16th Annual Student Center for Science Engagement Research Symposium

September 27th, 2024
NEIU Main Campus, Student Union
8:30 AM to 4:30 PM

Northeastern
ILLINOIS UNIVERSITY
Student Center for Science Engagement

The Student Center for Science Engagement
Sixteenth Annual Research Symposium

Friday, September 27th, 2024
NEIU Main Campus, Student Union
8:30 AM to 4:30 PM

Student Center for Science Engagement

Kenneth Voglesonger, Ph.D.
Interim Associate Dean,
College of Arts and Sciences

Jorge Cantu, Ph.D.
SCSE Director
Associate Professor, Biology

Laura West, M.S.
Student Academic Services Specialist in STEM

Luke Devereux, M.S.
STEM Advisor

Agustina Chirinos
Office Manager

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Joseph Hibdon, Jr., Ph.D.
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John Kasmer, Ph.D.
Associate Professor, Environmental Science

Ahmed Khaled, Ph.D.
Assistant Professor, Computer Science

Denana Miodragovic, Ph.D.
Assistant Professor, Chemistry

Andrew Young, Ph.D.
Assistant Professor, Psychology

Sixteenth Annual Student Center for Science Engagement Research Symposium

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Student Center for Science Engagement (SCSE)
MISSION AND GOALS

The mission of the SCSE is to significantly improve recruitment, retention and graduation rates for students in STEM disciplines, with an emphasis on minority, low-income, and first-generation students. The goals of the SCSE are being achieved by enhancing academic support through tutoring, advising, faculty-student research projects, and mentoring. We provide professional development opportunities to students through internships, networking opportunities, and connections with leaders in STEM industries and academic institutions. We also foster career exploration in STEM fields and the development of programming focused on reaching minority, low-income and first-generation students. The SCSE is proud to serve NEIU and support future student success in the sciences.

Sixteenth Annual Student Center for Science Engagement Research Symposium

Message from the College of Arts and Sciences

Welcome to the 16th Annual SCSE Student Research Symposium!

On behalf of the College of Arts and Sciences, we are delighted to welcome you to this celebration of student achievement in scientific research. This year, we have 55 presenters who have worked with over 20 faculty members. This symposium is a testament to the hard work, dedication, and curiosity of our students, their faculty and research mentors, and the staff at the SCSE!

We would like to express our sincere appreciation to the faculty mentors whose guidance and expertise have been invaluable in fostering the growth and development of our student researchers. Undergraduate research is a transformative experience that provides students with practical skills, fosters curiosity and critical thinking, allows students to be more competitive applicants as they enter the workforce and/or apply to graduate programs, and provides an all-around enriching experience for both faculty and students.

We would like to recognize the behind-the-scenes work of the SCSE staff and director, Dr. Jorge Cantú, to make this a seamless event. In addition, we know that the SCSE has a longstanding tradition of supporting scholars, offering many professional development opportunities, and providing a fun place to hang out with fellow scientists.

Finally, we would like to acknowledge the outstanding work of our students. Your research has made significant contributions to the scientific enterprise, and we are proud to showcase your accomplishments today.

Thank you for joining us. We hope you enjoy the symposium and feel inspired to pursue your own line of inquiry and research.

Tim Libretti, Interim Dean, College of Arts and Sciences
Ken Voglesonger, Acting Associate Dean, College of Arts and Sciences
Amanda Dykema-Engblade, Acting Associate Dean, College of Arts and Sciences

Sixteenth Annual Student Center for Science Engagement Research Symposium

SCSE Director's Message

Welcome to the 16th Annual Student Research Symposium of the Student Center for Science Engagement! This symposium showcases the research performed by your fellow students in laboratories across the US, including right here at Northeastern Illinois University (NEIU). The research presented today comes from all scientific disciplines including Physics, Chemistry, Biology, Psychology, Mathematics, Computer Science and more.

To the student researchers, your commitment and curiosity exemplify the spirit of discovery that fuels the scientific field. Embrace this opportunity to share your findings, and I hope this experience is the first of many on your path to scientific fame and fortune. To the research advisors, your passion for mentoring is on full display today. Thank you for the care and patience you show the next generation of scientists. The opportunity to present their work is a transformational experience for these budding scientists and would be impossible without your support. Thank you for sharing your projects, wisdom, and dedication.

This symposium would not have been possible without the assistance offered by various departments, programs and institutions, including the NEIU College of Arts and Sciences, NEIU Academic Affairs, the NEIU College of Business and Technology, the National Science Foundation (NSF) Advancing Research and Career Opportunities in STEM (ARCOS) program, the National Institutes of Health (NIH) MARC NU-STAR Program, and the NSF Illinois Louis Stokes Alliance for Minority Participation (ILSAMP). The resources and support from these entities contributed to the success of our program this year.

Lastly, I would like to acknowledge and appreciate the efforts of the SCSE staff members Laura West, Luke Devereux, Ginger Dragon and Agustina Chirinos. Their exceptional contributions were instrumental in steering student-centered professional development, providing comprehensive support for our summer program, showcasing the SCSE, and effectively organizing and coordinating this Symposium. The SCSE office wears many hats in supporting our students, and their outstanding work epitomizes this commitment. Without the remarkable efforts of these individuals, none of this would have been possible.

We are thrilled to have y'all here to celebrate this amazing event!

Jorge A. Cantú, Ph.D.
Director, Student Center for Science Engagement
Associate Professor of Biology
College of Arts and Sciences

SCHEDULE

8:30-9:00 A.M.
Breakfast and Registration
Alumni Hall South

9:00-9:30 A.M.
Welcome and Opening Remarks
Alumni Hall South

9:30-10:45 A.M.
Keynote Speaker Presentation
Dr. Oliver Lopez
Alumni Hall South

10:45 A.M.-11:00 A.M.
Break

11:00 A.M.-12:15 P.M.
Morning Podium Presentations
SU 003 and SU 214

12:15-12:45 P.M.
Lunch
Alumni Hall South

12:45-1:15 P.M.
Recognition of Students
Alumni Hall South

1:15-2:15 P.M.
Afternoon Podium Presentations
SU 003 and SU 214

2:15-2:30 P.M.
Coffee Break
Alumni Hall North

2:30-3:30 P.M.
Poster Session A
Alumni Hall North

3:30-4:30 P.M.
Poster Session B
Alumni Hall North

KEYNOTE ADDRESS

Dr. Oliver Lopez is an accomplished educator and statistician with a rich background spanning academia, research, and community engagement. At Chapman University, Dr. Lopez serves as a lecturer in statistics and biostatistics, teaching at both the undergraduate and graduate levels. He is dedicated to fostering the development of future statistical practitioners, equipping students with the essential tools for diverse applications in life, work, and research. His commitment to student growth is exemplified in his mentorship of non-STEM undergraduates, guiding them through data projects that culminate in presentations at the university's Student Research Symposium. Dr. Lopez's educational approach is innovative, incorporating real industry examples, ethics, and human subjects' protection into his courses, thereby enriching the learning experience for his students.

In addition to his academic role, Dr. Lopez is an active community leader, currently serving as a community board member at Southern California Kaiser, where he applies his statistical expertise to ensure ethical research practices and the protection of human subjects. His community involvement extends to collaborating with non-profit organizations focused on supporting high school students, working to integrate their initiatives into the campus community. Dr. Lopez is particularly passionate about assisting first-generation college students, especially those navigating the challenges of undocumented status, reflecting his deep commitment to comprehensive student support.

Dr. Lopez also brings significant industry experience as a former biostatistician, where he contributed to phase I, phase IIa, and phase IIb clinical trials across various medical conditions, including diabetes, wound closure due to disease progression, and innovative insulin delivery methods. His work also encompassed bioequivalence and pharmacokinetic studies, demonstrating his broad expertise in biostatistics. A PhD graduate in Biostatistics from the University of Southern California, Dr. Lopez completed his entire educational journey as an undocumented individual. His story is a testament to his resilience and dedication, and his commitment to education, research, and community engagement is evident in every aspect of his work.

PODIUM PRESENTATION SESSION #1A ABSTRACTS

CENSUSING LEEDY'S ROSEROOT (*Rhodiola integrifolia* ssp. *leedyi*), USING DRONE BASED DIGITAL IMAGING

Samantha Sandoval, Velma Elba, and Joel P. Olfelt Ph.D.
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Obtaining fundamental information about rare plant species, such as their presence in a location and population sizes is crucial in conducting informed management decisions. Survey techniques can be time consuming or perilous in certain environments. Unmanned Aircraft Systems (e.g. drones) have become increasingly utilized for monitoring rare plant populations because they can operate over difficult/extensive terrain and digitally capture permanent records with minimal disturbance. However, drone image quality can depend on weather conditions, piloting skills, and the presence of obstacles like tree canopies. We are comparing drone-based imaging technology with direct visual counts of individuals to census populations of the cliff dwelling, rare and endangered plant *Rhodiola integrifolia* ssp. *leedyi*. In this pilot study, we captured ~200 overlapping images using Phantom Pro 4 V2.0 and Mavic 2 drones of a relatively unobstructed and approximately ~60 m long cliff area. We also made visual estimates from the cliff base of the number of Leedy's roseroot plants. We are currently using Adobe Photoshop to compile drone images and we will compare the population size estimates from the drone images with our direct visual estimates. Preliminary drone image results show that Leedy's roseroot individuals are identifiable and distinguishable from other species. These pilot study results suggest that drone imaging can yield high quality, verifiable census estimates that can be directly compared across years. We plan to extend our techniques to overcome the challenges of censusing Leedy's roseroot populations that are obstructed by tree canopies.

LARGE LANGUAGE MODELS AS TRANSCRIBERS OF HERBARIUM VOUCHERS: HOW GOOD ARE THEY?

Daniel Stille[1], Thomas Campbell Ph.D.[2], Francisco Iacobelli Ph.D.[1], Riley Herbst[3], Gilbert F. Gwilliam III[4], Yarency Rodriguez[4], Lucia Kawasaki[4], Danny Kreider[4] and Matt von Konrat Ph.D.[4]

[1]Department of Computer Science, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625
[3]Department of Computer Science, Roosevelt University, Chicago, IL 60605
[4]Field Museum of Natural History, Chicago, IL 60605

In the modern digital era the essential task of digitization of natural history specimens of all types, especially of scientific label information, has been a massive effort around the world, but has not been able to produce results at scale due to limited human and financial resources. This study explores how specimen label information may be digitized at scale through the use of Large Language Models (LLMs). We tested using LLMs to transcribe and parse information from herbarium voucher/packet images. For typed text extraction from a specimen image, we initially used Tesseract-Optical Character Recognition and then relied on the vision capabilities of the LLMs themselves. For parsing, we used OpenAI's ChatGPT-3.5, 4 and 4o, Anthropic's Claude Opus and Sonnet, and Google's Gemini. Transcription outputs were compared to ground-truth data manually transcribed from Field Museum collections. With increasingly sophisticated and honed prompts, various models were evaluated for speed, cost and accuracy. We note that image preprocessing and attention to prompt engineering improved accuracy while accuracy and consistency varied between each LLM. Our testing has shown that LLMs have promise for significantly reducing the time and personnel costs of the herbarium transcription process. Proposed future work would continue prompt engineering to improve accuracy and would use custom LLMs to reduce variability in the results. This study further notes the potential of using LLMs in natural history collections across disciplines and suggests more research into optimizing workflows that have been stagnant in museums for many years.

USING MOSS AS A BIOINDICATOR OF URBAN AIR POLLUTION

Emily Erazo[1+], Kate Peltz[1+], Kage Guare[1+], Matt Von Konrat Ph.D.[2], and Tom Campbell Ph.D.[1,2]
[1] Department of Biology, Northeastern Illinois University, Chicago, IL 60625 [2]
Gantz Family Collections Center, Field Museum, Chicago, IL 60605
[+] These authors contributed equally to this work

Air pollution is the single largest environmental cause of premature death in the world. The 1990 Clean Air Act revisions have mandated lower emissions from pollution sources such as vehicle tailpipes and industry, though marginalized communities often experience disparities despite these mandates. Such regulations have often also overlooked other sources of particulate matter such as tires and brakes. Here, we report on an investigation using moss bags as bioindicators of air pollution, and of metals in particular. Mosses belong to a larger group of plants known as bryophytes. Mosses have been used for decades in many countries as a low-cost indicator species because of their ability to absorb water and contaminants from the air. In this experiment, we used a portable XRF machine to analyze and compare samples from *Sphagnum* moss bags placed strategically throughout the Chicagoland area. At each site, samples were exposed for 1-, 3-, and 4-week time periods to test speed of uptake of pollutants and determine an ideal timeframe for future studies. We refined and standardized our methods of XRF analysis and sample preparation to ensure consistency in the data and lay groundwork for future iterations of this ongoing research. We expect pollution hotspots to have higher levels of detectable contaminants in comparison to the protected natural areas and laboratory controls. This research clearly warrants further investigation and supports the potential use of mosses and XRF spectroscopy as a rapid, low-cost, and potentially accurate alternative to conventional metal pollution biomonitoring.

FUEL PROPERTIES OF BIODIESEL AND BIODIESEL BLENDS DERIVED FROM *ORYCHOPHRAGMUS VIOLACEUS*

Michael Noonan[1,2], Erin Walter[1], and DeMichael Winfield Ph.D.[1]
[1]USDA-ARS, National Center for Agricultural Utilization Research, Peoria, IL 61604
[2]Department of Chemistry, Northeastern Illinois University, Chicago, IL 60625

With the higher cost of commodity crops, there is interest in utilizing alternative crops as biofuel feedstocks. One such potential crop is *Orychophragmus violaceus* (Brassicaceae; common names: Chinese violet cress, February orchid), an annual or biennial native to China and North Korea that can grow in marginal lands. Unlike typical seed oils, *Orychophragmus violaceus* (Ov) contains the long-chain fatty acids nebraskanic [7,18-$(OH)_2$-24:1] and wuhanic [7,18-$(OH)_2$-24:2] acids. This work aims to determine Ov's viability as biodiesel. Base-catalyzed transesterification was performed to yield fatty acid methyl esters (FAMEs). The product consisted of 42.30% dihydroxy FAMEs, and FAME properties were tested using the ASTM D6751 standard for biodiesel. The cloud and pour points were 9.0°C and 1.0°C, respectively. The cold filter plugging point was -3.3°C. These cold flow properties were less favorable for biodiesel in colder environments. The induction period at 110°C (IP_{110}) was 1.62 h. Despite the IP_{110} not meeting the D6751 standard of 3 h, it is higher than most biodiesel. The kinematic viscosity at 40 °C and 100 °C was determined to be 3.190 $mm^2 s^{-1}$ and 1.554 $mm^2 s^{-1}$, respectively, which meets the D6751 standard. The lubricity of the biodiesel was 210 µm, which is significantly lower than the lubricity of ultra-low-sulfur-diesel (ULSD) of 632 µm. Our preliminary data suggests that Ov FAMEs may be suitable as an additive for ULSD blends due to its excellent lubricity and moderate oxidative stability. Blending of Ov FAMEs and ULSD will be performed, and resultant properties will be analyzed.

BENEFICIAL FUNGUS EMITS VOLATILES THAT INHIBIT PRODUCTION OF TRICHOTHECENE TOXINS BY FUSARIUM

Zaria Robinson[1,2], Susan McCormick Ph.D.[1], Guixia Hao Ph.D.[1], Nicholas Rhoades Ph.D.[1], Robert Proctor Ph.D.[1], and Martha Vaughan Ph.D.[1]
[1]USDA, Agricultural Research Service, National Center for Agricultural Utilization Research, Mycotoxin Prevention and Applied Microbiology Research Unit, Peoria, IL 61604
[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Fusarium fungi are among the most destructive to agricultural productivity and safety. They not only cause diseases which reduce crop yield but also contaminate crops with poisonous toxins that if consumed cause serious health problems. Fusarium graminearum (Fg) infects cereal crops and contaminates grain with trichothecene toxins. Sarocladium zeae (Sz) is a beneficial fungus that frequently colonizes corn and wheat plants without causing any negative effects to the plant, and Sz, has been shown to increase plant resistance to Fusarium pathogens. Our team recently discovered that co-culturing Sz with Fg completely inhibits Fg trichothecene production. Metabolite analyses revealed that Sz, strains capable of inhibiting trichothecenes, produce several candidate metabolites including volatile sesquiterpenes. To test the hypothesis that the sesquiterpene volatiles or other Sz metabolites affected Fg growth and trichothecene production, the two fungi were grown together on plates sharing the same media or on I-plates which allow only for volatile exposure between the fungi. The diameter of Fg and Sz colony growth was measured daily for a week and compared between treatments. The fungal metabolites were then extracted from the media and the amount of trichothecene was determined using gas chromatography mass spectrometry. Fg growth was not affected by Sz metabolites, but trichothecene production was inhibited on I-plates suggesting that volatiles were responsible for the inhibition. Application methods for the beneficial fungi with optimal volatile production to control trichothecene contamination are underway.

PODIUM PRESENTATION SESSION #1B ABSTRACTS

DESIGN AND IMPLEMENTATION OF AN INTERACTIVE AI-DRIVEN COUNSELING SYSTEM (ACOSUS)

Sanjana Motte Vishwanatha[1], Deep Mandloi M.S.[1],
Palvi Aggarwal, Ph.D.[2], Shebuti Rayana, Ph.D.[3], Sherrene Bogle, Ph.D.[4],
Yun Wan, Ph.D.[5], and Xiwei Wang, Ph.D.[1]
[1]Department of Computer Science, Northeastern Illinois University, Chicago, IL 60625
[2]University of Texas at El Paso, El Paso, TX 79968
[3]SUNY at Old Westbury, Old Westbury, NY 11568
[4]Cal Poly Humboldt, Arcata, CA 95521
[5]University of Houston-Victoria, Victoria, TX 77901

The primary objective of this research project is to assist underserved individuals in STEM fields at community colleges in transitioning to universities and the job market. This will be done through an AI-driven counseling system that provides detailed insight into students' backgrounds to advisors, allowing them to offer better guidance. The web application enables administrators to enter key factors influencing students' transfer decisions and readiness for academic and career success. These factors are assigned weights used by a neural network model to predict students' success rates, thereby improving the application's predictive accuracy. The interactive web application's technology stack includes MongoDB for data storage, a React frontend, an Express backend server, and a Flask API server hosting a neural network model developed with SciKit Learn. The model server involves data preprocessing, data transformation, and scaling using the MinMax scaling algorithm. The transformed data is then fed into the neural network model, which predicts the success rate. In summary, the AI-driven counseling system aims to significantly enhance students' academic and career success, benefiting not only the students but also their advisors. It provides insights into students' backgrounds and calculates success rates, enabling advisors to guide students more effectively toward achieving academic and career success.

AWIPS: DBGEO PLUG-IN ENHANCEMENTS FOR AVIATION WEATHER CENTER AIRCRAFT OBSERVATION

Yair Jordi Banuelos[1,2], Maurice McHugh Ph.D.[1], Joe Zajic M.S.[1], Lee Byerle Ph.D.[1], Jaina Morgan M.S.[1], Ry McClure[1], Matthew Comerford[1]

[1]National Oceanic and Atmospheric Administration (NOAA), Silver Spring, MD 20910

[2]Department of Computer Science, Northeastern Illinois University Chicago, IL 60625

In response to the evolving demands of meteorological data processing within the Advanced Weather Interactive Processing System (AWIPS), this project outlines significant enhancements to the DBGeo plugin. DBGeo is a plugin within AWIPS that is responsible for applying attributes to a given geometry. The current DBGeo plugin lacks flexibility in handling new data types, requiring extensive manipulation or custom coding for each new data source, which poses challenges in implementation. The primary objective is to refactor DBGeo to integrate diverse data types efficiently through a unified architecture configurable via XML files. This approach aims to streamline data integration within AWIPS, reducing dependency on custom coding and enhancing capabilities to visualize temporal data associated with meteorological parameters such as temperature and pressure associated with a geometry. Specifically, the updated plugin will support the display of turbulence recorded by aircraft, significantly augmenting AWIPS's functionality for meteorological forecasting and analysis at the Aviation Weather Center. The study focuses on software development within a research context, emphasizing departures from traditional plugin architectures. Methods include software refactoring and XML configuration implementation. Results include improved data handling capabilities and enhanced visualization tools within AWIPS. The significance of these enhancements lies in their potential to optimize meteorological data processing, supporting more accurate weather forecasts and better decision-making for aviation weather center operations. Future directions include expanding plugin functionalities to accommodate evolving data sources and refining integration processes.

THE SYNCHRONIZATION OF FIREFLIES

Favour Ogukwe[1], Danny Abrams Ph.D.[2], Guy Amichay Ph.D.[2], and Aaron Scheiner[2]
[1]Department of Biology, Northeastern Illinois University, Chicago, IL 60625
[2]Department Engineering Sciences and Applied Mathematics, Northwestern University, Evanston, IL 60208

This project explores the synchronization phenomenon in coupled oscillators using the Kuramoto model to analyze the collective behavior of fireflies. Drawing on concepts from Steven H. Strogatz's "Nonlinear Dynamics and Chaos," we aim to understand the mechanisms behind the synchronization of fireflies' flashing patterns. The Kuramoto model describes a system of oscillators interacting through sinusoidal coupling. By employing both analytical and numerical methods, we examine how the coupling influences synchronization. We simulate the Kuramoto model with a population of oscillators representing fireflies. Each oscillator's phase evolves according to its natural frequency and coupling interactions with other oscillators. We vary the coupling strength and observe the transition from incoherence to synchronization. Stability analysis helps identify fixed points and their stability, providing insights into the conditions necessary for synchronization. The results show that as the coupling strength increases, the system transitions from an incoherent state, where fireflies flash independently, to a synchronized state, where they flash in unison. This transition is marked by a critical coupling strength above which synchronization is achieved. Our findings highlight the robustness of the Kuramoto model in capturing the essence of synchronization phenomena observed in nature, such as the synchronous flashing of fireflies. This study underscores the significance of nonlinear dynamics and chaos in understanding complex biological systems. The synchronization of fireflies, explained by the Kuramoto framework, shows how simple interaction rules can lead to complex, emergent behaviors, and may also help us understand related phenomena such as circadian rhythm.

DOUBLE RING ATTRACTOR MODEL OF DROSOPHILA NAVIGATION

Wesal Hammo[1], William Kath Ph.D.[2], and Marco Gallio Ph.D.[3]
[1]Department of Mathematics, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Engineering Sciences and Applied Mathematics, Northwestern University, Evanston, IL 60208
[3]Department of Neurobiology, Northwestern University, Evanston, IL 60208

Drosophila, poikilothermic insects, thrive in cooler environments and struggle in warmer ones due to their inability to regulate their body temperature. Their primary survival strategy for managing temperature is to move from one location to another. In the Gallio laboratory at Northwestern University, we observed these flies as they navigated their environment, exploring and processing information. Our study focused on the neural activity associated with their navigation. We developed a model to simulate the neuron firing patterns in the Drosophila brain as they sought out optimal temperatures. Using MATLAB, we created a double-ring attractor model that encodes both heading and goal directions, simulating the neural activity patterns—referred to as "bumps"—that occur as the flies move. This model allows the heading and goal directions to interact dynamically, reflecting the ongoing adjustments made by the flies as they navigate. We then ran simulations to observe whether the model shows a preference or an increase in neural activity when the flies move toward a more favorable temperature direction.

INTRODUCTION TO THE FUNDAMENTALS OF QUANTUM COMPUTING

Jacqueline Landi, Hayden Huynh, Habib Mohammed, and Graciela Perera Ph.D.
Department of Computer Science, Northeastern Illinois University, Chicago, IL 60625

Quantum Computing is becoming one of the main sectors in technology, and it will be expanding its access here in Chicago, after Governor JB Pritzker announced he would invest 500M dollars into the quantum industry; making Illinois one of the global competitors in the quantum market. Additionally, as there have been advances in the quantum computing industry in the past few years, the production of quantum computers is still challenging, as well as educating the next generations of quantum computer scientists. What makes quantum computing function is the theory of quantum mechanics and quantum physics. Regardless of the fields where quantum is involved, we can acknowledge the various capabilities a quantum computer has in comparison to our classical computers and their undetermined extent of applicability. Thus, enhancing the understanding of quantum computing to undergraduate students from all backgrounds is a problem due to the limited access to quality educational materials. This research project will address the issue by developing materials and hands-on examples of easy-to-learn quantum algorithms and its relation to computer science concepts. That is, for example, finding a profound understanding of how quantum computation works through the Bernstein-Vazirani algorithm. Introducing undergraduate students to a world where quantum information processing occurs through quantum transformation (also known as quantum gates) is the fundamental basis toward quantum computing.

PODIUM PRESENTATION SESSION #2A ABSTRACTS

ANALYSIS OF MANGANESE DIOXIDE AS A PHOTOCATALYST FOR THE DEGRADATION OF POLYSTYRENE

Kevin Kelly, Andres Jimenez, and Samantha Brown-Xu Ph.D.
Department of Chemistry, Northeastern Illinois University, Chicago, IL 60625

Artificial heart valves, Lego sets, and cozy blankets are all made from polymers. So are the plastic straws, single-use bags, and disposable Styrofoam containers littering oceans and stuffing landfills. One potential solution to this mounting plastic waste problem is to upcycle it into higher-value chemicals and fuels. This is an energetically uphill process, and many methods of plastic upcycling require more energy and cost inputs than they save. Visible-light activated photocatalysts, however, use abundant and free solar radiation to facilitate plastic upcycling reactions, offering a potential process for making plastic upcycling economically and environmentally rational. This experiment tested MnO_2 as a potential photocatalyst for the oxidative degradation of polystyrene. First, MnO_2 nanoparticles were synthesized from $MnSO_4$, using a simple coprecipitation method. The resulting solid was then added to a solution of polystyrene dissolved in dichloromethane and exposed to intense visible light for a three-week period. Samples of the solution were pulled at one-week intervals, and the extent of degradation of the polystyrene chains was analyzed using GPC and FTIR spectroscopy. Test studies using the model dye compound rhodamine B revealed the ability of MnO_2 to degrade organic molecules under visible light illumination. The photocatalyst itself was also characterized using time-resolved transient absorption spectroscopy. Once this data is fully analyzed, the photocatalytic efficiency of this particular MnO_2 material can be evaluated and compared to other photocatalysts. The results will provide insights into the reaction mechanism and will inform future studies to optimize the reaction conditions.

INVESTIGATING PROTEOSTASIS IMBALANCES IN *C. ELEGANS* EXPRESSING TDP-43, AN AMYOTROPHIC LATERAL SCLEROSIS DISEASE ASSOCIATED PROTEIN

Brittany Zaruszak[1], Joshua Kalarical[2], and Cindy Voisine Ph.D.[1]
[1]Department of Biology, Northeastern Illinois University, Chicago, IL 60625
[2]Lake Zurich High School, Lake Zurich, IL 60047

Amyotrophic Lateral Sclerosis (ALS) is a fatal neurodegenerative disease characterized primarily by degeneration of motor neurons leading to muscle atrophy and paralysis. Mutations in TAR-DNA protein of 43 kDa (TDP-43) have been linked to familial cases of ALS. TDP-43 is an RNA binding protein shuttling mRNA between the nucleus and cytosol. In ALS, TDP-43 accumulates in the cytosol of affected neurons as hyperphosphorylated and ubiquitinated aggregates. Imbalances in key proteostasis pathways, such as protein clearance, have been implicated in many neurodegenerative diseases. Proper targeting of misfolded proteins for degradation is critical for cellular health. To learn more about the connection between proteostasis imbalances and TDP-43 neurotoxicity, we are taking advantage of the simple nervous system and well characterized behavioral assays of the nematode *C. elegans*. Using a ribosome profiling dataset of *C. elegans* expressing TDP-43 pan-neuronally, three upregulated genes, *usp-33, asp-17,* and *lgmn-1* involved in protein clearance were identified. Genetic crosses and molecular genotyping were used to select TDP-43 expressing worms that are homozygous for the deletions. Currently, motility assays are being performed to evaluate motor neuron deficits. Additionally, a western blot will be conducted to determine the level of TDP-43 in the newly generated strains. We hypothesize that *C. elegans* expressing neuronal TDP-43 harboring deletions of *usp-33*, *asp-17*, and *lgmn-1* genes to have altered TDP-43 levels and reduced motility indicating involvement of these genes in TDP-43 clearance. Understanding the mechanisms neurons employ to clear TDP-43 aggregates may reveal therapeutic targets to alleviate ALS pathology.

EVALUATING PLEASANTNESS, DISTINGUISHABILITY, AND DIRECTIONAL ASSOCIATIONS OF HAPTIC STIMULI IN A MOBILITY CANE FOR BLIND/LOW VISION USERS

Ellis K Mudrik[1] and Frederick R Prete, Ph.D. [2]
[1]Department of Biology, Lake Forest College, Lake Forest, IL 60045
[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Approximately 23 million blind/low-vision people use mobility canes. However, traditional canes cannot detect obstacles beyond their tip, necessitating collisions in lieu of avoidance. Our goal is to ameliorate this shortcoming by incorporating haptic (vibratory) feedback into the cane handle, triggered by tip-mounted distance sensors. These experiments were designed to improve that feedback. In Experiment 1, 33 subjects rated the 'pleasantness' and distinguishability of nine haptic stimuli (differing in frequency, duration and amplitude) generated by a DRV2605 haptic driver controlling a Precision Microdrives 306-10H ERM actuator housed in a prototype cane handle. Stimuli were combined into 20 unique triplets (groups of three) and presented randomly. Overall, triplet ratings were negatively correlated with stimulus frequencies ($F_{(1,17)} > 10$, $p < 0.006$), but not with duration. The eight triplets that met our criterion for pleasantness (mean rating > 3.7 on a five-point Likert scale) had lower median frequencies than less preferred triplets (88 vs 94 Hz, respectively; $t > 3.9$, $p < 0.0012$). Of the nine individual stimuli, three of the four with the lowest amplitude occurred most frequently in the eight highest-rated triplets: "single soft fuzz," "single strong pulse," and "transition hum." In Experiment 2, subjects indicated whether they associated individual stimuli with a direction (left, right, straight-ahead). Out of 468 claims of directionality, 43% were Straight-ahead, 30% were Left, 27% were Right. Although directionality claims were not randomly distributed across stimuli (ChiSq = 50.2, p = 0.0013), no individual direction/stimulus count reached significance. These results are consistent with our previous research and enhance our understanding of how to integrate haptics into assistive technologies.

IMPACT OF DRUG TREATMENTS ON CSC CHROMATIN STRUCTURE

Natalia Szponder[1,2], Karla Isabel Medina M.S.[2], and Vadim Backman Ph.D.[2]
[1]Department of Biology, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Biomedical Engineering, Northwestern University, Evanston, IL 60208

Cancer stem cells (CSCs) are cancerous cells that exhibit similar behaviors to stem cells, demonstrating the ability to differentiate, self-renew, and initiate tumor formation. CSCs exhibit a higher level of metastasis in cancer and resistance to chemotherapy. The specific mechanisms for adopting chemoresistance are still unknown. CSCs are able to change their phenotype from CSCs to non-CSCs. CSCs have different chromatin structures and have denser chromatin compaction than non-CSCs. Studying the chromatin will allow an understanding of the control of gene regulation in CSCs. Treatments used were epigenetic inhibitors that cause changes to the chromatin states and gene expression. A live-cell non-invasive imaging technique, partial wave spectroscopic (PWS) microscopy was used to analyze chromatin packing when treated with anti-cancer treatments. CSCs are expected to differ in chromatin structure from non-CSCs. Understanding the chromatin structure of CSCs will provide insights into how these cells can alter their chromatin structure to promote their survival during treatment with cancer therapies. Potentially uncovering new therapeutic avenues and strategies to overcome treatment resistance. This would pave the way for possible more effective treatments against resistant cell populations and improve clinical outcomes in cancer treatment.

PODIUM PRESENTATION SESSION #2B ABSTRACTS

GRAPH NEURAL NETWORK PARTICLE RECONSTRUCTION FOR DUNE'S PROTOTYPE NEAR DETECTOR

Nathaniel Santiago[1,3], Jessie Micallef Ph.D.[2,3] and Jesse Thaler Ph.D.[2,3]
[1]Department of Physics, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Physics, Massachusetts Institute of Technology, Cambridge, MA 02139
[3]The NSF Institute for Artificial Intelligence and Fundamental Interactions, Cambridge, MA 02139

Deep Underground Neutrino Experiment (DUNE) is the upcoming flagship neutrino accelerator experiment in the U.S. that will utilize a novel near-detector design. This design is currently being tested in a 2x2 module arrangement at Fermilab. In order to observe particles that deposit energy outside of the limited 2x2 prototype volume, the detector is being supplemented with 2 collections of scintillator planes, which are detectors from DUNE's predecessor experiment, MINERvA. The goal of this project is to extend the machine learning architecture that already exists for the 2x2 prototype in order to analyze and incorporate data from the MINERvA components. The training data for this project originates from simulated particle interactions, which is then fed into a detector response simulation for the MINERvA detector components. The output of these simulations is then interpreted as geometric information about particles present in the detector, which is then fed into a graph neural network that identifies particle tracks. This work builds key connections in the framework needed to interpret and understand the results of DUNE.

USING PIEZOELECTRIC TRANSDUCERS TO LOCATE BUBBLES ACOUSTICALLY

Jeremy Raucci, Carlos Villeda, and Orin Harris Ph.D.
Department of Physics, Northeastern Illinois University, Chicago, IL 60625

The PICO (Pacific Institute for Community Organization) and SBC (Scintillating Bubble Chamber) collaborations use bubble chambers to search for dark matter. Cameras are used to record bubble events, and this data is processed for position reconstruction of the bubbles inside the chamber. In addition, acoustic data is taken through piezoelectric transducers to define an acoustic parameter used for analysis. We explore the possibility of using only acoustic data for position reconstruction. A 4000 ml beaker filled with water is used to model a bubble chamber. Two piezoelectric transducers are affixed to the beaker acting as receivers for a third, driven piezoelectric transducer. Acoustic data is taken for the beaker filled with only water and for various objects inside the water over a range of voltages and frequencies that the transducer is driven at. The position of the driven transducer is also varied. The data is processed using a Discrete Fourier Transform and a power spectrum is found. By analyzing the Fourier transform and power spectrum we can determine if an object is inside the water.

USING THERMAL CAMERAS TO EXPLAIN CONDUCTIVITY OF DIFFERENT MATERIALS AND SHAPES

Tracy Nguyen and Jamie Millan Henao Ph.D.
Department of Physical Sciences, Harold Washington College, Chicago, IL 60601

Thermal conductivity affects climate change as it affects heat transfer through materials and plays a crucial role in greenhouse effect, ocean heat uptake, permafrost, and methane release. I am working on economic growth, climate change and innovation. The hypothesis was that using objects of different shapes and sizes effect thermal conductivity. For this study, a TG165 FLIR camera was used for taking pictures. I used a sand bath on a hot plate, where I put in sheets of different materials. I captured the temperature of the sheets after a few minutes in the sand bath, then I captured their temperature on the table. In a second experiment, I heated up a hot plate with an aluminum plate on it. Then I placed heat sinks of different sizes and shapes, this allowed me to visualize how different shapes conduct and take in heat. The importance of this experiment is to visualize the conductive properties of the materials and shapes with the thermal camera. Using the thermal camera, I captured the visual differences in how different heat sinks conduct heat. I found temperature of Nickel on top with glass in the bottom 21.6ºC, the temperature of Zinc in sand on a hot plate to be 45.8ºC and the temperature of large plate heat sink next to small plate heat sink to be 39.8ºC. From these data it can be concluded that thermally conductive materials of different shapes and sizes contained and released heat differently, and their strategic use can help with efficient thermal management.

POSTER PRESENTATION SESSION A ABSTRACTS

SYNTHESIS AND CHROMATOGRAPHIC APPLICATION OF SULFUR-DOPED CARBON NANODOTS

Fawzaan Khan, Mamoon Aref, Abedejalil Atiyeh, and Stefan Tsonchev Ph.D.
Department of Chemistry, Northeastern Illinois University, Chicago, IL 60625

We created highly fluorescent sulfur-carbon nanodots (SCNDs) using D-fructose and sulfuric acid. Our study explored optimal conditions for synthesizing SCNDs and their effectiveness for chromatographic applications. We synthesized SCNDs by heating the D-fructose and sulfuric acid mixture at 500°C for 120 seconds, producing charcoal powder. This powder was ground, filtered with deionized water, and confirmed to contain SCNDs through UV-induced luminescence. To enhance the adhesion of SCNDs to silica gel, we degassed the SCND solution to remove air bubbles, mixed it with silica gel, and baked the mixture at 170°C to 220°C. This process formed a bonded stationary phase with the silica gel, ensuring that SCNDs adhered firmly. We evaluated the performance of this SCND-coated silica gel in chromatographic separation using gravity-fed columns. One column contained a slurry of baked SCND-coated silica gel and deionized water, while the other contained unmodified silica gel. Pink Dye, Chlorophyll, Erythrosine B were used to test separation efficiency, and fluorescence intensity was measured using a spectrophotometer. Our preliminary results indicate that columns with SCND-coated silica gel exhibit superior separation efficiency compared to those with unmodified silica gel. This was particularly evident when separating similar organic compounds in a mobile phase consisting of deionized water. These findings suggest that sulfur-doped SCNDs can significantly enhance chromatographic separation efficiency, offering potential advancements in various analytical chemistry applications.

VISUALIZING TREE TRANSPIRATION RATES TO UNDERSTAND THE HYDROLOGICAL PROCESSES USING ICT INTERNATIONAL SAP FLOW METERS

Michael Banks, Liam Hamp, Nathaniel Olmedo, Nathan Severyns, Niki Varvara, Sung Yong, and Gregory Anderson Ph.D.
Department of Physics, Northeastern Illinois University, Chicago, IL 60625

Understanding hydrology is crucial for comprehending climate dynamics, with tree transpiration playing a key role in the water cycle. This study aims to measure transpiration rates of various tree species to enhance our understanding of their influence on hydrological processes. Using Community Research On Climate and Urban Science (CROCUS) equipment installed on six trees and meteorological equipment on the roof of BBH, we collected data on transpiration rates and influencing factors like temperature, solar radiation, and vapor pressure deficit. Accurate data collection is essential for closing the water cycle. We installed four transpiration meters on May 31st and two additional meters on July 19th to gather real-time data from three tree species: two Swamp White Oaks (*Quercus bicolor*), one American Elm (*Ulmus americana*), and three Sugar Maples (*Acer saccharum*). Using the ICT International Sap Flow Meter Model program, we downloaded data via USB-C cables to measure the transpiration rates of these trees on Northeastern Illinois University's campus. The goal of this research is to provide detailed data on tree sap flows and transpiration rates during the summer using the ICT International Sap Flow Meter Model, thereby improving our understanding of the hydrological processes involved in the water cycle.

ASSESSING GENETIC DIVERSITY IN PAINTED TURTLES: A COMPARATIVE STUDY OF OPEN AND ISOLATED POPULATIONS

Christina Acosta, Jorge Cantu Ph.D., and Beth Reinke Ph.D.
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Genealogies have been developed for numerous species to explore genetic isolation, inbreeding, and genetic drift within populations. However, few have examined Painted Turtles (*Chrysemys picta*) across varying landscapes. This study aims to compare the genetic diversity and variability of Painted Turtle populations in an open landscape adjacent to a large river with those in a more isolated, enclosed lake environment. By collecting whole blood samples from Painted Turtles in Thomson, Illinois (an open landscape), and Stone Lake, Wisconsin (a closed landscape), we will extract DNA and utilize Polymerase Chain Reaction (PCR) tests to analyze the microsatellites of each population. This approach will allow us to assess their genetic relatedness and variability. We predict that the Illinois population, connected to the Mississippi River, will exhibit higher genetic variability, while the isolated Wisconsin population will demonstrate reduced genetic diversity. Understanding these levels of genetic diversity will inform conservation strategies, aid in identifying vulnerable groups, and provide insights into how different landscapes affect genetic variation and evolutionary processes, ultimately guiding efforts to mitigate habitat fragmentation and preserve biodiversity. Future research will focus on comparing genetic relatedness and coloration pattern and intensity.

TESTING SENSITIVITY OF *Drosophila* DEFICIENT IN *Dna2* TO DNA DAMAGE

Hannah Michael-Schwartz and Elyse Bolterstein Ph.D.
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

The *DNA2* gene plays a known role in DNA replication and repair across diverse species. The gene reboots stalled replication forks and monitors homologous recombination. It also inhibits tumor growth and cell apoptosis. *D. melanogaster* makes excellent genetic models due to rapid breeding, short lifespan, and high percentage of human disease homologs. Our research uses *D. melanogaster* to characterize *Dna2*'s capacity to mediate different forms of DNA damage. Our experiments evaluate the impact of different types of DNA damage on *D. melanogaster* deficient in *Dna2.* Past research in our lab has shown the *Dna2*-deficient flies are sensitive to DNA replication stress but not double-stranded breaks. We expand on this by analyzing mortality of *Dna2*-deficient flies after treatment with camptothecin to induce both types of damage and paraquat which causes oxidative stress. We hypothesize that camptothecin-exposed *Dna2*-deficient flies will be sensitive to damage caused by camptothecin, but not paraquat because oxidative stress is difficult to isolate from other variables. The *DNA2* gene merits further research given its omnipresent role in supporting genetic fidelity. Human diseases including endometriosis and Seckel syndrome have etiology in DNA2. Discovery of the gene's actions under specific conditions may provide insights into treatment and a deeper understanding of molecular pathways during DNA replication and repair.

ANALYZING GENE EXPRESSION OF HUMAN PIG11 HOMOLOGS (PIG11a AND PIG11b) IN ZEBRAFISH EMBRYOS

Nayeli Maldonado[1], Eileen Jarrett[2], and Jorge Cantu Ph.D.[1],
[1]Department of Biology, Northeastern Illinois University, Chicago, IL 60625
[2]College of Lake County, Grayslake, IL 60030

TP53 is a tumor suppressor gene that regulates cell cycle arrest, DNA repair, and apoptosis in response to cellular stress. TP53 acts as a transcription factor that can promote the expression of many pro-apoptotic genes, including *tp53-induced gene 11 (pig11)*. The loss of PIG11 can contribute to cancer development by reducing apoptosis and allowing damaged cells to survive. In zebrafish, the *pig11* gene has been duplicated, giving rise to two sister genes called *pig11a* and *pig11b*. To understand its function, we will determine where and when *pig11a* and *pig11b* are expressed during development using a process called whole-mount situ hybridization (WISH). This technique allows us to visualize gene expression patterns in intact embryos, providing information about which cells express *pig11* during development. To determine where Pig11 is expressed, we will focus on the five following stages: neurulation (10 hours post-fertilization, hpf), after neural tube formation (18 hpf), differentiation of sensory neurons (24 hpf), during peak apoptosis in the spinal cord (36 hpf), and after peak apoptosis (3 days post-fertilization, dpf). We expect that *pig11a* and *pig11b* will be expressed in areas of developmentally-related programmed cell death, such as the brain and spinal cord.

GENETIC VARIABILITY IN SOUTH DAKOTA'S ONLY LEEDY'S ROSEROOT POPULATION

Velma Elba, Adam Ciecierski, Jared M. Gattis, Syedunnisa Reza, and Joel Olfelt Ph.D.
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Leedy's roseroot (*Rhodiola integrifolia* ssp. *leedyi*) is a federally threatened plant species known in only seven populations in the U.S. There are four populations in Minnesota, two populations in New York, and a single population with 218 individuals in South Dakota. The South Dakota Leedy's roseroot population has been recognized for less than 10 years and is located in the Black Elk Wilderness in the Black Hills National Forest. The population's small size and isolation suggest that it might harbor unique alleles and be experiencing inbreeding depression. We collected leaf tissue from 25 plants in August 2022, and 7 more plants in August 2023 under Recovery Permit number ES86044B. Our overall goal is to describe the genetic variability present in the South Dakota population and to compare its characteristics with those of the NY and MN populations. We used Qiagen DNeasy Plant Pro Kits to extract and purify DNA from the 2022 samples, and the 2023 samples. We have amplified eleven microsatellite loci for all of the sampled individuals, and we have preliminary data from at least 11 individuals for each of six loci. These data show an average of 3.2 alleles per locus with a range of one to five alleles per locus. We will use the data to estimate the levels of genetic variability in the South Dakota Leedy's roseroot population and compare the South Dakota estimates with the Minnesota and New York Leedy's roseroot populations. These data can be used to inform management practices for the species.

IMPACT OF EXTRACELLULAR *scl* GENE FAMILY IN *C. elegans* EXPRESSING TDP-43: UNRAVELING NEUROTOXICITY MECHANISMS

Krishna Niraj Parikh and Cindy Voisine, Ph.D.
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disorder characterized by progressive loss of neurons controlling voluntary muscles, leading to muscle weakness, atrophy, and paralysis. In ALS, TAR DNA-binding protein 43 (TDP-43) forms abnormal aggregates in the cytoplasm of neurons, which may spread in a prion-like manner. Manipulating extracellular matrix components may lead to inhibition of this transmission. To investigate TDP-43-related neurotoxicity, we use the nematode *C. elegans*, which is amenable to genetic manipulation and has a simple nervous system. Ribosome profiling of young adult *C. elegans* expressing human TDP-43 and wild-type animals identified differentially translated genes in the *scl* gene family, with some members upregulated over 50 times in TDP-43 animals. These genes are associated with longevity, stress resistance, and are expressed in the extracellular matrix. Genetic crosses were performed to introduce specific *scl* gene deletions into the TDP-43 transgenic line. To evaluate the effects of these deletions on TDP-43 neurotoxicity, behavioral assays are being conducted to monitor movement. In the thrashing assay, worms are placed in a buffer, and their body bends (thrashes) are counted over 30 seconds. Wild-type *C. elegans* typically exhibit ~50 thrashes, while TDP-43 transgenic strains average around 10 thrashes. We hypothesize that deleting *scl* gene members will alleviate motor neuron deficits, increasing the thrashing rate of TDP-43 animals. By comparing thrashing rates, we can determine if *scl* gene deletions improve motility, clarifying the role of *scl* genes in modulating TDP-43 neurotoxicity.

THE EFFECT OF ANTHROPOGENIC NOISE STRESS ON TURTLE HATCHLING ASYMMETRY

Sarai Barahona[1], Sara Crow[2] and Beth A. Reinke Ph.D.[2]
[1]Department of Earth Science, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Asymmetry in animals can occur due to stressors in the environment, such as extreme temperature or moisture levels, the presence of invasive species, or exposure to pollution or toxins. Anthropogenic noise is becoming increasingly common but there is little study on how it may affect the embryos of wildlife exposed to sounds while in the nest. For eight hours a day during incubation, we exposed painted turtle eggs to four noise treatments: nature, construction, human conversation, and traffic. Upon hatching, we will measure the asymmetry of the shells of hatchlings, and we expect to find turtles that are exposed to construction and traffic will be more asymmetric than those exposed to human conversation and nature. More asymmetric individuals may have lower survival and reproduction than those who are highly symmetric, so understanding how anthropogenic noise can affect asymmetry is important since there could be population-wide consequences when entire nesting areas are exposed to noise pollution. This knowledge could inform conservation management decisions for freshwater turtles or other egg-bearing species.

COGNITIVE REFLECTION PREDICTS GENDER ESSENTIALISM IN GIRLS, BUT NOT BOYS

Jennifer Vargas, Christina Esparza-Cassidy, Anabelle Jimenez, John Sayson, and
Andrew G. Young, Ph.D.
Department of Psychology, Northeastern Illinois University, Chicago, IL 60625

Research shows that cognitive reflection, the ability to override intuitive responses, is related to adults' essentialist thinking. Essentialism is the belief that certain traits or characteristics are innate and unchangeable (e.g., girls are born liking dolls and boys are born liking trucks). Understanding factors involved in essentialist thinking is important because adults and children with more essentialist beliefs tend to exhibit more social bias and prejudice. Our study examined cognitive reflection and essentialist beliefs in children. We conducted an online experiment with 5-12-year-old children (n = 185; Mean Age = 9.17 yrs; 51% female). We measured their cognitive reflection using the CRT-D (example item: "Emily's father has three daughters. The first two are named Monday and Tuesday. What is the third daughter's name?"). We also measured their essentialist thinking about gender (example item: "Do you think Andrew can change whether or not he is a boy if he wants to?"). Girls with higher cognitive reflection scores had fewer essentialist beliefs about gender, $r = -0.334$, $p < 0.001$. However, there was no relationship between cognitive reflection and gender essentialism in boys, $r = 0.060$, $p = 0.574$. These results suggest that the connection between essentialist thinking and cognitive reflection emerges early in development. Further, this connection is highly context-dependent – reflective thinking predicted gender essentialism in girls, but not boys. Future research will explore the mechanisms underlying this gender difference and whether interventions aimed at enhancing cognitive reflection can have a lasting effect on children's social belief systems.

THE EFFECT OF SOCIAL COMPARISON ON CHILDREN'S COGNITIVE REFLECTION

Anabelle Jimenez, John Sayson, Christina Esparza-Cassidy, Jennifer Vargas, and Andrew G. Young, Ph.D.
Department of Psychology, Northeastern Illinois University, Chicago, IL 60625

Previous research suggests adults are more likely to engage in critical thinking when assessing others' reasoning. For example, adults who are told they are receiving information from a specific source (e.g., a prior research participant) are more likely to question the logic of the information compared to when it is presented without a source. However, research has not yet examined whether children are more likely to engage in critical thinking in social versus non-social settings. The present study investigates whether children demonstrate more cognitive reflection (the ability to answer tricky brain teasers) in social versus non-social conditions. In an online study, we measured the cognitive reflection of 5-12 year old participants using the CRT-D (example item: "What do cows drink?") before and after a short training activity. In a non-social condition, children practiced generating reasons for why their initial answers on a guessing activity may be incorrect. In a social condition, children practiced generating reasons for why peers' initial answers on a guessing activity may be incorrect. Data collection is ongoing (current n = 35). Preliminary results suggest that children in the social condition improve their critical thinking (i.e., performance on the CRT-D) more than children in the non-social condition. The results from this study will not only help us better understand ways to reduce thinking biases in children, but also highlight social comparison as a vehicle to improve critical thinking.

SURVEYING THE POPULATION OF THE STATE ENDANGERED KIRTLAND SNAKE AND BUTLER GARTER SNAKE

Alex Dolgin[1], Nick Sekits[2], and Joseph Milanovich Ph.D.[2]
[1]Department of Biology, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Biology, Loyola University of Chicago, Chicago, IL 60611

With the expansion of human inhabited areas, many snakes' habitats are shrinking. Therefore, we are surveying nature preserves in Northern Indiana, sponsored by the Indiana Department of Natural Resources, for the Kirtland Snake (*Clonophis kirtlandii*) and Butler Garter Snake (*Thamnophis butleris*).

POSTER PRESENTATION SESSION B ABSTRACTS

A SURVEY OF PARTICULATE MATTER IN CHICAGO

Michael Banks, Liam Hamp, Nathaniel Olmedo, Nathan Severyns, Niki Varvara, Sung Yoon, and Gregory Anderson Ph.D.
Department of Physics, Northeastern Illinois University, Chicago, IL 60625

Particulate matter (PM) consists of solid and liquid particles that are suspended in the air that have a diameter size no larger than 10 micrometers. These particles originate from both anthropogenic sources: construction, industrial by-product, smoke; and natural sources: pollen, dust, and fires. As an air pollutant, PM has a negative impact on human health which can lead to: a decrease in lung function, heart function, and contribute to premature death. In Chicago, PM has been known to exceed EPA safety standards thus affecting the health of people in the area. The goal of this research is to contribute to the ongoing survey of PM in the Chicagoland region using stationary sensors from the Atmospheric Science Lab on the NEIU science building roof and using mobile sensors throughout downtown Chicago as a part of the Community Research on Climate and Urban Science (CROCUS) collaboration. The science building roof has several pieces of equipment that are capable of measuring PM. As a part of the 2024 summer CROCUS field campaigns, teams were sent through urban canyons and measured PM throughout Chicago, focusing on the urban canyons downtown. Continued survey of PM in the Chicagoland area is invaluable in determining not only baseline air quality but also assist future research in determining how air pollutants such as PM move throughout the city.

BUILDING A NATURAL HISTORY COLLECTION USING THE SCIENCE OF STUDY SKIN PREPARATION AND THE ART OF TAXIDERMY

Rafael C. Sazo, and Beth A. Reinke Ph.D.
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Natural history collections are useful tools for data collection and for educational use in classrooms. The Biology Department of Northeastern Illinois University does not currently have a cohesive natural history collection, though we offer classes in the identification of local fauna. Since most universities have legacy collections that are decades or centuries old, we have a unique opportunity to create our own natural history collection, the preparation of which is beneficial to students interested in the subject, and revives rarely practiced techniques to display and preserve species of interest. We worked on two species, the European Starling and the American Robin, to perform and perfect protocols in the art of taxidermy and study skin preparation. We also spoke with curators at the Field Museum to incorporate their knowledge of specimen accession, preparation, and display. We are working to use specimens collected from window strikes at NEIU to develop a comprehensive display of local bird species and a deep collection of study skins for scientific and educational purposes. The use of ethically obtained specimens (in contrast to historical collections that would sacrifice animals for display) helps bring awareness to the problem of window strikes, which is threatening migratory bird species worldwide and especially in Chicago. The collection will help faculty and students interested in the topic to have a more visual and hands-on experience for learning species identification and will provide myriad opportunities for designing and answering scientific research questions.

A NEURAL NETWORK-BASED RECOMMENDER SYSTEM FOR COURSE ENROLLMENT IN HIGHER EDUCATION

Maimouna Ichaka Coulibaly, and Lizi Zhu Ph.D.

Department of Computer Science, Northeastern Illinois University, Chicago, IL 60625

The evolving landscape of higher education, marked by continuous curriculum updates and technological advancements, presents challenges in course selection for students and their advisors. This paper investigates a neural network-based course enrollment recommender system that aims to address these challenges by providing personalized course suggestions. Unlike traditional machine learning approaches, our system leverages deep learning techniques to analyze a broad range of data, including student demographics, course descriptions, and instructor profiles. By employing neural networks, we capture complex patterns and relationships within the data, offering improved recommendation accuracy and relevance. Our experiments demonstrate that the neural network-based system not only enhances the relevance of course recommendations but also provides diverse options, aiding students in making informed decisions.

GENETIC GUARDIANS: THE CRITICAL ROLE OF DNA2 IN GENOME STABILITY

Christian Villegas, Ivan Rivera, and Elyse Bolterstein Ph.D.

Department of Biology, Northeastern Illinois University, Chicago, IL 60625

DNA is essential for the survival and reproduction of living organisms and undergoes constant replication and repair. Mutations, arising from replication errors, mutagen exposure, or health conditions, threaten genomic integrity. The DNA2 gene is crucial for maintaining DNA stability and regulating replication, thus playing a vital role in cellular health. We investigated Dna2 function using Drosophila melanogaster, which shares ~70% genetic similarity with human disease-causing genes. Our goal was to expose Dna2-deficient flies and flies that overexpress Dna2 to various mutagens to understand Dna2's role in DNA repair. Previously, our lab found Dna2-deficient flies exhibit sensitivity to methyl methanesulfonate (MMS), which causes large DNA adducts and impairs replication. We extended this research by investigating how lower doses of MMS influence the sensitivity of Dna2 mutant flies, as well examining the response of Dna2 mutants to the mutagen's bleomycin (double strand breaks), potassium bromate (oxidative stress), and nitrogen mustard (interstrand crosslinks). Our results revealed that different Dna2-deficient alleles showed similar dose-dependent sensitivity to MMS. Dna2 mutants were not sensitive to bleomycin or potassium bromate but were sensitive to nitrogen mustard. To test the hypothesis that lack of Dna2 improves DNA damage tolerance, we treated flies that overexpress Dna2 to MMS, bleomycin, and potassium bromate, and found no difference compared to wild type flies. Together the findings support the role of Dna2 in responding to replication stress but not other types of DNA repair. This research can advance our understanding of DNA repair mechanisms and potentially aid future cancer and disease treatments.

SYNTHESIS AND PHOTOCATALYTIC PROPERTIES OF BiCuOS AND $BiFeO_3$ FOR USE IN UPCYCLING PLASTIC WASTE

Andres Jimenez, Kevin Kelly, and Samantha Brown-Xu Ph.D.
Department of Chemistry, Northeastern Illinois University, Chicago, IL 60625

Constant plastic production has led to an increased level of plastic waste and has become a pressing environmental concern. Therefore, new methods for repurposing plastic, such as upcycling into more reusable chemicals, are needed in order to reduce the stress of plastic waste on the environment. Photocatalysis has emerged as a promising approach to chemically recycling plastic due to its ability to harness solar energy to drive chemical reactions. Therefore, we synthesized nanoparticles of two different photocatalyst materials, bismuth copper oxysulfide (BiCuOS) and bismuth iron oxide ($BiFeO_3$), in order to test their ability to break down plastic. Two methods of synthesizing the BiCuOS samples were tested: a one-pot method and an aqueous-based low-temperature method. The $BiFeO_3$ sample was synthesized in solution using hydrothermal reaction conditions. Each sample was dispersed in water and in dichloromethane to make stable solutions, and their absorbance was characterized by UV-Vis spectroscopy. BiCuOS showed broad visible light absorbance (400-700 nm), while $BiFeO_3$ primarily absorbed in the 400-500 nm range. The samples were then studied by femtosecond transient absorption spectroscopy to monitor the kinetics of electron movement in the photocatalyst materials after light is absorbed. These results will be evaluated to determine differences in the behavior of the materials and the effect of the solvent, which will enable a deeper understanding of their photocatalytic capabilities and methods to optimize the polymer degradation reaction. It is expected that the broader absorption and elevated band energies of BiCuOS will lead to higher photocatalytic reactivity.

EVALUATING THE IMPACT OF PROTEIN CLEARANCE GENES ON THE ORGANISMAL HEALTH OF *C. ELEGANS* EXPRESSING TDP-43, AN AMYOTROPHIC LATERAL SCLEROSIS DISEASE ASSOCIATED PROTEIN

Joshua Kalarical[1], Brittany Zaruszak[2], and Cindy Voisine Ph.D.[2]
[1]Lake Zurich High School, Lake Zurich, IL 60047
[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Amyotrophic Lateral Sclerosis (ALS) is a fatal neurodegenerative disease. Although most cases of ALS are sporadic, approximately 10% of cases are familial. Some familial cases are associated with mutations in the gene encoding the TAR DNA-binding protein (TDP-43). Under physiological conditions, TDP-43 shuttles mRNA out of the nucleus and into the cytosol. However, in ALS-affected neurons, TDP-43 accumulates in the cytosol as ubiquitinated aggregates. The appearance of TDP-43 aggregates suggests a failure in cellular protein clearance mechanisms. To address the role of protein clearance in TDP-43 related toxicity, we are using *C. elegans* that express human TDP-43 pan-neuronally along with gene deletions in three different components of protein clearance pathways called *asp-17, usp-33* and *lgmn-1*. *C. elegans* is an ideal model organism because these hermaphrodites have a simple nervous system and a short life span. To assess the impact of these gene deletions on TDP-43 toxicity, I am performing fecundity assays. Using a worm pick to gently remove each newly hatched larva, the total number of progeny per animal are counted. Based on the data that was collected, wildtype strains typically have 330-350 progeny whereas the TDP-43 transgenic animals have 230-250 progeny. Introducing the gene deletion reduced progeny production in TDP-43 expressing animals suggesting a further decline in organismal health. Therefore, we conclude that proper function of protein clearance pathways is critical to reducing TDP-43 toxicity.

THE ROLE OF COGNITIVE REFLECTION IN CHILDREN'S BIAS BLIND SPOT

John Sayson, Anabelle Jimenez, Christina Esparza-Cassidy, Jennifer Vargas, and
Andrew G. Young, Ph.D.
Department of Psychology, Northeastern Illinois University, Chicago, IL 60625

The bias blind spot (BBS) is the human tendency to see oneself as less biased than others. For example, people often recognize other people's political biases but see themselves as objective, possibly leading to misunderstandings and interpersonal conflict. Previous research with adults shows that cognitive reflection – the ability to override intuitions – does not mitigate BBS. However, this has not been investigated in children, who are theoretically less biased and more amenable to learning. We hypothesized that more reflective children would be less prone to BBS. In an online study over Zoom, we measured cognitive reflection in 5-12 year old participants with questions like "What do cows drink?" The intuitive answer is milk but the correct answer is water. Children then completed Hagá et al.'s BBS task (2018), in which they rated their own and other children's biases in two domains (how fast one runs in a race / how friendly one is). Data collection is ongoing (current N = 35). Preliminary results suggest that BBS emerges after age 7 and increases with age, replicating prior research (r = .481, p = .004). However, children with greater cognitive reflection also seem to demonstrate greater BBS, (r = .635, p < .001), even after controlling for age, ($r_{partial}$ = .500, p = .003). This finding is contrary to all prior research with adults and our own hypothesis. Results of this study will further our understanding of ways to mitigate BBS in an effort to reduce its potentially negative impacts on children.

PATTERN DIVERSITY AND HERITABILITY IN A WIDESPREAD FRESHWATER TURTLE SPECIES

Alain Iniestra[1] and Beth A. Reinke Ph.D.[2]
[1]Department of Environmental Science, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Offspring inherit a mixture of colors and patterns from their parents. These unique color and pattern combinations can serve functions such as mate attraction or predator deterrence. Painted turtles, (*Chrysemys picta*), are so called because of the colorful yellow and red stripes on their head and limbs. The painted turtle also has a bright orange color on its plastron with a complex, unique, dark pattern overlaying it. The function of the plastron pattern is currently unknown. However, it has been observed that there is limited variation in plastron patterns between siblings. In this study, we identified the heritability of the pattern shape to observe intra and inter-populational differences in Illinois and Wisconsin. To do this analysis, we compare conventional pattern and cluster analysis techniques with those developed by Intelligent Information Technologies using a neural network. We predict that we will find little variation from mother to offspring, and between siblings, showing that the patterns are highly heritable. This research is important because it is unknown what function the patterns of painted turtles serve. Understanding the function can help us better understand conservation.

COGNITIVE REFLECTION HELPS CHILDREN OVERCOME FALSE CONSENSUS

Christina Esparza-Cassidy, Jennifer Vargas, John Sayson, Anabelle Jimenez, and Andrew G. Young Ph.D.
Department of Psychology, Northeastern Illinois University, Chicago, IL 60625

In adults, trusting unreliable sources increases susceptibility to pseudoscience, medical misinformation, and fake news. Consensus across multiple people often increases trust in their shared message, especially when a group arrives at a consensus through independent reasoning (true consensus). Contrastingly, non-independent consensus (false consensus) often undermines the reliability of a group's ideas, as they may result from choices to copy or conform. While adults strongly favor true over false consensus, many elementary school-aged children show no preference or prefer false consensus. We predicted low cognitive reflection (the ability to inhibit gut intuitions and reflect further) is partially responsible for children's preferences for false consensus. In an online study, 5-12-year olds (n = 178) completed a cognitive reflection test (CRT-D; example item: "What weighs more, one pound of feathers or one pound of rocks?"). Children then heard opposing facts about a foreign country from two groups of informants (e.g., "Citizens of this country eat cheese vs. sausages"). In a true consensus group, informants responded confidentially. In a false consensus group, informants looked at each other's answers before responding. As predicted, less reflective children were more likely to trust information from false consensus groups, $r = .209$, $p = .005$. This effect remained strong, even after controlling for age, executive function, and intelligence quotient. These results highlight cognitive reflection as an important factor in children's social learning from conflicting testimony. These data might help design interventions to reduce children's and adults' susceptibility to false consensus and improve trust in reliable information sources.

DETERMINING THE CORRELATION BETWEEN PHENOTYPE AND CAROTENOID CONCENTRATION IN PAINTED TURTLES (*Chrysemys picta*)

Cesilia Aguilar and Beth Reinke Ph.D.
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Many animals use coloration for attracting mates, deterring predators, defending territories, or communication. Understanding how the coloration is created and expressed can tell researchers about how important color is to a species. Painted turtles are a widespread group of freshwater turtles with brightly colored skin stripes and shells. The bright colors are created by a pigment group called carotenoids, which have to be obtained from dietary sources. However, we know little about how the amount of carotenoids obtained correlate with the colors expressed in tissue. We collected plasma and shell tissue samples from 100 turtles from two populations in Illinois and Wisconsin. We also measured the reflectance of the bright colors on the shell and skin tissue. We expect to find a strong, positive correlation between circulating carotenoids in the plasma and the carotenoid chroma of the skin at both sites. However, due to differences in human infrastructure and water quality we expect there to be a tighter correlation between tissue carotenoid concentration and the carotenoid chroma of the shells in the Wisconsin population than in the Illinois population. Understanding the expression of painted turtle coloration will aid researchers in identifying the function of the color, and better understanding the evolutionary history of this species and any others expressing carotenoid-based coloration.

ARCOS STEM ACADAMY POSTER SESSION

Investigating differences in soil quality indicators across forest and savannah ecosystems in urban setting. Created by Rotan Abuhashish (NEIU), Calvin Chen (HWC), Anicet Lezao (HWC), Mahmed Polli (NEIU), and Enoch Asare (HWC). Presented by Anicet Lezao.

Instrumentation: Learning the Fundamentals of Programming Sensors. Created and presented by Alexis Olvera Flores (NEIU), Santiago B. Gutierrez (NEIU), and Jacqueline Landi (NEIU).

The ARCOS Summer STEM Academy is a summer research opportunity geared towards first and second year students who are interested in learning about scietific research and exploring different STEM fields. Students in the program worked with other students from Northeastern Illinois Univeristy and Harold Washington College, and faculty from NEIU. During their time in STEM Academy students got the opportunity to learn various technical research skills, conduct field research, and present about their findings and summer experience at their own symposium! Participation in the STEM Academy has positively impacted how NEIU and HWC students interacted with the STEM community. Students from this past summer shared that they now felt more equipped to contribute to the community and to pursue their goals within STEM fields.

About the Student Center for Science Engagement (SCSE)

The Student Center for Science Engagement (SCSE) is a resource to help students succeed at NEIU and in their future careers in the sciences. We serve all students interested in the sciences, and we support the following departments and programs: Biology, Chemistry, Computer Science, Earth Science, Environmental Science, Mathematics, Physics and Psychology.

We offer:

- **One-on-One Professional Advising** – STEM advisors guide students in exploring majors and career options and assist with applying for internships and graduate school. Advisors support students in advancing their professional training by securing resources that support their academic and professional goals.

- **Professional Development Workshops** - Workshops cover a broad range of topics including graduate school preparation, internship applications, and career planning. The SCSE emphasizes building strong professional development skills.

- **Tutoring and GRE Preparation** - The SCSE provides daily tutoring services in upper-level Biology, Chemistry, Computer Science, Earth Science, Mathematics, Physics and Psychology courses. Free GRE preparation support is offered annually during the summer.

- **Research Opportunities** – Students are encouraged to gain valuable hands-on experience through summer research opportunities with NEIU faculty as well as with faculty and researchers at other institutions.

- **Conference Attendance and Participation** - The SCSE supports students to attend and present their research at conferences locally and nationally.

- **Invited Speakers -** The SCSE invites individuals representing a variety of organizations and industries to speak with students about internships and career opportunities in a broad range of fields.

16th Annual Student Center for Science Engagement Research Symposium

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