environment. There are six different glypicans in mammalian genomes, but glypican 1 and glypican 3 are the receptors of interest due to their increased expression in cancerous cells and both being known to play a role in the regulation of the Wnt pathway. To observe the effects of glypicans 1 and 3 on the efficacy of TMZ, we will be using glioblastoma multiforme cells due to their known overexpression of glypicans.

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The Evolution of Advertising Through Social Media
Ellen Solem
Emily Sauter

This paper investigated the ways in which advertising has developed due to the creation of social media. The main focus of this paper was how consumers develop parasocial relationships with brands, the way in which advertising methods have shifted to a one-on-one focus, as well as the evolution of the way in which advertisements are circulated through the use of content creators and audio editing. The argument within this paper was analyzed through the use of tweets, TikTok videos, and TikTok comments for recognizable brands such as Wendy's, Burger King, Arby's, and Kwik Trip. Through this analysis, it was discovered that brands have begun to foster a sense of emotional attachment with consumers as well as reaching consumers on a personal level to create a sense of loyalty. There have also been both pros and cons created due to social media advertising such as content feeling more authentic and being more likely to resonate with consumers due to the participatory aspect. An observed con is parasocial relationships reaching a point of feeling too realistic, which provides consumers with the idea that a brand mascot has a persona. Future research should continue to explore the connection and effects between brands, advertising, and parasocial relationships.

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The Gallae; Gender and Worship: Trans* Priestesses of the Ancient Mediterranean
Casey Carlisle
Alisa Eimen

For my presentation, I will be giving a lecture on the Gallae, a group of ancient Mediterranean eunuch priestesses who were dedicated to a maternal goddess. In my talk I will explore the lived negotiations between gender presentation, spirituality, sacrifice, worship, and sexuality. This lecture will be recorded and released as an episode for my upcoming podcast, Feminine Masculinities: A Queer History Podcast.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61283

The impact of a damaged amygdala on aggression in green anole lizards
Brooke Andel
Rachel Cohen

The green anole lizard (*Anolis carolinensis*) is seasonally breeding, with dramatic behavioral, physiological, and morphological changes between the breeding and non-breeding season. It is known that across different seasons, there is a change in the number of neurons within the amygdala. When transitioning from breeding to non-breeding, that is when neurons die via apoptosis. This is a region in the brain that is shown to play a major role in behavior, especially aggression. This study sought to see the impact of induced neuron death on the lizard's behavior. To induce neuronal death within the amygdala, stereotaxic brain surgery was performed on each of the lizards. To begin, resident- intruder behavior tests were conducted and recorded for 15 minutes prior to the surgeries. The lizards were allotted 5 minutes of acclimation to the cages prior to intruder being added in with the resident and recording each video. These procedures locate and target small areas in an organism such as the brain, via a three-dimensional coordinate system. Anoles will be anesthetized with isoflurane and placed on ice for sedation. A small incision is drilled through the skull to the brain and the amygdala is injected with staurosporine (100 nl), which is a neurotoxin that induces cell death through intrinsic apoptotic pathways, via a hamilton syringe. After injection the opening is sealed with vaseline and the lizard recovers for three days. Afterwards, post-surgery behavior videos were then recorded in the same way as the pre-surgery video. Brain, blood, and tissue samples will be collected. Behavior recordings were then analyzed using BORIS software to determine if there were changes in behavior pre- and post-surgery. This is done by using an ethogram to quantify the different events and types of behaviors that are displayed by the lizards.

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The Impact of COVID-19 Infection on the Development of Autoimmune Diseases
Eden Cherinet
Keenan Hartert

The risk of getting autoimmune diseases after getting covid. What genes are expressed in patients with covid and certain autoimmune disease patients.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61439

The Use of Compression Leggings for Improving Recovery from Exercise in College Students
Chayton Schmidt, Lauren Bondhus, Selvin Hernandez, Kylie Hensch, Marissa Muller, Natalie Dodson, Cody Dayton, Sean Sheets
Corey Selland

Strenuous exercise can result in muscle damage and delayed onset muscle soreness. Additionally, an acute reduction in strength, power, and exercise performance is common with vigorous exercise and delayed onset muscle soreness. Various recovery methods to minimize or reduce muscle soreness and attenuate performance decrements is of interest to athletes and coaches. Therefore, the purpose of the current study is to evaluate the use of compression leggings as a recovery from strenuous exercise. College-aged adults provided informed consent and were deemed apparently healthy according to the Physical Activity Readiness Questionnaire (PAR-Q+) participated in the study. Participants had their height, weight, perceived readiness to exercise, perceived recovery, perceived stress, muscular strength, muscular power, and aerobic fitness assessed. Participants completed two exhaustive exercise sessions (separated by at least 7 days). Following each exercise session, participants followed one of two recovery modalities, a traditional aerobic cool-down (15 minutes cycling at 55% of maximum heart rate) or 15 minutes using the compression leggings at a pressure level of 5. Twenty-four hours after each exercise session, perceived readiness to exercise, perceived recovery, perceived stress, muscular strength, muscular power, and aerobic fitness were assessed. The subjective measures (perceived readiness to exercise, perceived recovery, perceived stress) and objective measures (muscular strength, muscular power, and aerobic fitness) will be compared between the low-intensity active

recovery and the compression leggings recovery procedures. Elucidating a difference between the recovery methods may provide valuable information on applying recovery tactics for athletes and coaches.

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Thriving Abroad: Factors Affecting Depression Among Undergraduate International Students.
Nomin Senadheera
Wade Davis

The purpose of this research project is to identify and investigate the causes and lifestyle factors affecting depression among undergraduate international students attending a regional comprehensive university in the Midwest. Given the unique circumstances and stressors faced by the students studying outside their home countries, international students experience high levels of depression. Depression can impact these students' overall health and affect their futures. Current research shows the prevalence of depressive thoughts for international students and the universities need to take more action. This project is designed to examine the relationship between a series of demographic variables such as age, domestic and international support systems, financial security, length away from home countries, and areas of studies and depression. Primary research consists of the completion of 50+ surveys to international undergraduate students ages 18 to 25 at a comprehensive regional undergraduate university—in the upper-Midwest. The answers will be evaluated using analytical and statistical methods. This project is designed to examine the relationship between depression and demographic variables such as age, domestic and international support systems, financial security, length away from home countries, and areas of academic study. At the conclusion, I plan to report my findings to the university leadership and provide recommendations to encourage the university to help international students be more social, keep in touch with their families regularly, meet new friends, and provide information about where to find help if they feel depressed or lonely, and help them overcome this situation and educate everyone else about their situation.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61125

Touch Dynamics: A Biometric Authentication Method for Mobile Devices
Niftalem Kassa
Rushit Dave

The widespread adoption of smartphones has led to a growing demand for secure and convenient identity authentication methods. Touch dynamics, which analyzes the unique characteristics of an individual's touch behavior, has emerged as a promising biometric modality for mobile devices. This paper provides a comprehensive overview of touch dynamics-based authentication, covering its underlying principles, system architectures, feature extraction techniques, classification algorithms, and performance evaluation metrics. Additionally, the paper discusses the advantages and limitations of touch dynamics compared to traditional biometric methods, such as fingerprint and facial recognition. Furthermore, the paper explores the potential applications of touch dynamics beyond authentication, such as user profiling and affective computing. Despite its promising potential, touch dynamics-based authentication faces challenges that warrant further exploration. Enhancing robustness against environmental factors, mitigating the impact of device variations, and addressing concerns regarding privacy and security are crucial areas for future research. By addressing these challenges, touch dynamics can become a ubiquitous and trusted biometric modality for mobile devices, revolutionizing the way we interact with technology. The research anticipates that touch dynamics will demonstrate promising results in terms of authentication accuracy, robustness, and user acceptability. The discussion will address the implications of the research findings for the future of biometric authentication and mobile security.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61005

Ultra-High-Performance Concrete (UHPC) Mechanical Properties
Raissa Natacha Ineza
Fatih Bektas

Ultra-High-Performance Concrete (UHPC) is a relatively new class of concrete that can have strengths up to 30,000 psi. This is considerably high compared to normal strength concrete that has a strength around 4,000 psi. UHPC mixes have shown to be superior to traditional concrete mixes: for instance, compared to a girder made of regular concrete, a UHPC girder can span 20-25% further, or allow shallower cross-sections to cross the same distance. In addition to technical benefits UHPC mixes are long-lasting, durable construction materials that are designed to serve over 60 years. UHPC mixes are generally propriety materials with a high price tag. There is a great interest from state department of transportations to develop local mix designs. Key design components of UHPC include a tightly packed matrix using well-graded solid particles (i.e., aggregate, unhydrated cementitious materials), minimum amount of water to increase strength, high amounts of superplasticizer for fluidity, and addition of fibers to increase ductility. A laboratory research program is proposed to produce 18,000-psi concrete using materials available to the State of Minnesota. The proposed research includes designing of several UHPC mixes and testing them to determine their mechanical properties. Hemp fibers, which can be a potential local material, will also be tested as a UHPC ingredient. A cost analysis will be done. The proposed research is designed to be an explanatory work for future funding from Minnesota Department of Transportation and Agricultural Utilization Research Institute.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61333

Understanding the effect of estradiol treatment on the development of the preoptic area in the green anole lizard brain.
Kaylyn Batchelor
Rachel Cohen

Sex differences in forebrain morphology arise during development and are often linked to hormonal changes. These dimorphisms frequently occur in regions related to reproductive behaviors. Steroid hormones, such as testosterone and estradiol have important roles in vertebrate development by producing sex-specific structures, including the copulatory system and areas of the brain. Our experiment's overall goal is to examine the effects of estradiol on the brain and copulatory system development. Specifically, this study focuses on the preoptic area (POA) of the brain. This region exhibits sexual dimorphism, with male vertebrates displaying a morphologically larger preoptic brain area compared to females. Previous research establishes estradiol as having a role in masculinizing the POA in rats. Although these findings have been displayed in rodents, there is no research on estradiol effects on the preoptic brain area in other vertebrates such as green anole lizards (*Anolis carolinensis*). We hypothesize that estradiol masculinizes the POA in green anole lizard development, therefore we anticipate that female lizards treated with estradiol would exhibit an enlarged POA, resembling the size of a male POA. To address this hypothesis, we treated lizard embryos with either estradiol or vehicle control and collected tissue after hatching. We previously utilized PCR on genomic DNA to determine the sex of the hatchlings. We are currently sectioning brains to examine POA morphology of the hatchlings treated with estradiol or vehicle control to see if there are any effects of hormones on brain development. The growing understanding of estradiol in green anole lizards will promote a better prediction for how estradiol treatment could affect brain morphology in other vertebrates.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61319

Understanding the Role of Glypicans in the Human Body and Disease Development
Keyur Karmacharya, David Rezac
Samantha Katner

Glypicans are members of the heparan-sulfate proteoglycan-associated protein family and play pivotal roles in cellular functions like influencing development, structural support, and wound healing. Specifically, glypican-1 (GPC1) has been implicated in promoting cell growth, which raises questions about its involvement in glioblastoma, a highly aggressive brain cancer. Glioblastoma poses significant challenges due to several factors

such as genetic diversity and rapid growth of the tumors as well as the location of the tumors – ultimately creating limited treatment efficacies and approaches that result in poor long-term outcomes. Here, we generated CRISPR-edited glioblastoma cell models and employed the models in a variety of techniques to analyze the role of glypicans in glioblastoma proliferation. Our preliminary findings indicate distinct protein expression profiles among the CRISPR-edited models which may indicate altered protein interactions with glypicans. Further investigation is underway to identify proteins associated with glypicans and their potential influence on glioblastoma progression. Overall, this research provides a foundation for understanding the role of glypicans in glioblastoma proliferation which may offer insights that could inform targeted therapeutic approaches and advance our understanding of this devastating disease.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61134

Unearthing Insights: Long-term soil CO2 monitoring instrumentation.
Max Ritter
Jake Swanson

Our project is to develop an instrument to measure the carbon dioxide concentrations in subsurface soils over an extended period of time. The instrument collects measurements intermittently and transmits it to a cloud server. The focus of our team is to optimize the electrical components to ensure reliable functionality without causing operational issues.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61316

Unveiling the Unique Transcriptional Regulatory Landscape of *Eggerthella lenta*.
Cyrille Date
Cecilia Noecker

Transcription factors (TFs) are protein domains that regulate gene expression in response to an external stimulus. Inducers are transcription factors that turn a gene "on" and repressors turn genes "off". A model bacteria like *Escherichia coli* has over 250 transcription factors in its genome. Another characteristic of a model bacteria is the two-component systems transcription factor. In this TF, one protein responds to the signal from a separate protein. This is not the case for our bacteria of interest, *Eggerthella lenta*. *E. lenta* is a common human gut microbe with many unusual metabolic pathways. *E. lenta* also has a unique one-component system that receives the signal and also directly regulates transcription. While there is general knowledge of TFs in other species, it is not clear what genes are regulated by these *E. lenta* TFs and how they are distributed within and across different *E. lenta* strains. This research aims to find out the nature of the genes being regulated as well as the location of the TFs in *E. lenta* genomes. I am using RStudio to analyze *E. lenta* genomic data and genome annotations to pinpoint the location of these TFs and their regulatory targets. I will also compare these TFs across *E. lenta* genomes across different geographic locations and hosts. This research will show us how *E. lenta* uses its unique TFs to not only survive in, but also impact the human gut microbiome ecosystem.

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What is the Relationship between Concussions and Academic Performance in College Student Athletes?
Kylie Andresen, Jennifer Maharaj, Alyssa Killian, Madalyn Kinneberg
Jehad Adwan

This research aims at understanding whether there is a relationship between the occurrence of concussions and academic performance among student athletes at MNSU.

Official abstract to be shared once research data collection has concluded.

https://symposium.foragerone.com/2024-undergraduate-research-symposium/presentations/61331

Your Tablet May Know You Better Than You Know Yourself- Continuous Authentication Using Minecraft.

Pidge Witiak, Zach Winterfeldt, Tucker MacCallum, Pedro Gomes do Nascimento
Rushit Dave

This research aims to further understanding in the field of continuous authentication using behavioural biometrics. We are contributing a novel dataset that encompasses the gesture data of 15 users playing Minecraft with a Samsung Tablet, each for a duration of 15 minutes. Utilizing this dataset, we employed machine learning (ML) binary classifiers, being Random Forest (RF), K-Nearest Neighbors (KNN), and Support Vector Classifier (SVC), to determine the authenticity of specific user actions. Our most robust model was SVC, which achieved an average accuracy of approximately 90%, demonstrating that touch dynamics can effectively distinguish users. However, further studies are needed to make it viable option for authentication systems. You can access our dataset at the following link: https://github.com/AuthenTech2023/authentech-repo

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