ILLINOIS COLLEGE

CELEBRATION OF EXCELLENCE

ABSTRACTS

April 17, 2026

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CELEBRATION OF EXCELLENCE 2026
Abstracts

ORAL PRESENTATIONS

The Illusion of Protection: Why the Animal Welfare Act Fails and Animals Still Suffer

MacKenzie Jones
Faculty Sponsor: Lee Crank
9:00 am :: Crispin 210

Would you continue to use a product if you knew the blood of hundreds lies in its making? This is a choice one must make when buying countless everyday products. Animal testing has long been used across the world, and the United States is no exception. Animal testing was historically justified by creating an illusion of product safety but the practice has only a 5% success rate and this reasoning relies on outdated methods. Modern scientific alternatives can achieve more precise goals without causing harm to animals. In efforts to reduce the harm of animal testing, the Animal Welfare Act (AWA) was put into place in 1966, but this law is a legislative framework with significant loopholes that allow the continued inhumane treatment of animals. The AWA was designed to regulate animal research but its narrow definitions and exemptions—particularly the exclusion of animals in the genera Rattus and Mus—undermine its effectiveness, necessitating both policy reform and increased consumer accountability to address the significant ethical concerns. Animals excluded from the protections of the AWA are nominally overseen by groups such as the Public Health Service and Institutional Animal Care and Use Committees but they continue to experience inhumane treatment with minimal substantive safeguards. This subject is troubling to discuss, but discussion is the only solution to the mass ignorance of the practice. It is time for us to stand against the policy that only gives the appearance of protection and demand stricter legal protections, including expanding species coverage under the AWA, increasing oversight, boycotting products produced through this practice, and investing in humane alternative testing methods.

North Korean Opera as Political Propaganda

Meryn Davis
Faculty Sponsor: Nichol DelGiorno
9:00 am :: Dunham Auditorium (Crispin 220)

This presentation examines North Korean revolutionary opera as a type of music culture influenced by government control and political ideology. Examining how musical culture can be purposefully created to sway audiences and strengthen national identity, this presentation focuses on the connection between music, performance, and political authority. The objective of this presentation is to examine how North Korean revolutionary operas, particularly the infamous Sea of Blood, serve as propaganda by combining storytelling, music, and theatre to support the Juche ideology surrounding the leadership of Kim Il Sung and Kim Jong Il.

Central research questions include: What musical and theatrical ideas make revolutionary opera persuasive? How does the North Korean government organize performance and repertoire to convey ideological ideas? Why is music a particularly potent tool for political persuasion? This presentation will explore the context, purpose, and dissemination of these operas, taking into account how their melodies and performances allow song to spread and become part of daily life. It will look into how state-sponsored theaters, education, and media distribution help political institutions maintain this ideological system. This presentation argues that North Korean revolutionary opera demonstrates how music can be purposefully designed to influence emotions, shape collective memory, and encourage nationalism.

AI-Powered Research: Evaluating and Comparing Leading Research Tools

Christopher Jones

Faculty Sponsor: McKenna Jaquemet

9:20 am :: Crispin 210

In recent years, a newer form of technology has emerged to the forefront of how our society operates, known as Artificial Intelligence, or AI. As this technology becomes more integrated into society, a question arises surrounding the reliability of what information generated, which this study sought to test. The researcher tested 17 different AI Research Tools for legitimacy and reliability of the produced results. The selected generative AI models were compared against human-conducted research in academic databases and Google Scholar. The results were further analyzed in order to streamline the results for clarity. Results indicated that the research conducted by the AI models was relatively reliable, and AI Research Tools seem to be moving towards being a valid and appropriate tool for streamlining the research process. Further research, however, would be needed to validate that claim.

Old World Blues Digital Music Production

Nathan Wood

Faculty Sponsor: Nichol DelGiorno

9:20 am :: Dunham Auditorium (Crispin 220)

This presentation will demonstrate the creative process and product of my independent study combining musicology with composition and digital production. The goal of the digital compositional project is to yield a complete music track that will be published for public consumption on a well-known collaborative video game project, a popular mod for the video game Hearts of Iron IV, for which I am on the development team known as Old World Blues. The composition process involves synthesizer audio engineering, composition with classical and contemporary techniques, orchestration, mastering, and implementation into the finished game update. I worked closely with Dr. DelGiorno during the entire compositional process as she helped challenge me to develop my toolkit as a digital music producer. The finished product will be an electronic music track inspired by sci-fi technology themes and stereotypical “vampire” music. My presentation will dive into the compositional and audio-engineering process, and covers many of the topics pertinent to modern digital music production.

The Statistics of Inclusion: A Diversity Audit of Schewe Library’s Economics Section

Mia Goins

Faculty Sponsor: McKenna Jaquemet

9:40 am :: Crispin 210

This research focused on conducting a diversity audit of the economics section (Dewey Decimal Section 330s) of Schewe Library to evaluate representation within the collection and identify patterns across author/creator demographics. The audit collected data on authors’ race, ethnicity, gender, and sexuality using self-reported data from online research and official publication biographies. The data showed that an overwhelming majority of authors identified as white, cisgender, and heterosexual men. Authors from racial minorities were significantly underrepresented and tended to write specifically about their own communities, while white authors largely wrote about economics more generally. LGBTQ+ perspectives were extremely limited, with those represented identifying as mostly white gay men. The collection was also found to skew heavily toward classical, neoliberal, and venture capitalist perspectives, with Marxist and Keynesian voices in the minority. Schewe librarians will use this data for future deselection and acquisition so as to more accurately represent a wider variety of perspectives, focusing on Black and Brown, LGBTQ+, disabled, and alternative economic perspectives.

Fang Runin as a Product of Patriarchy and Imperialism- The Impact of Mythopoeia on the Characterization of a Woman of Color in Contemporary High Fantasy

Claire Peters

Faculty mentor: Beth Capo

9:40 am :: Dunham Auditorium (Crispin 220)

While the worlds of fantasy novels are created in complex and imagined spaces, they are not created without influence from the real world. R.F. Kuang's The Poppy War (2018-2020) trilogy is a dark fantasy set in a world that reflects the cultural and political systems of China and Japan, with the central conflict being contextualized by the Second Sino-Japanese War. Fang Runin, a dark-skinned war orphan, acts as the morally grey heroine whose character cannot be examined outside of the context of the war violence she experiences or the gender dynamics and racial discrimination rooted in Nikan's social and political structures. As she navigates the societal boundaries set by privilege and tolerance, she either confronts or conforms to these structures. Through the application of feminist theory and postcolonial theory, Rin's characterization can be placed within the context of the mythopoeia of Kuang's world. This research shows that characterization and worldbuilding cannot work alone to properly represent Fang Runin as a woman of color.

Fact or Tune?: Can Teachers Truly Use Musicals to Teach?

Theodore Biela

Faculty Sponsor: Jenny Barker-Devine

10:00 am :: Crispin 210

This presentation, based on my senior capstone project, is an analysis of Hamilton and 1776, two American historical musicals, and their ability to be used as effective tools that teachers can use in their history classrooms as accurate sources. I picked these two as many of my current students, while student teaching, have a fascination with both of these musicals, and I made it my goal to find a way to incorporate their interests into the classroom in a way that was more than just showing the musical and having students answer some questions about it. In doing so, my research focused primarily on the musical's ability to be accurate to real history, any omissions or details left out, representation of characters, and the reason behind their creation.

By the end of this research, all of my analysis comes together to create a set of guidelines that can and should be used mainly by history teachers, but can be used by all types of teachers, to determine whether or not Hamilton, 1776, or any other musical movie is academically effective enough to be used to teach students in a non-traditional, captivating style. The goal I have for this project is to have my research be presented in the future during professional development and department meetings in my future schools. Furthermore, I would like all teachers, or those hoping to be teachers, to consider what I am discussing in the future.

Expanding the Click Chemistry Toolbox: Greener Cycloaddition Catalysts from First-Row Transition Metals

Princess Akyea-Obesebea, Beamlak Hiltework, and Camille Prefountain

Faculty Sponsor: Jocelyn Lanorio

10:00 am :: Dunham Auditorium (Crispin 220)

Click chemistry is an important tool in modern science, used in applications from drug design to materials development. This project explores more sustainable ways to carry out the azide–alkyne click reaction by using different metal salts as catalysts. We compared copper(II), nickel(II), and zinc(II) salts in how well they worked and what kinds of products they produced when reacting benzyl azide and phenylacetylene in water or without using any volatile organic solvent. Copper(II) salts gave excellent results, with a pure, medicinally important product formed, and they could be reused twice for $CuCl_2$ and four times for $CuSO_4$. Nickel(II) produced two biologically important products, and zinc(II) mostly gave the unexplored form called the 1,5-isomer, up to 90.8%. We used a range of techniques, including infrared spectroscopy, chromatography, and NMR, to identify the products. These results help improve the environmental impact of chemical reactions and make this useful chemistry more accessible and adaptable.

IC's Literary Journal, Forte, Presents Poetry Out Loud!

Abby O'Malley, Ellie Wilson, Miranda Araujo, Noel Carney, Yvonne Iskrev, Asia Madkins, and Allen Oakley

Faculty Sponsor: Kara Dorris

10:00 am :: Sibert Theatre, McGaw Fine Arts Center

Illinois College's literary journal Forte is run by IC students to showcase the creative writing skills of IC students and alumni. In this session, Dr. Kara Dorris will introduce the editors and selected student contributors. Then editors and contributors will read original poetry as well as sharing the inspiration, meanings, and stories behind their work.

Post-WWII Women's Fashion in the United States

Norah Hacker

Faculty Sponsor: Brittney Yancy

10:20 am :: Crispin 210

WWII impacted the trajectory of post-war women's fashion and the iconic styles of the 1950s. The goal of this project was to research how the transition from war-time fashion to post-war fashion in the United States took place, and how American women were engaging with fashion during this time. Research showed that the disruption of the French fashion industry during WWII led to the increasing popularity of certain American designers. Additionally, the utilitarian styles demanded by clothing rationing during WWII contributed to the rise of ultra-feminine post-war styles. The beginning of these post-war women's styles is generally attributed to Christian Dior's 1947 collection, dubbed the "New Look," which was characterized by longer, fuller skirts and more form-fitting bodices. This project includes an analysis of the lives and designs of three female American fashion designers: Claire McCardell, a pioneer of leisure wear; Ann Lowe, a designer and creator of exquisite evening gowns; and Juli Lynne Charlot, a singer and actress who invented the iconic poodle skirt. By drawing from biographies and fashion archives, this project places their designs in the broader context of post-war fashion to offer insight into how these designers engaged with fashion and why their designs were unique and appealing to women.

A Glass Mind: The Poetics of Becoming in College

Alicia Pitkin

Faculty Sponsor: Samantha Smith

10:20 am :: Dunham Auditorium (Crispin 220)

Poetry inspired by social psychology will be explored in poems related to the poet's experiences in college. During this presentation, each poem will be read and discussed in light of the interaction between larger social themes and the student's individual experiences. Poems will discuss topics such as conformity and obedience, cultural competency, self-presentation, self-monitoring, and interpersonal relationships. While unconventional, this presentation will demonstrate how the use of poetry can reflect the impact that social constructs have on an individual navigating the social constructs of college.

Sources of Quantum Advantage: A Systematic Review of Quantum Computational Frameworks

Luke Laurenzana

Faculty Sponsor: Marilyn Markel

10:40 am :: Crispin 210

Quantum computation offers theoretical speedups over classical methods, with algorithms such as Shor's factoring algorithm and the Quantum Approximate Optimization Algorithm (QAOA) demonstrating practical applications. The source of this advantage has been the subject of intensive study, with current understanding pointing to a structured use of entanglement and contextuality. This review examines the well-known gate-based, measurement-based, and topological models and how they can achieve quantum advantage and limit classical simulatability. A comprehensive search of arXiv, supplemented by other peer-reviewed journal publications, identifies theoretical studies published between 2010 and 2024 using predefined inclusion criteria based on model universality, classical simulability analysis, and explicit discussion of computational resources. This review examines how different models use quantum resources and how these resources relate to predictions of quantum computational advantage. By synthesizing results across the literature, this study aims to identify common theoretical mechanisms and gaps in understanding the sources of quantum advantage.

Investigation of genetic similarity of three populations of The Hawaiian Bog Orchid, Peristylus holochila.

Ben Dobbs

Faculty Sponsor: Laura Corey

10:40 am :: Dunham Auditorium (Crispin 220)

Peristylus holochila, commonly known as the Hawaiian Bog Orchid, is an endangered species of orchid endemic to the Hawaiian Islands of Maui, Kauai, and Molokai. Within these limited populations, there is a significant morphological difference between the Maui population and the other two. To investigate whether the morphological difference represents a different species, we developed DNA bar-coding protocols using four genes: matk, trnL, rbcL, and the Internal Transcribe Sequence (ITS) of nuclear ribosomal DNA. These genes were sequenced from individuals from each island's population. The consensus sequences were compared to each other and to sequences from other related species. Results from these comparisons are inconclusive right now. More genes will be sequenced in the future, looking for genes with more relevance to the spine morphology found on the Maui population.

Poetry Against Injustice

Abby O'Malley

Faculty Sponsor: Kara Dorris

10:40 am :: Sibert Theatre, McGaw Fine Arts Center

There has been a big debate about the U.S. Immigration and Customs Enforcement, known as ICE. These agents, their methods, and their purpose have been widely contested and seen as too brutal or inappropriate. This presentation will consist of poems and their discussion that are a protest against this organization, are used to show the cruelty of the agents, and discuss how everyone deserves basic human rights. The poems all have different formats, are from multiple perspectives, and include many genres. The discussions will explain the poem further and its importance. This is a vital topic, as it is widely argued in today's world, but it is also essential for everyone to understand that each human being deserves certain rights, respect, and treatment.

The Avant-Garde in Theatre: Philip Glass Buys a Loaf of Bread

Lillian Deter with students Jayde Hudson, Corwin Townsend, and alumna Olivia Joy

Faculty Sponsor: Nancy Taylor Porter

1:00 pm :: ICEBOX Theatre, Kirby Learning Center

The oral tradition is one of the oldest forms of storytelling. Poems, chants, and epics have been passed down through generations, creating cultural touchstones that we all understand. But what happens when dialogue loses its meaning? When the words that come out of our mouths become repetitive gestures like tapping our fingers? Philip Glass Buys a Loaf of Bread is a 1994 short play by David Ives centering on prolific, minimalist composer Philip Glass. In this play, Philip Glass attempts to buy a loaf of bread from a bakery, but he encounters a former love and is transported into a surreal representation of his own memories. Inspired by Glass's use of repetitive musical phrases, Ives's play creates an absurdist space inside the bakery and uses percussive, surreal dialogue to explore themes of love and human nature.

Theatre on the Edge: A Monster Anthology

Carson Blaney, Meryn Davis, Lillian Deter, Jerzi Hinds, Jayde Hudson, Jacob Petrovich, Jaden Saunders, Corwin Townsend, Ellie Wilson, and alumna Olivia Joy

Faculty Sponsor: Nancy Taylor Porter

1:20 pm :: ICEBOX Theatre, Kirby Learning Center

Theatre on the Edge (TH 352) studies non-traditional means of theatre making, such as using the actor's instrument—body and voice—as objects, as elements in other art forms (for example, music/soundscapes, visual art, film, etc.), and as abstract expressions of nature and humanity based largely on the theories and practices of actor and teacher Jacques Lecoq and director Anne Bogart. They have also explored the political impetus behind much of the groundbreaking theatre practitioners' work of the 1960s and 70s, how those artists wanted to raise consciousness about a variety of issues. This year, we are exploring the idea of the "monstrous." What makes a monster? Why are we attracted to them? Is it their power? Their independence? Our identification with someone who is rejected for things they can't control? How much is monstrosity in the eye of the beholder? This montage, based on students' research, emotional/visceral responses, and course content, has culminated into a provocative theatrical performance.

The Rise and Fall of Dormitory Court at Illinois College

Kairy Mercado-Ramos

Faculty Sponsor: Jaclyn Tabor

1:40 pm :: Crispin 125

Dormitory Court, a peer-based disciplinary system at Illinois College, was officially established on January 27th, 1883, with the purpose of regulating student life through student-led legal proceedings. This research examines the historical evolution of the organization using The Rambler, Jacksonville Courier archives, and Board of Trustees minutes as primary source materials. Initially, it was founded to provide students with practice in court procedures while handling minor dormitory infractions. The court's early cases often resulted in lighthearted penalties, such as fines requiring the payment of apples or peanuts. Analysis of Illinois College's records reveals a shift over time in the organization's function. The disbursement of punishment evolved from harmless fines to acts of hazing and bullying. This study details the administrative decision to disband the court after it was deemed unsafe and demoralizing due to its involvement in prohibited hazing activities. The research explores how the dissolution of Dormitory Court served as a precursor to modern student government at Illinois College, tracing the transition from a peer-based disciplinary system to the formal approval of a Student Council in 1927.

INTERNSHIP PRESENTATION

Youth Development in Montpellier: An International Internship Experience

Jiech Bel

Faculty Sponsors: Brittney Yancy and Margherita Orlando
(Internship & Administrative Coordinator, University of Minnesota at Montpellier)
9:00 am :: Crispin 125

Based in the Psychology Study Abroad program at the University of Minnesota in Montpellier, France, this presentation examines my internship experience at Resto Bébé, a local nonprofit organization dedicated to supporting families with infants and young children. Through this immersive experience, my internship introduced how early childhood resources, family support systems, and community-based services contribute to healthy youth development. Informed by resilience frameworks, I applied a strength-based model to working with approximately fifty families and youth at Resto Bébé. This hands-on experience exposed me to how practitioners translate theory into practice, enhancing my understanding of how the real-world setting, the social and environmental factors influence childhood well-being. Working in a cross-cultural environment, using family resilience theory, I facilitated family discussions using social, cultural, and spiritual resources to help them identify their needs and create solutions. Our group facilitations included social emotional learning activities that allowed me to observe the behaviors and attitudes of the children ranging from zero to two. From navigating language barriers and understanding resource disparities, the internship expanded my understanding of cultural humility and culturally responsive approaches to youth development. This internship strengthened my commitment to serving families and children through holistic, community-centered care and expanded my perspective on global youth development. This experience clarified my future aspirations as a counselor focused on community health, youth advocacy and resilience, and international care, while continuing to explore ways to support vulnerable families and promote healthy youth development worldwide.

HONORS PRESENTATIONS

Fact Versus Fiction on Flapper Culture

Allison Fraley

Faculty Sponsor: Brittney Yancy

9:20 am :: Crispin 125

"Fact Versus Fiction on Flapper Culture" investigates the tension between the literary portrayal of flappers and the historical reality of women during the Roaring Twenties. Drawing on the lives of F. Scott and Zelda Fitzgerald, this comparative analysis reveals that the flapper identity in F. Scott's iconic novel, The Great Gatsby, alongside the real career of a 1920's flapper, his wife, Zelda Fitzgerald. This paper argues that canonical portrayals of flapper culture in characters like Daisy Buchanan in The Great Gatsby diverge from the real, nuanced lives and careers of American flappers like Zelda Fitzgerald. Through a literary analysis, this project reveals Daisy Buchanan's identity represents a passive, romanticized ideal of American womanhood. Whereas Zelda Fitzgerald's, Save Me the Waltz, a semi-autobiographical novel, uncovers Zelda's lived experience, and centers fine arts as a means for women in the 1920s to generate financial independence. Save Me the Waltz chronicles the emergence of the American flapper identity that is shaped by gender tensions, fashion and the 1920s consumer culture, and a professional career in the arts. Analyzing her artwork portrays an American flapper whose life is nuanced by female autonomy, mental health struggles, creative self-definition, and the complex realities of securing economic agency. The project argues that a comparative approach situates fiction alongside lived experiences and material culture provides a nuanced understanding of the social impact of true American flapper and more broadly, the American woman of the 1920s.

How Red Is That Red? Quantifying Allura Red in Everyday Snacks Using UV-Vis Spectroscopy

Alyssa Piper and Adel Honold

Faculty Sponsor: Jocelyn Lanorio

9:40 am :: Crispin 125

Bright red sports drinks, candies, and energy beverages are everywhere on campus, but how much of that color actually comes from synthetic dye? Allura Red AC, also known as FD&C Red No. 40, is one of the most widely used food colorants in the United States, yet few consumers consider how much is present in their favorite snacks. Recently, the dye has also received increasing regulatory attention worldwide, raising the question: why?

This project investigates the concentration of Allura Red in a selection of popular products, including sports drinks, electrolyte beverages, energy drinks, and brightly colored candies. Using ultraviolet-visible (UV-Vis) spectrophotometry, the dye's maximum absorbance wavelength is determined, and a calibration curve is constructed from standard solutions. Prepared snack samples are then analyzed quantitatively using the Beer–Lambert law to calculate dye concentrations.

Why is Student Assessment Important?

Jenni Boden

Faculty Sponsor: Suzanne Kell

10:00 am :: Crispin 125

This presentation explores the importance of student assessment through both personal and practical lenses. It begins with a reflection on my journey into teaching, including the experiences that shaped my passion for education and my decision to pursue a teaching degree. I will also highlight how the Education Department at Illinois College has supported my growth over the past three years, providing meaningful opportunities and preparing me to become an effective educator.

The presentation then focuses on my honors project: a diagnostic report conducted in an elementary classroom. I worked with a kindergarten student who initially performed slightly below baseline and demonstrated low confidence. The initial assessment measured skills such as CVC word recognition, syllables, segmentation, and phoneme deletion. Based on the results, I designed individualized lessons targeting the student's specific needs. By the end of the semester, the student showed measurable improvement on the same assessment and demonstrated increased confidence, participation, and ability to apply learned skills.

Finally, I will analyze the assessment data and explain its significance. Student assessment is essential for identifying learning gaps, guiding instruction, and monitoring progress. It enables teachers to provide targeted, one-on-one support and ensures that students do not fall behind. Ultimately, effective assessment practices not only improve academic outcomes but also foster student confidence and engagement both inside and outside the classroom.

Examining the effects of physical intervention and therapies on motor development in children with disabilities

Kaelyn Mitchell

Faculty Sponsor: Prasanna Acharya

10:20 am :: Crispin 125

Therapies and physical adaptations for children with developmental delays and subsequent disabilities play a much bigger role in the world than people know. Recent studies have examined the effects of physical activity and intervention programs on cognitive and motor development in children with disabilities. This literature review will offer insight into why therapy and adaptations are needed by explaining the motor development in children with autism spectrum disorder, as well as the developmental trajectories relating to motor skills in children with cerebral palsy. Three types of physical activities and therapies that focus on children with autism spectrum disorder, cerebral palsy, and Down syndrome will be discussed. These include adapted exercises and sports for children with autism spectrum disorder; aquatic therapy for children with cerebral palsy; and treadmill training for children with Down syndrome. The literature supports the positive effects on motor development: children with autism spectrum disorder showed an increase in motor composite tests after completing a twenty-four-week physical activity program as compared to the control group ; children with Down syndrome had quicker walking onset in the experimental groups with treadmill training compared to the control group; and children with cerebral palsy showed a statistically significant increase in motor function after six weeks of aquatic training. It is important to make the world more accessible, especially for children with disabilities, as it sets them up for success throughout their lives. These therapies and interventions have shown marked increases in motor function.

Persistent Persuasion: A Qualitative Content Analysis of World War II Print Propaganda and Donald Trump's 2020 Presidential Campaign Messaging

Lucy Aldrich

Faculty Sponsor: Yorkow Oppon-Acquah

10:40 am :: Crispin 125

This study compares World War II print propaganda and 2020 immigration campaign messaging. Ten World War II posters and ten videos or images from Donald Trump's official social media accounts were analyzed using qualitative content analysis. Each artifact was coded for fear, enemy framing, patriotism, realistic threat, symbolic threat, and call to action, drawing on Lasswell's theory of propaganda (Lasswell 1927), Social Identity Theory (Tajfel and Turner 1986), and Integrated Threat Theory (Stephan, Diaz-Loving, and Duran 2000). The findings indicate that both eras employed these persuasive elements to mobilize their audiences, though modern artifacts more frequently relied on fear and realistic threat appeals than the WWII artifacts. Symbolic threat appeared less frequently in both periods, while patriotic appeals were prevalent in each era. Overall, these findings suggest that fear, realistic threat, and patriotism function as central persuasive strategies in both wartime propaganda and contemporary political messaging. This study highlights patterns of continuity and adaptation in emotional framing over time, contributing to broader discussions about the evolution of political persuasion in American politics.

Correlation or Causation? Exploring the link between Epstein-Barr Virus infection and Multiple Sclerosis

Shelby Seiler

Faculty Sponsor: Laura Corey

1:00 pm :: Crispin 125

Epstein-Barr virus (EBV) is a widespread herpesvirus that establishes lifelong infection in B lymphocytes and has been linked not only to infectious mononucleosis and several cancers but also to multiple sclerosis (MS). This paper reviews the biomedical literature on the biology of EBV infection and the evidence connecting EBV to MS development. Longitudinal research has shown that MS risk is "greatly increased" following EBV infection, and nearly all individuals with MS have prior exposure to the virus. Proposed mechanisms include molecular mimicry between EBV proteins and myelin, chronic activation of EBV-infected B cells, and sustained immune dysregulation. There is evidence that EBV-infected B cells may cross the blood–brain barrier and promote chronic inflammation and autoimmune reactions against neural tissue. Together, these findings suggest that EBV may play a direct role in initiating or amplifying MS pathology, which shows the need for therapies that target EBV or EBV driven immune responses.

Pathogen Go Fish: Gamifying Microbiology Learning

Macie Petropoulos

Faculty Sponsor: Laura Corey

1:20 pm :: Crispin 125

Gamification has been shown to be an effective learning strategy in a variety of contexts. For my Honors project, I will be making Go Fish cards using clinically important microbial pathogens covered in BI 245 Microbiology. Each card will have a picture of the pathogen, the name of the pathogen, cell type and features, and nutritional and oxygen requirements. Each card will have a corresponding card with the name and picture of the disease it causes, as well as information on the signs and symptoms, treatment, and prevention of the disease. These cards will allow me to further study pathogens and be able to relate them to what I might see as I pursue a nursing career. Simple Go Fish game play will reinforce learning pathogen-disease pairs. There are also possibilities for more complex game play involving additional attributes such as rash identification.

POSTERS

1. Game Theory and Tennis Serving Strategies

Glenn Conway

Faculty Sponsor: Marilyn Markel

The purpose of this study is to investigate the strategies of Illinois College tennis players and to evaluate areas for improvement. This study directly examines the start of every tennis point, specifically which serve directions players choose and when they alternate. These factors create differences in win percentages at given points and match outcomes between teams, with better strategy choices leading to better outcomes. Previous research into tennis serve strategies is limited, most finding that professional tennis players use their best strategies but do not randomize in ideal ways. Analysis of college tennis athletes has not been conducted, directly motivating this work's application to understanding college tennis strategy through these academic approaches. Using recorded tennis match data on sets played by Illinois College tennis players and self-reported strategy data from participants, I employ descriptive statistics and spatial analysis to better understand serve decision-making. I expect to find that college players do not play their optimal strategies in the same way as professionals do, due to significant differences in time commitment, and that Division III college athletes play for enjoyment rather than monetary gain. I also expect to find that, similar to the professional game, college players fail to completely randomize between their serve strategies from one serve to the next. These results will be used to give suggestions to college players to improve their tennis match outcomes, and will be provided to the Illinois College tennis coach to improve coaching efficiency.

2. Animal Confinement: An Exploration of Ethical Concerns and Arguments

Regan Filkin

Faculty Sponsor: McKenna Jaquemet

The debate over keeping animals in captivity has been widely researched and discussed for many years. Some scholars question whether or not it is ethical to keep animals in environments such as zoos, aquariums, and entertainment facilities. This project explores the arguments against animal captivity, such as psychological stress and animal behavior, as well as the physical harm to the animals due to their enclosed environments. Because the animals in captivity live in such tight spaces, long-term effects often result in abnormal behaviors and physical health problems. Advocates of animal confinement argue that captivity opens the door to education about distinct animals and helps conserve many of the species' habitats. By examining various scholarly articles, research studies, and argumentative speeches, this project will weigh out the benefits and challenges to animal captivity, and ultimately provide more effective alternatives to conserving wildlife habitats for the animals.

3. Hotel Cancellation Prediction with XGBoost and Customer Segmentation using K-Means Clustering

Rei Chikyu

Faculty Sponsor: Yanan Liu

We used real-world hotel booking data to predict consumers' booking cancellation probabilities and to cluster customers based on their demographic features. We conducted this research to explore my interest in data analysis, machine learning, and their applications to support decision-making in the real business world. We selected the hotel industry specifically as our context because I love traveling and was interested in gaining deeper insights into the industry's dynamics. We developed two machine learning models. The first model applies XGBoost to predict the likelihood of booking cancellations. We started with data cleaning, including identifying and excluding outliers. We next engineered features to identify factors influencing booking cancellations. Then we built and tuned XGBoost classification models and used k-fold cross-validation for hyperparameter optimization. Using that model, we predicted the likelihood of booking cancellations for consumers given their demographic information and previous behavior patterns. At last, we evaluated model performance using the Receiver Operating Characteristic (ROC) curves and achieved an Area Under the Curve (AUC) of 0.879. The second model applies K-Means clustering to group customers into different segments based on their behavioral patterns, including the cancellation probability we estimated from the first model. We used the silhouette score and selected the optimal number of segments to evaluate the quality of this segmentation. This integration of cancellation probability prediction and customer segmentation can provide useful insights for hotel management strategies and enable the hotel to manage cancellation risks and improve customer retention.

4. Resonant Frequencies in PEC Cavity

J'Aiden Cranwell-Meneses

Faculty Sponsor: Ashiq Rahman

Electromagnetic waves and resonant frequencies were measured within a perfectly conducting resonance cavity. When the cavity has different dimensions, different frequencies will resonate within it, which can be controlled and selected to be used for various applications, such as signal or EM-field amplification. Maxwell's Equations in 2D, and the analytical solution for a PEC (Perfect Electric Conductor) Cavity were used within a program to measure different sizes of resonance cavities and the frequencies that can resonate within them. Starting with dimensions of 0.2 m by 0.3 m, it was determined that at 0.3 m, the highest resonance frequency was around 0.9 GHz, followed by a frequency of 1.2 GHz. At 0.4, the highest resonance frequency was at about 0.85 GHz, followed by a frequency of 1 GHz. At 0.5 m, the highest resonance frequency was 0.8 GHz, followed by a frequency of 0.95 GHz. These results are consistent with analytical resonance frequencies for rectangular PEC cavities. The highest resonant frequency corresponds to the mode at which the wavelength is the shortest, while the second highest frequency is a mode where the wavelength is longer.

5. Computational Modeling of the Biot-Savart Law: Investigating the Effects of Finite Wire Discretization

JJ Simmerman

Faculty Sponsor: Ashiq Rahman

The Biot-Savart Law is the fundamental tool in magnetostatics for relating current distributions to magnetic flux density (B). While analytical solutions exist for simple conductor shapes, complex geometries such as Helmholtz coils often require numerical integration techniques. This project utilizes a Python-based computational model to simulate magnetic field distributions by discretizing current-carrying wires into finite vector segments. Using the NumPy code library, the Biot-Savart Law was numerically integrated for single circular loops and Helmholtz coil configurations. The primary goal of this study is to identify the "computational sweet spot"—the minimum number of segments required to achieve high physical accuracy without wasting processing power. To evaluate this relationship, the number of wire segments (N) was varied from 10 to 150. The simulation demonstrated that as segment density increased, the relative error of the calculated magnetic field decreased from 5.3921% to 0.0234%. At large observation distances, the model successfully verified the inverse-cube decay law for magnetic dipoles with a deviation of only 0.056%. The results indicate that a minimum discretization of 103 segments per loop is required to achieve a precision of 0.05% in field uniformity for Helmholtz configurations. Ultimately, these findings provide a quantitative blueprint for researchers to balance computational efficiency with numerical accuracy, ensuring that simulations of complex electromagnetic systems are both precise and resource-conscious.

6. Simulating 2D Cylindrical EM Waves by Solving Maxwell's Equations Using FDTD Method

Jesus Romero

Faculty Sponsor: Ashiq Rahman

Maxwell's equations are fundamental in physics knowledge, and they describe the behavior of electromagnetic fields. Obtaining numerical solutions for complex scenarios can often be difficult. With this project, a numerical solver is created based on the Finite-Difference Time-Domain method to simulate wave propagation. To discretize the equations, the Yee grid method is used, allowing both the electric and magnetic fields to evolve in time within loops. These methods can allow simulations to investigate wave propagation, boundary reflection, and transmission through materials. To test the accuracy of the model, the amplitude of the electric field was measured as a function of radial distance from a Gaussian sinusoidal point placed at the center of the grid. The data was analyzed by comparing the simulated radial amplitude against the known analytical solution for a two-dimensional cylindrical wave. In this solution, the amplitude decays by $1/\sqrt{r}$ due to energy conservation. This is shown in the simulation as well, so this confirms the accuracy of the model. The results further allow for a deeper understanding of electromagnetism by using computational methods.

7. Ritsumeikan Data Science Program (RDSP): Overview and Analysis of The Use of Data Science to Predict Economic Factors

Valentine Orizi

Faculty Sponsor: Takako Soma

This paper presents an overview of the Ritsumeikan Data Science Program (RDSP), attended at Ritsumeikan University's Osaka-Ibaraki campus in December 2025, and examines the role of data science in improving the accuracy of economic predictions. The program consisted of six lectures covering topics such as AI-driven time series forecasting, participatory sensing, machine learning foundations, robotics, and natural language processing. By using the information gathered from these lectures and supporting it with existing academic literature, this paper argues that data science has significantly enhanced the reliability and explanatory power of economic forecasting models. Machine learning methods, including random forests, neural networks, and deep learning architectures, consistently outperform traditional econometric approaches by capturing non-linear relationships and adapting to real-time information. Applications in areas such as GDP growth prediction and regional economic development assessment further demonstrate the value of these tools for policymakers. However, challenges remain, including model interpretability, data quality, and limited performance in highly volatile economies. This paper concludes that data science, when used alongside traditional economic theory and human judgment, serves as a complement to conventional methods rather than a replacement, enabling more informed and evidence-based economic decision-making.

8. A Low-Cost Integrated Neonatal Care Device for Low- and Middle-Income Countries: Design and Development of a Multi-Functional System for Treating Jaundice, Hypothermia, and Hypoxic Ischemic Encephalopathy

Jack Flatley, Xaiver Applegate, and Xavier Rivera

Faculty Sponsors: Lisa Murray and Ratish Kumar - Biomedical Engineer at Hospital Sisters Mission Outreach, Springfield, IL

Low- and middle-income countries (LMICs) face significant challenges in providing accessible and affordable treatment for common neonatal conditions, including jaundice, hypothermia, and hypoxic ischemic encephalopathy (HIE), where limited access to essential medical devices contributes to preventable neonatal morbidity and mortality in low-resource healthcare environments. Hospital Sisters Mission Outreach identified the need for a portable, easy-to-use neonatal treatment system capable of delivering safe rewarming, controlled cooling, and phototherapy in low-resource settings such as St. John's Hospital in Moshi, Tanzania. In these environments, existing devices, including phototherapy systems, incubators, and cold therapy units, are often prohibitively expensive and infrastructure dependent. In response, the engineering team is addressing these challenges through consideration of global, economic, and societal constraints, including cost, accessibility, manufacturability, and usability in resource-limited settings. A low-cost, integrated neonatal care device, J.E.R.R.Y. (Jaundice and External Radiant Rewarming for the Youth), is being designed as a multi-functional system that integrates three key components: a phototherapy module utilizing blue light within the 450–465 nm wavelength range, a convection-based heating element for controlled rewarming, and a phase change material (PCM) system capable of both heat retention and cooling for thermal regulation. This work highlights how engineering design, when guided by global considerations, can address healthcare disparities by improving access to life saving neonatal treatments, ultimately contributing to better health outcomes, supporting healthcare providers, and promoting sustainable, scalable solutions for neonatal care in resource-limited settings.

9. Global Maternal and Child Health Equity: A Feasibility Study for A Phototherapy Prototype to Treat Neonatal Jaundice

McKenzie Murray

Faculty Sponsors: Lisa Murray and Ratish Kumar - Biomedical Engineer at Hospital Sisters Mission Outreach, Springfield, IL

In many low-income countries, women and children do not receive adequate healthcare services. This is due to a lack of resources, inadequate maternal education, and the extreme costs of medical equipment. As per the World Health Organization (WHO), maternal mortality rates in Low- and Middle-Income Countries (LMICs) contributed to 94% of the total maternal fatalities worldwide in 2017. LMICs carry a disproportionate number of deaths associated with severe neonatal jaundice. Neonatal jaundice is a prevalent, yet curable condition found at birth. Undetected jaundice results in a condition called kernicterus. Kernicterus can cause cerebral palsy, hearing loss, and mental disorders. In low-resource countries neonatal jaundice is left undetected due to medical devices in poor condition, lack of healthcare providers, and ineffective phototherapy. Conventional phototherapy is a non-invasive treatment for neonatal jaundice. Although phototherapy has proven to be safe and effective, it proves to be costly. One unit can cost up to $3,500, making it impossible to maintain and be used in low-resource hospitals. Hospital Sisters Mission Outreach in Springfield, IL works hard to meet the needs of individuals around the world. The organization is unable to keep up with the demand for used phototherapy equipment. The research completed serves to assist Hospital Sisters Mission Outreach meet the goal of manufacturing an adequate amount of phototherapy devices that will be used in hospitals in low-resource areas. The proposed devices will be easy to maintain and easily accessible to those in low-resource countries.

10. Can Ordinary Nickel Do the Job? Exploring Common Nickel Salts in Click Chemistry

Camille Prefountain

Faculty Sponsor: Jocelyn Lanorio

Click chemistry is a widely used chemical technique that quickly and reliably joins small molecules together. It is essential in fields like biomedical research, drug development, and materials science due to its high efficiency and compatibility with biological systems. Traditionally, this reaction is catalyzed by copper, which works well but can be toxic in certain environments.

This project explored whether common, inexpensive nickel salts, specifically $NiCl_2$, $NiSO_4$, and $NiCl_2(PPh_3)_2$, could be used as greener alternatives to copper in this reaction. The click reaction was carried out in water using mild conditions and sodium ascorbate as a reducing agent. The nickel catalysts successfully produced the desired product with yields as high as 78%.

Analytical techniques showed that the nickel-catalyzed reaction formed a mixture of two structural isomers (1,4- and 1,5-substituted triazoles) in nearly equal amounts. This contrasts with copper catalysis, which typically favors only one isomer. The ability to access these alternate products could be valuable in designing new molecules with unique properties for use in biology, materials science, and nanotechnology.

11. Recycling Copper Catalysts for Sustainable Triazole Synthesis in Aqueous Media

Beamlak Hiltework

Faculty Sponsor: Jocelyn Lanorio

In chemistry, making useful molecules quickly and cleanly is important. One popular method is “click chemistry,” where molecules snap together easily with the help of a copper catalyst. We studied whether copper can be reused in this reaction to reduce waste. We tested three different copper compounds, $CuSO_4$, $CuCl_2$, and CuSCN, by reacting benzyl azide and phenylacetylene to form a triazole, a compound used in medicine and materials. $CuSO_4$ and $CuCl_2$ worked well and made high amounts of product, while CuSCN did not. We were able to reuse $CuSO_4$ up to four times with good results. Our work used tools such as infrared spectroscopy and gas chromatography to check the product. This project shows that chemical reactions can be both effective and environmentally friendly, which is an important step toward sustainable science.

12. Exploring Zinc(II) Catalysis in Aqueous Azide–Alkyne Cycloaddition for Sustainable Triazole Formation

Akyea-Obesebea Princess

Faculty Sponsor: Jocelyn Lanorio

In modern chemistry, “click reactions” are popular ways to quickly join molecules and create useful compounds, such as those found in medicine or plastics. Usually, these reactions require copper, which works well but has downsides like toxicity and environmental harm. In this project, we explored the use of zinc, a safer metal, to carry out a similar reaction between two common building blocks: benzyl azide and phenylacetylene. We tested three zinc salts in water and analyzed the results using lab techniques like chromatography and spectroscopy. One of the salts, zinc acetate, gave especially good results and produced a cleaner product. Our findings show that zinc-based catalysts can be a safer, more sustainable alternative for building molecules. This research experience also helped us develop skills in experimental design, teamwork, and chemical analysis.

13. Effectiveness of Daily Sedation Interruption in Mechanically Ventilated Adult Intensive Care Unit Patients: Systematic Review

Ashley Groves and Emma Huelskamp

Faculty Sponsor: Angela Bentley

Mechanical ventilation is a lifesaving intervention for critically ill patients who are admitted to an Intensive Care Unit (ICU). The use of mechanical ventilation requires the continuous use of sedatives. Sedation is used to promote patient comfort, prevent aggression, reduce anxiety and protect the patient’s airway. However, prolonged use of sedation is associated with longer ICU stays and higher risks of complications. Sedation interruption, or “sedation vacation”, is an approach that entails pausing the continuous sedation daily to assess neurological status and readiness for potential extubation.

The purpose of this systematic review is to evaluate whether sedation vacation for intubated/ventilated patients receiving continuous sedation decreases hospitalization stays among adults. The specific aims to be assessed include (1) decreased days on a ventilator, (2) decreased length of hospitalization, and (3) reduced need for sedatives while on the ventilator.

A general interpretation of results concludes that Daily Sedation Interruption (DSI) is safe, practical, and typically beneficial to decrease the duration of hospitalization in mechanically ventilated adult patients. Most evidence indicates that DSI should be standardized for patients meeting a certain criterion. That criterion includes hemodynamic stability, no active seizures, without extreme agitation or increased intracranial pressure (ICP), respiratory instability, the use of neuromuscular blockades, or other considerations that could compromise the patient’s safety. Policy implications should incorporate the adoption of DSI protocols in hospitals and educating and training staff to provide consistent and safe implementation of evidence-based DSI strategies.

14. Effectiveness of Meditation in Stress and Anxiety Management Among College Nursing Students: A Systematic Review

Judivine Sydouane Djouka Tagakou, Lily Ingram, and Anita Shibu

Faculty Sponsor: Angela Bentley

Stress among nursing students is a pervasive and well-documented concern in nursing education. Nursing school is widely regarded as one of the most demanding academic paths, characterized by sleepless nights, emotional strain, and a continuous pressure to perform. The constant balancing act between coursework, clinical duties, and personal responsibilities exposes nursing students to heightened levels of stress and anxiety. When left unaddressed, this psychological strain can impair concentration, reduce empathy, and increase the risk of burnout even before students enter the workforce.

In response to these challenges, meditation has gained attention as a simple yet effective nonpharmacological intervention to promote psychological well-being. Rooted in mindfulness and self-awareness, meditation practices encourage present-moment awareness and relaxation, offering an accessible means of coping with academic and clinical demands.

15. Burnout in Critical Care Nurses: The Impact of Debriefing

Lexie Blackley and Justine Agsalda

Faculty Sponsor: Angela Bentley

Nursing is a stressful profession. Some nurses describe the stress associated with nursing as “burnout”. This trend within our nursing profession is currently on the rise as nursing professionals are working in highly stressful environments for long periods of time with little support and resources. Burnout in nursing can be described as a lack of emotional feelings in the nursing professional that may influence their interactions with patients. ICU nurses are known to have patients with higher acuity levels, ICU nurses also report having a higher level of burnout.

The purpose of this literature review is to recognize the benefits of debriefing among interprofessional staff to reduce burnout in critical care nurses. The aims of this study are to (1) determine what causes burnout in critical care nurses and (2) determine if debriefings are therapeutic for critical care nurses experiencing burnout.

16. The Impact of Socioeconomic Status and Psychosocial Factors on Burnout in College Students

Bobby Driver, Kylee Golden, Justine Agsalda, and Lexie Blackley

Faculty Sponsor: Elizabeth Rellinger Zettler

The stress of classes, extracurriculars, and, for many students, work can negatively impact the mental health of college students. As part of an ongoing study on resilience, two hypotheses were studied. H1: Students from high socioeconomic status (SES) backgrounds will report higher levels of psychosocial capital which will, in turn, relate to lower rates of burnout. H2: Psychosocial factors, including psychological well-being and emotional intelligence, will be correlated to lower rates of burnout. Participants were recruited from across the Illinois College campus and 125 participants completed questionnaires including the Psychological Capital Questionnaire, the Brief Emotional Intelligence Scale, The Copenhagen Burnout Inventory, and the Professional Quality of Life Scale. Contrary to previous studies, we did not find a significant difference between SES and burnout levels. The second hypothesis was supported: psychosocial strengths were associated with lower levels of burnout. Separate multiple regressions were run to predict personal and school-related burnout using measures of psychological well-being (hope, self-efficacy, and optimism), emotional intelligence (ability to appraise one’s emotions and ability to regulate one’s emotions), and professional quality of life (perceived support, compassion satisfaction, secondary trauma, and moral distress). For personal burnout, approximately 26% of the variance in resilience was explained by emotional regulation, compassion satisfaction, and secondary trauma. For school-related burnout, approximately 26% of the variance in resilience was explained by emotional regulation and compassion satisfaction.

17. Frequency of Traumatic Brain Injuries (TBI’s) and Performance on Short-term Memory Tasks in College Students

Jenna McVeigh and Madalyn Norman

Faculty Sponsor: Elizabeth Rellinger Zettler

Traumatic brain injuries (TBIs), including concussions, are increasingly common among college-aged individuals, particularly those involved in athletics. Repeated TBIs have been associated with short-term cognitive impairment and long-term neurological conditions such as chronic traumatic encephalopathy. This study examined whether a higher frequency of TBIs is associated with poorer short-term memory performance in college students. Participants completed a background questionnaire assessing concussion history and then engaged in four standardized cognitive assessments: the Corsi Block Test, Digit Span Test, Stroop Test, and a Photographic Memory Recall Task. These measures evaluate visuospatial working memory, auditory-verbal memory, attention, and cognitive flexibility.

We hypothesized that individuals reporting a greater number of concussions or TBIs would demonstrate lower performance across short-term memory measures. By comparing test outcomes with self-reported TBI frequency, we aimed to evaluate potential correlations between injury history and cognitive functioning. Data collection has been completed; however, statistical analyses are ongoing. Results and their implications will be presented. This study contributes to the growing body of literature examining the cognitive impact of repeated head injuries and may inform campus health initiatives for student-athletes and other at-risk populations.

18. Self-Efficacy and Autonomy as Predictors of Resilience and Burnout in Healthcare Workers

Emma Dunsworth, Ella Ausmus, Lexie Blackley, and Justine Agsalda

Faculty Sponsor: Elizabeth Rellinger Zettler

Healthcare workers have long shifts that are often highly intensive and occur in environments that are frequently low in support and encouragement. Some healthcare providers also serve in roles that do not allow for autonomy. As part of an ongoing study, we proposed that healthcare workers who had higher levels of education, more workplace autonomy, and higher self-efficacy would show higher levels of resilience and lower levels of burnout. Healthcare providers were recruited through social media sites and asked to complete a 30-minute questionnaire. Of 144 respondents 0, 49 identified as nurses, 30 identified as healthcare specialists (e.g., doctors, physicians assistants, occupational therapists, physical therapists, etc.). The remaining participants identified themselves as mental health professionals such as counselors, clinicians, social workers, and others providing specialized services. In addition to providing information about their educational backgrounds and careers, participants completed the Connor-Davidson Resilience Scale 10, The Copenhagen Burnout Inventory, The Measure of Moral Distress-Health for Care Professionals, and the Self-Efficacy and Life Schemes scales from the Spirituality Index of Well-Being. Correlational analyses will be used to explore the interrelationships between these variables and to create a model of the role of autonomy and self-efficacy in preventing burnout. The results and implications of this project will be discussed.

19. Correlations between Psychological Strengths and Resilience among College Students

Kylee Golden, Bobby Driver, Lexie Blackley, and Justine Agsalda

Faculty Sponsor: Elizabeth Rellinger Zettler

College students are increasingly experiencing elevated levels of psychological distress, making resilience a primary factor in maintaining well being. Previous studies have shown that that over 75% of college students are impacted by stress. Additionally, students pursuing careers in healthcare may face additional stressors due to demanding expectations in classrooms and in health settings. In the present study, which is part of an ongoing study of student resilience, the relationship between psychological strengths (hope, emotional intelligence, healthy self-care, support, optimism, and self-efficacy) were explored as predictors of resilience. A total of 125 undergraduate students were recruited from courses across the Illinois College campus. Each completed a questionnaire that assessed resilience and various other psychological traits. Contrary to expectations, no significant differences in resilience were found between future healthcare majors and other students. However, the hypothesis that psychological strengths would be significant predictors of resilience was supported. A multiple regression was run to predict the composite measure of resilience using measures of self-efficacy, psychological well-being, emotional intelligence, social support, and healthy self-care. The model was significant with a high level of collinearity among predictor variables. Thus, backward regression was used to refine the model. The final model, entered with emotional intelligence, self-efficacy, and hope, exhibited a moderate degree of predictability for resilience.

20. Exploring the Impact of Immersive Virtual Reality on the EEG Neurofeedback Experience

Gavin Rasmussen

Faculty Sponsor: Yu-Hua Yeh

The goal of this project was to build an interface to examine the feasibility and effectiveness of integrating virtual reality (VR) with electroencephalography (EEG)-based neurofeedback to train sensorimotor rhythm (SMR) activity. Neurofeedback has shown promise in improving self-regulation of brain activity, but traditional systems can lack engagement and accessibility. By incorporating VR, this interface may create a more immersive and motivating training environment. Specifically, EEG signals were collected and processed in real time using a BIOPAC system to measure participants' SMR activity, which was then used to control visual elements within a VR environment. This project establishes a foundation for future research and provides insight into how immersive environments may enhance brain-computer interface applications.

21. The structure and context of social calls produced by tree roosting bats Lasiurus and Lasionycteris

Miranda Araujo and Laney Goddard

Faculty Sponsor: Bryan Arnold

As highly social mammals, bats produce a variety of social calls that extend beyond search phase and typical echolocation. Social calls are highly variable among species as they can communicate a broad range of information that includes individual identification, food location, and predator warnings. The goal of this research is to further understand and analyze how ecological context shapes the frequency and complexity of social calls in the hoary bat (Lasiurus cinereus), the eastern red bat (Lasiurus borealis), and the silver haired bat (Lasionycteris noctivagans) using automated recorders. Automated recorders were placed at Siloam Springs State Park in Clayton, Illinois, from mid May through mid August in three different ecological contexts: 1) open habitats with limited tree cover; 2) forested flight corridors; and 3) outside artificially constructed bat boxes built specifically for tree roosting bats. Collected recordings were analyzed using the bioacoustic program Kaleidoscope, which identified calls to species based on frequency and duration in comparison to a call library. After species identification, spectrograms were visually inspected and categorized as echolocation or social calls and placed into a social call type category based on shape and structure. The project is ongoing, but at the time of this report at least seven different social call types have been identified among different bat species including a song-like call from the silver haired bat (Lasionycterius noctivagans).

22. Social calls as indicators of foraging activity in Big Brown Bats (Eptesicus fuscus)

Melvin Hodge

Faculty Sponsor: Bryan Arnold

Bats produce a variety of high frequency sounds, including echolocation calls to identify potential prey items and navigate in their environment, and social calls which may have various functions. Recently, research has focussed on examining social calls present in audio files recorded from automated recorders, as this can be a powerful tool to infer the behavior of bat species by linking the context of the recording to different call types. Big brown bats (Eptesicus fuscus) produce different types of social calls including frequency modulated bout (FMB) calls which are unique because of the role they play in foraging, functioning as a territorial signal to ward off conspecifics also foraging in the area. To examine the presence of FMB calls in different ecological contexts, we used data collected from automated recorders installed at Siloam Springs State Park in Clayton, Illinois focusing on recorders installed outside artificially constructed bat boxes. We observed two periods of time in the summer comparing FMB call density at various points in the night. Our results show that earlier in the summer FMB calls were equally common throughout the night, while later in the summer FMB calls were more frequent in earlier periods, indicating a shift in foraging behavior to earlier vs. later periods. While this study is ongoing, our preliminary results suggest that biologists can identify foraging patterns from audio recordings, allowing for a powerful method to assess behavior in a nocturnal setting.

23. Assessing genetic relatedness of co-captured bats in mist nets using variable microsatellite markers

Jenna Sharp

Faculty Sponsor: Bryan Arnold

Understanding bat social structure and genetic relatedness is essential for effective conservation. This study investigated whether bats captured simultaneously in the same mist net exhibit genetic relatedness, potentially indicating kin-structured foraging or roosting behavior. Field data were collected using minimally invasive techniques including mist netting and wing biopsy punches from captured individuals. Field data sheets dating back to 2015 were reviewed to identify same-species individuals with the same recorded capture time. The study focuses on four bat species native to Illinois: Big Brown Bats, Eastern Red Bats, Evening Bats, and Northern Long-Eared Bats. Tissue samples underwent DNA extraction and polymerase chain reaction (PCR), during which fourteen existing microsatellite primers, originally developed for different species, were tested for possible cross species amplification. Six of these primers successfully amplified DNA fragments in the target species. The amplified samples will support ongoing microsatellite analysis and DNA sequencing to further assess relatedness among captured individuals. By integrating field surveying methods with molecular techniques, this project aims to identify potential familial behavioral patterns, ultimately contributing to a deeper understanding of bat social organization and informing conservation strategies that support habitat management and population stability.

24. Classification of Bacteria Found From Soil Samples and the Methods Used

Morgan Carrino

Faculty Sponsor: Gwen Knapp

Antibiotic resistance is a very serious issue in today's world and is an ongoing health issue that is growing worse as antibiotics continue to be overprescribed. Antimicrobial resistance is an ongoing issue due to the fact that it can increase the spread of disease, illness, and even death. Developing the skills of understanding a colony's morphology, gram-stain, and using differential and selective media can help to further understand how different bacteria behave and overall start to figure out what strain of bacteria is being used and how it contributes to antimicrobial resistance. In order to obtain bacteria samples, soil is a great source of antimicrobial-producing bacteria due to its availability to contain abundant and diverse amounts of nutrients, bacteria, etc. Antibiotic resistance is a bacteria's ability to change and evolve to become more resistant to treatments including antibiotics. The healthcare field is running out of antibiotics as bacteria become more resistant which will ultimately lead to drug-resistant illness and less treatment options.

25. The Roles of Sexual Dimorphism and Age in Human Cranial Angle Measurements

Grace Vaughn

Faculty Sponsor: Miranda Karban

Many studies have analyzed sexual dimorphism in adult skulls; however, little research has been done to investigate differences in male and female cranial angles pre- and post-puberty. Cranial angles were measured from a sample of lateral radiographs from 46 European-derived extant human subjects (22 male, 24 female) from The University of Toronto Burlington Growth Study. Subjects were sampled at two longitudinal age groups, before and after the onset of puberty (Age 1: 8.0-9.2 years Age 2: 14.0-16.4 years). Sex- and age-related variation in cranial angles was assessed at both age points using t-tests.

In both sexes, the rhinion-nasion-glabella angle and gonion-gnathion-infradentale angle were found to change significantly between the two sampled age groups. The glabella-nasion-sella angle was found to change significantly between the two sampled age groups only in females, while the gonial angle was found to change only in males. No significant sexual dimorphism was found at Age 1, but the gonial angle was found to significantly vary between the sexes at Age 2. This timing corresponds with puberty, and could be caused by hormonal variation that leads to males developing a more protruding jawline. These results are relevant to forensic age and sex estimation from skeletal remains.

26. Permanent Tooth Eruption Timing and Malocclusion Class in Modern Humans: A Dental Cast Analysis

Hollie Petitt

Faculty Sponsor: Miranda Karban

This study was conducted to assess the association between deviations in permanent tooth eruption times (based on American Dental Association guidelines) and malocclusion classification within modern humans.

The sample of this study consists of dental casts of 30 North American subjects (15 female, 15 male) primarily of European descent obtained from the American Association of Orthodontists Foundation (AAOF) Craniofacial Growth Legacy Collection. Each malocclusion class was represented by 10 subjects. The deviation of eruption times from established norms was calculated based on the observation of initial gingival emergence for each tooth in the permanent dentition.

Statistically significant deviations in eruption time were found between malocclusion classes for teeth #2, #4, #7, #10, and #14 (Universal Numbering System). These deviations were confined to the maxillary arch, with no significant deviations observed in the mandibular dentition. These deviations occurred mostly in subjects with Class II or Class III malocclusion, showing a general trend of early eruption in Class III and late eruption in Class II.

This pattern of deviation may exist due to differences in bone density between the mandible and maxilla, leading to more complexity in root structure and eruption paths in the maxilla. Knowledge on standard eruption times of the permanent dentition and levels of deviation from those standard eruption times, especially of maxillary teeth, could potentially aid orthodontic treatment planning.

27. Nasal Bone Development in Extant Humans

Jerica LaMarsh

Faculty Sponsor: Miranda Karban

Human nasal bone development begins during gestation and continues throughout adolescence until maturity. Some studies suggest bone degeneration occurs in older adults. This study focuses on the development of nasal bone structure to determine if nasal bone shape is altered during childhood development or later in life.

Cephalograms from a total of 30 European-derived extant human subjects were measured, including 15 longitudinal growth study participants, each sampled at two age points (age 1: 4.0-4.42 years and age 2: 15.83-18.17 years), and 15 adult postmortem crania. A total of 19 landmark and sliding landmark points were collected spanning from the glabella to the rhinion. Generalized Procrustes Analysis, Relative Warps Analysis (RWA), and Kruskal-Wallis tests were performed to analyze the data.

Some shape variation was found between age group 1 and the other ages in RW1. Age group 2 and the postmortem sample clustered together. Kruskal-Wallis tests found sexual dimorphism along RW3 in the postmortem sample.

These results suggest that between age group 1 and age group 2, the nasal root and the mid-nasal bridge develop and reach maturity. The sexual dimorphism is likely due, in part, to differences in the supraorbital (brow ridge) projection. Further studies could assess additional age points to determine more precise timing of nasal and anterior frontal bone development.

28. Post-Metamorphic Lens Regeneration in Xenopus laevis

Tatum Wimbrow

Faculty Sponsor: Paul Hamilton

Regenerative capabilities can be observed in the African clawed frog, Xenopus laevis. Through lentectomy, the complete removal of a lens, X. laevis tadpoles are capable of regenerating a new lens from the cornea epithelium, but mature X. laevis frogs are not capable of this regenerative process and lose this ability during metamorphosis. It remains unknown what changes occur within the mature cornea that inhibit the regenerative mechanism, but we suspect it is the development of the cornea stroma. Through a series of four different experiments, we explored the regenerative capabilities in X. laevis tadpoles and attempted to challenge mature X. laevis corneas using enzyme treatments and scratch treatments to disrupt the stroma structure. In this study we developed an in vivo regenerative assay in an attempt to see if the in vivo environment produced better regeneration results than previous ex vivo trials. While this work remains ongoing, here we present an update on the progress of this project as we work towards our goal of unlocking lens regeneration from the mature frog cornea.

29. Antibiotic Ototoxicity Screening in Xenopus laevis Tadpoles

Juliana Rensing

Faculty Sponsor: Paul Hamilton

Many antibiotics prescribed to patients possess potential ototoxic effects with varying severity. To determine the risk of this side-effect in new drug development, it is necessary to evaluate the health of hair cells within the inner ear. Due to the complexity of studying the inner ear of mammals, alternative models have been developed to do preliminary screening of the potential ototoxic nature of drugs. Traditionally, the hair cells of the zebrafish lateral line system have been a useful model for early ototoxicity screening. However, fish are not as closely related to mammals as frogs are, and our lab proposed using Xenopus laevis tadpoles due to their equally accessible lateral line system and closer evolutionary relationship to mammals. Tadpoles possess lateral lines on the sides of their body with neuromasts that allow them to sense movements in the water as they swim, and these neuromasts contain hair cells that can be studied for damage from antibiotics and other small molecules. In our research, we first subjected both control and experimental groups of Xenopus laevis tadpoles to a wash of YO-PRO-1, a fluorescent nucleic acid stain used to identify hair cell nuclei. Tadpoles were then separated into control and experimental groups, and the control tadpoles were placed in a dilute Normal Amphibian Solution (NAM) while the experimental groups were placed into a dilute NAM solution containing one of three antibiotics: Kanamycin, Neomycin, or Gentamicin. Following the antibiotic exposure, hair cells in neuromasts were analyzed using a fluorescence microscope to determine their number and brightness. While this work remains ongoing, we provide insight into the progress that has been made in using tadpoles as a model for determining the potential ototoxicity of new antibiotics or drugs early in the research process.

30. Precise Temperature Control In Aircraft Avionics Using Thermoelectric And Liquid Cooling Systems

Cameron Knapik

Faculty Supervisor: Josiah Kunz

Advancements in modern aviation have significantly enhanced the performance and reliability of avionics systems, enabling more effective monitoring of aircraft integrity by both pilots and ground control. However, this performance increase has led to higher power consumption and greater heat generation. If unmanaged, this thermal load can impair system performance or cause long-term damage to critical electronic components. These electronics operate within precise temperature ranges and suffer significant performance decline even slightly outside those thresholds. Conventional cooling methods, such as air convection, often fail to provide sufficient thermal management across complex avionics bays.

This research examines the application of thermoelectric cooling technologies to achieve more efficient and localized thermal regulation in avionics environments. Thermoelectric devices offer rapid and precise spot cooling, making them suitable for mitigating concentrated sources of waste heat. A proportional–integral (PI) control algorithm is used to monitor temperature error relative to a desired set point and regulate thermoelectric cooling. The study compares the performance of traditional air convection cooling with hybrid cooling configurations incorporating thermoelectric modules and, in one case, supplemental liquid cooling.

Two different cooling models were constructed and evaluated to determine the most efficient cooling method. Model A utilized thermoelectric cooling with wind tunnel-driven airflow, while Model B employed a comprehensive hybrid approach incorporating air convection from the wind tunnel, thermoelectric cooling, and a liquid cooling system. These configurations are evaluated to determine the effectiveness of hybrid thermal management strategies for maintaining stable operating temperatures in avionics systems.

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