PRESBYTERIAN COLLEGE

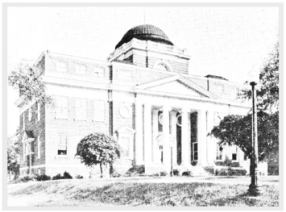
COLLEGE *of* ARTS & SCIENCES | SCHOOL *of* PHARMACY

HONORS DAY SYMPOSIUM

2026

Honors Day Symposium

PRESENTER ABSTRACTS



Presbyterian College

April 9, 2026

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Dear PC Community,

I am tremendously excited to see the academic work and achievements of students take center stage during Honors Day. During this annual event, we recognize the exceptional work of students and we celebrate the collaborative efforts that take place between students and faculty.

PC is known for its academic rigor, and many students soar above and beyond classroom expectations. Involvement in Honors Day is a particularly strong testament to their dedication, focus, and talent.

Our students have put their hearts and souls into their research and creative work. They have pursued their passions and satisfied their curiosity in the wide variety of disciplines in the liberal arts. They have risen early and stayed up late, all in an effort to present their best work. We are proud of their many accomplishments.

Please join me in congratulating the students presenting during Honors Day and the students receiving awards today. I am grateful for the faculty who have mentored these diligent student researchers and artists.

Welcome to Honors Day!

Respectfully,

Anita Olson Gustafson

Anita Olson Gustafson, Ph.D.
President of Presbyterian College

April 9, 2026

Dear Members of the Presbyterian College Community:

It is a joyous occasion to be celebrating the scholarly and creative accomplishments of Presbyterian College students. Honors Day at PC represents the best of who we are and reflects the essence of what we do as a learning community. The academic work you will see today – whether in the form of presentations, poster sessions, or performances – demonstrate the impressive scholarly and creative activity that PC students pursue with faculty mentors in the College of Arts and Sciences, in the School of Pharmacy, and in our Physician Assistant and Occupational Therapy programs. Congratulations to all the students whose work is being highlighted today!

Students from all departments and programs on campus participate in research opportunities available throughout the year. Since a Senior Capstone or Signature Work is required for all undergraduate majors, Presbyterian College students actively explore scholarship in their chosen field. Collaborative student-faculty research is at the heart of PC Summer Fellows program, and some undergraduate students carry out Honors Research projects as part of their major. Our graduate programs are also actively engaging students in Capstone and other research projects. These scholarly experiences introduce students to the value of pursuing the life of the mind and launch them into further study and exploration for their post-PC careers.

I also want to recognize the outstanding dedication and effort of the faculty members who have served as research advisors, academic mentors, creative collaborators, moderators, and organizers for this event. Dr. Stefan Wiecki leads a talented group of faculty, staff, and students who produce this important celebration of academic work each year at Presbyterian College. Thank you for your dedication to making the magic of Honors Day happen.

Please enjoy the 2026 Honors Day Symposium!

Sincerely,

Erin Sallee McAdams

Dr. Erin S. McAdams
Provost and Vice President of Academic Affairs
Professor of Political Science

Osteogenesis of Horn and Antler

30-Minute Departmental Honors Presentation

Annabeth Katherine Adams
Jim Wetzel, Ph.D.
Department of Biology

Despite having similar external appearance and physical structure, the cranial appendages noted on the Mammalian families Cervidae (antlered species such as Deer) and Bovidae (Goats and other horned species), these structures are quite different in both their developmental pattern and cellular structure. Groups including Cervidae that feature antlers showcase very well documented research on the relationship between overall cranial appendage osteogenesis and the endocrine hormones that regulate osteogenesis. By comparison, there have been very few studies concerning this hormone and morphology association in Bovidae. This study presumes to advance that knowledge by documenting and comparing the internal cranial bone structure of horn in Bovidae based on measurements of age, sex and breed to better understand the relationship between their cranial osteogenesis and hormonal testosterone cycling.

Creative Writing: Senior Portfolio
15-Minute Presentation

Annabeth Katherine Adams
Robert Stutts, Ph.D.
Department of English

Students in Creative Writing: Senior Portfolio revise previously written pieces for a professional portfolio.

Annabeth's Artist Statement:
The reason I write, I feel, is pretty much the same for anyone else who does so. It's to get out those things that you wouldn't be able to say otherwise. To make peace with my emotions. And to share a story that someone out there needs to hear, whether it′s for them or for me. Sometimes I don't think what I write is necessarily good, but honestly it doesn't matter as long as it makes someone think or feel at least something, then it's good enough for me.

Using HBot to teach French Cuisine

15-Minute Presentation

Brayden Adams
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

This project examines how French cuisine—widely recognized as a cornerstone of national identity, cultural heritage, and social practice—can be taught more effectively through interactive learning. While scholars emphasize that French gastronomy encompasses tradition, pleasure, and communal meaning rather than mere lists of dishes, classroom instruction often relies on passive methods that limit engagement and retention. Research on intangible cultural heritage highlights the importance of experiential, participatory approaches that reflect the lived nature of culinary traditions, suggesting that static teaching tools fail to support meaningful categorization skills or cultural understanding. To address this gap, the project introduces a 3D Unity-based educational game in which players sort French food items into their appropriate categories using a conveyor-belt mechanic. By integrating game-based interaction with culturally grounded content, the system transforms abstract gastronomic knowledge into an active learning experience. This approach aligns with studies showing that visual classification and ingredient recognition are central to understanding culinary identity, offering a more immersive pathway for developing cultural literacy, memory retention, and deeper engagement with French cuisine.

The Art of the Female Gothic

30-Minute Departmental Honors Presentation

Rebekah J. Archer
Lynne Simpson, Ph.D.
Department of English

The female gothic, a subgenre of gothic, cannot be clearly defined other than by this simple statement: gothic literature that is written by women. This definition was first introduced in Ellen Moers's pioneering 1976 work, Literary Women: The Great Writers. Since then, the genre and its definition have been contested, debated, and developed, to the point that literary critics cannot agree on all that it entails. Specifically for this honors research, Moers' definition will be used in the context of common gothic themes. Additionally, the literature analyzed in this paper also features a female protagonist, so seminal female gothic novels like Mary Shelley's Frankenstein will be excluded. Daphne du Maurier's Rebecca, Shirley Jackson's We Have Always Lived in the Castle, Carson McCullers' The Ballad of the Sad Café, Joyce Carol Oates' "Where Are You Going, Where Have You Been?" and Flannery O'Connor's "Good Country People" all explore similar themes. The 'haunted house' in these works serves as a literal and metaphoric space of fear and insecurity, one often made worse by the 'ghosts' of guilt and memory. The female protagonists who inhabit them suffer male predation and as a result, undergo tragic transformations including moral, physical, and/or psychological decline.

Emma Woodhouse: Early Feminist Icon?

15-Minute Presentation

Cree Augustine
Lynne Simpson, Ph.D.
Department of English

When writing Emma, Jane Austen famously quipped, "I am going to take a heroine whom no one but myself will much like." Austen was successful in this endeavor – Emma Woodhouse became a widely disliked character by critics, particularly for the qualities that make her a proto-feminist. Critics have long questioned the femininity of Emma Woodhouse because of her self-assurance. Emma also initially rejects the typical societal expectations of women in nineteenth century England, especially marriage. However, several notable feminist critics of Austen, including Marylyn Butler, Jan Fergus, and Claudia Johnson, have contended the opposite, stating that Emma simply acts with the same confidence and authority that the men of her same social status do. In this essay, I argue that the exact qualities and traits that critics point out as flaws in Emma′s character that make her ″unlikable″ actually make her laudable as an early example of a proto-feminist character in a traditional, conservative society.

The Role of Propaganda in Shaping Public Perception of the Crusades

15-Minute Presentation

Cree Augustine
Richard Heiser, Ph.D.
Department of History

During the period of the Crusades, the European public demonstrated an immense willingness to support and even directly participate in the crusading movement. It has been called into question whether or not a propaganda effort of some kind is to credit for the rapid support. Research supports the idea that propaganda was not only present during the medieval period, but was widely used across Western Europe as a tool for recruitment and garnering support from the public, compiled into a paper titled "The Role of Propaganda in Shaping European Public Perception of the Crusades during the Medieval Period."

Cultural and Linguistic Fusion in al-Andalus: An Interdisciplinary Study of the Muwashshah and Jarcha

30-Minute Departmental Honors Presentation

Lydia Usama Awadalla
Sharon Knight, Ph.D.
Department of Modern Foreign Language

This project explores the muwashshah and the jarcha as literary forms that reflect the cultural and linguistic diversity of al-Andalus. Using philological and musical methods alongside close textual analysis, the study examines how Arabic, Hebrew, and early Romance languages coexist within a single poetic structure. The structured, courtly form of the muwashshah contrasts with the intimate and often feminine voice of the jarcha, highlighting the dynamic relationship between elite literary tradition and everyday expression. By examining themes of longing, separation, and emotional expression, the project situates these poems within a cultural milieu shaped by sustained multilingual exchange and shared artistic traditions. Within this context, the muwashshah and the jarcha emerge not merely as early foundations of Hispanic lyric poetry, but also as sophisticated expressions of cultural and artistic synthesis. Ultimately, this study underscores how the literary and musical hybridity of medieval Iberia continues to inform contemporary discussions of identity, linguistic contact, and cross-cultural creativity.

The Effects of Salinity on the Gut Microbiome of Mummichog (Fundulus heteroclitus)

30-Minute Presentation

Reece Maclain Bradberry
Stuart Gordon, Ph.D.
Department of Biology

Salinity is a major environmental factor influencing fish physiology, affecting processes such as osmoregulation, energy allocation, and stress responses. The gut microbiome is a community of microorganisms in the host's digestive system that aids in digestion and helps regulate gut health. Changes in the gut microbiome can impact overall health, therefore we aimed to study how various salinities affect the composition of the gut microbiome of killifish, Fundulus diaphanus. Eighteen fish were placed in a tank with a salinity of 50 parts per thousand (experimental) and 8 fish were placed in a tank with 0 parts per thousand (control). After extracting the gut contents, DNA was extracted for Illumina sequencing of 16s rRNA amplicons. In parallel, the same DNA will be used for in-house Oxford nanopore amplicon sequencing. Additionally, students in a Microbiology course will use the samples from the same fish to identify gut microbes using culture-based approaches. For the students who do not pursue research outside of coursework, it provides a tangible example of research methodology and the importance of microbes in nature. Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number P20GM103499. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Teacher Perceptions of the Influence of High-Stakes Testing in 3rd Grade

15-Minute Presentation

Emily Rhea Brown
Julia Wilkins, Ph.D.
Department of Education

Ever since the implementation of the No Child Left Behind Act of 2001, there has been an emphasis on accountability and measurable outcomes related to student achievement, which has led to a reliance on high-stakes standardized testing within the elementary grades. Third grade is considered a critical year for this type of standardized assessment, which places pressure on both students and teachers. While concerns regarding excessive testing are frequently discussed in educational settings, relatively little research has focused on teachers' firsthand perceptions of how excessive testing influences their classroom instruction and student engagement. This study explores third-grade teachers' experiences related to using instructional time to prepare students for standardized tests and its impact on students' motivation, engagement, and overall learning experiences. The study is guided by two research questions: (1) How does perceived overtesting influence third-grade teachers' instructional decision-making? and (2) How do third-grade teachers perceive the impact of overtesting on students' motivation and engagement? I conducted classroom observations and semi-structured interviews with three third-grade teachers from different school settings across the Carolinas, including one private school, one public school, and one charter school. By examining teachers' insights across varying school contexts, this research aimed to highlight the practical implications of high-stakes testing in early elementary education. This information could benefit policymakers as well as school administrators in bringing awareness to the effects of excessive testing on classroom instruction and student experiences. Note: This study is currently in progress, and observations and interviews are still being completed.

The Spoke in the Wheel: Lessons from Bonhoeffer for the Proper Relationship Between the Church and the State

15-Minute Presentation

Jonathan Warner Bush
Kirk Nolan, Ph.D.
Department of Religion

During his time in America, Dietrich Bonhoeffer experienced life in a country defined by a politics of separate spheres of authority between church and state. He criticized this dynamic, believing that American theology had become diluted and secularized. Back in Germany, he also encouraged the church to take on a more interactive role in challenging the actions of the state. With debate about the role of the church in relation to the state resurfacing in the United States in the past few years, Bonhoeffer's words offer insight into the implications of this debate and the policy of "separate spheres" overall.

Transforming Smartphones into High Resolution Microscopic Tools

Poster Presentation

Phillip Rankin Byrd
Andrew Mount, Ph.D.
Department of Biology

Fluorescence microscopy is traditionally restricted to well-funded institutions due to the high cost of equipment, which often ranges from tens to hundreds of thousands of dollars. This financial barrier limits the research capabilities of students and independent laboratories. To address this, we present Pocket MUSE, an ultra-low-cost fluorescence microscope integrated with a standard smartphone. By utilizing frustrated Total Internal Reflection (fTIR), Pocket MUSE selectively illuminates fluorophores within a thin specimen region, achieving high-quality imaging at a fraction of the cost of traditional systems. This technology seeks to democratize scientific imaging, making advanced microscopy accessible to students and researchers worldwide.

Surfaced-Enhanced Raman Spectroscopy (SERS) of Rhodamine B on Gold Nanoparticles

30-Minute Departmental Honors Presentation

Autumn Devadney Channer
Latha Gearheart, Ph.D.
Department of Chemistry and Biochemistry

Nanoparticles are materials with dimensions measured on the nanometer scale with unique chemical properties. They are applied to surface-enhanced Raman spectroscopy (SERS), a technique used to amplify Raman scattering intensity and detect low analyte concentrations. Although SERS offers many advantages when it comes to Raman spectroscopy, it is limited in reproducibility. They are sensitive, allowing them to enhance weak signals, but that strength is not guaranteed twice. This research project focused on using gold nanoparticles as a SERS substrate to detect traces of Rhodamine-B, an FDA-regulated dye. The Raman spectra were collected using a Deltanu 200a instrument to evaluate intensity changes with dye concentrations. It is hypothesized that increasing the concentration of Rhodamine-B will result in higher Raman integration intensity.

A Study of the Paleopalynology of the Atokan-Desmoinesian Boundary at the Roaring Creek Locality, Parke County, Indiana

30-Minute Departmental Honors Presentation

Hallie Ann Cohen
Michael Rischbieter, Ph.D.
Department of Biology

The Roaring Creek locality of Parke County, Indiana, preserves an extremely detailed record of many Pennsylvanian-age coal swamp plants during the Atokan-Desmoinesian stage in geologic time (~305 MYA). The coal-swamp deposits that Roaring Creek is found in were formed during a time of constantly changing climatic oscillation, as late Paleozoic ice sheets expanded and contracted across the supercontinent Gondwana. Glacial maxima lowered sea levels, exposing wet lowlands that became coal swamps, while glacial minima raised sea levels. Using paleopalynology, or the analysis of fossil pollen and spores, we reconstructed this ancient environment across stratigraphic layers to evaluate the ongoing discussion concerning the geologic age of Roaring Creek. Sixteen vertical, time transgressive sediment blocks collected in 1981 by Dr. William DiMichele and Dr. Michael Rischbieter were processed using standard palynology techniques which resulted in a series of microscope slides containing a variety of pollen, spores and cuticular remains. The palynomorphs were photographed using a Nikon E800 microscope equipped with Differential Interference Contrast (DIC) with an attached JENOPTIK GRYPHAX digital camera. Species-level identifications were made by comparing the recently taken images in Fall 2025 with previously published images found in the paleopalynological literature. Layer 8, the oldest layer, showed the most biological diversity and the clearest images. It contained the index fossils Radiizonates difformis and Dictyotriletes bireticulatus, supporting one interpretation that Roaring Creek is Late Atokan in age. Upper layers showed less diversity and a dominance of the genera Laevigatosporites and Lycospora. In the upper layers, there was a higher abundance of fern-derived spores, which supports an alternative interpretation that Roaring Creek more closely aligns with it being early Desmoinesian in geologic time. These contrasting observations show that Roaring Creek may be a

unique locality that captures a transitional boundary characterized by glacial cycles and a shifting coal-swamp vegetation.

Measuring Stress Due to Recently Changing Reproductive Policies in the United States

30-Minute Departmental Honors Presentation

Hallie Ann Cohen
Sarah Burns, Ph.D.
Department of Psychology

Recent shifts in reproductive policies in the United States have caused various emotions and stress to arise, including legal battles and personal reactions. Due to changing access to contraceptives, abortion, and other reproductive healthcare options, individuals have been impacted on a personal level throughout the country. Most of the time, reactions to policy changes are measured in terms of legal outcomes, but the emotions and stressors on a personal level are often overlooked. In many states, specifically the southeastern states, reproductive bodily autonomy has been reduced significantly since Roe v. Wade was overturned by the Dobbs decision in 2022. In other states, such as those in the Northeast, reproductive access has remained the same or become more widely available. We aim to investigate the wide range of emotional and physiological reactions from individuals who have been affected by the recently changing reproductive policies in their state, across the United States. It is essential to understand how these policy changes can impact individuals from diverse demographic backgrounds, including their state of residence, age, gender, and socioeconomic status. Knowing how these changes affect different individuals can give us a better understanding of which groups are disproportionately affected by the policy changes. During Summer Fellows, we have developed a survey to assess stressors related to reproductive healthcare policy changes. The survey includes demographic variables and stress-related items. This research can help bridge the gap between legal policies and real-life experiences by surveying individuals about their own lived emotional experiences. With IRB Approval in January 2026, we will distribute the survey between the months of January and February 2026. We anticipate that individuals in more restrictive states will report higher stress levels than those who live in less restrictive states. We further hypothesize that individuals who have lower SES and educational level will report more stress than those who do not. We will also explore potential differences based on gender and fertility status, as participants may be uniquely impacted depending on these factors.

Renovation and Modernization of One Presbyterian College's Oldest Residence Hall

15-Minute Presentation

Lawton Anthony Cox
Francis Cashman, Ph.D.
Department of Physics

We constructed a comprehensive redevelopment proposal for one of Presbyterian College's oldest residence halls, Clinton Hall, originally constructed in 1964. The proposed renovation involves a full demolition and redesign aimed at improving safety, accessibility, space efficiency, and overall student living conditions. The updated design prioritizes ADA-compliant accommodations, enhanced community engagement spaces, and improved functional layout to better meet modern residential and regulatory standards. Using AutoCAD as the primary design platform, the project began with the creation of digitized floor plans by tracing original architectural drawings to accurately reconstruct the buildings structural framework. This foundational digital model was scaled precisely and served as the basis for our proposed models. The second design phase introduced spatial reconfiguration, including redesigned room layouts, added study areas, expanded lounge spaces, and the integration of furniture blocks at realistic dimensions to validate the spatial functionality. Hatching techniques like filling non occupied spaces with color for such things as walls. These were applied to clearly distinguish structural components like walls from occupiable areas. The final phase transforms the completed models into professional sets of blueprints from AutoCAD's plot feature. This incorporates detailed dimensions with printed measurements, standardized layers, annotations, and proper scaling for construction documentation. We successfully demonstrate how modern drafting technology and thoughtful spatial planning transforms outdated residential facilities into safer, better accessible, and a community driven living environment that fits the needs of all students to make their time at PC more comfortable, productive and enjoyable.

Religion's Role In The Crusaders' Life

30-Minute Departmental Honors Presentation

Brian William Coyle
Richard Heiser, Ph.D.
Department of History

Religion structured nearly every aspect of a crusader's life, shaping daily routines, moral reasoning, and importantly interpretations of victory or defeat in battle within a deeply Christian worldview. On the basis of the primary sources and the research of modern historians, it can be argued that the crusaders experienced themselves in the crusades not as conquerors but as penitential pilgrimages. Religious rituals such as Mass, confession, fasting, and vows followed the armies into battle. By examining the historiographical debate between moral critics and revisionist scholars, the paper demonstrates that religion was much more than a simple justification for violence it instead was the framework through which crusaders interpreted their world and their actions within it.

The Effects on Public Perception Towards the Sixth Crusade Due to Frederick II's Status as an Excommunicate.

30-Minute Departmental Honors Presentation

Grace Elizabeth Culbreath
Richard Heiser, Ph.D.
Department of History

Frederick II is a well-known historical figure during the Crusades. Having been crowned both the King of Sicily and Holy Roman Emperor, he vowed to take the cross and go on a Crusade to retake the Holy Land, which was then under Muslim control. However, after years of delaying his crusade to remain in his imperial position, he was excommunicated by Pope Gregory IX. Soon after, he set sail to complete a Crusade of his own, regardless of his status as an excommunicate. This honors research will discuss the historical background of the Sixth Crusade, analyze the historiography surrounding the subject, and answer the question at large: How did Frederick II's status as an excommunicate affect public perception of his Crusade, including among citizens and the European papacy?

How Did Frederick II's Status as an Excommunicate Affect Public Perception of His Crusade?

30-Minute Departmental Honors Presentation

Grace Elizabeth Culbreath
Richard Heiser, Ph.D.
Department of History

Frederick II is a well-known historical figure during the Crusades. Having been crowned both the King of Sicily and Holy Roman Emperor, he vowed to take the cross and go on a Crusade to retake the Holy Land, which was then under Muslim control. However, after years of delaying his crusade to remain in his imperial position, he was excommunicated by Pope Gregory XI. Soon after, he set sail to complete a Crusade of his own, regardless of his status as an excommunicate. This honors research will discuss the historical background of the Sixth Crusade, analyze the historiography surrounding the subject, and answer the question at large: How did Frederick II's status as an excommunicate affect public perception of his Crusade, including among citizens and the European papacy?

Patient-Centered Ethics in the Pharmaceutical Industry

30-Minute Departmental Honors Presentation

Blair Elizabeth Darby
Karen Mattison, Ph.D.
Department of Economics and Businesss Administration

The pharmaceutical industry plays a critical role in public health, yet rising concerns about drug affordability, research bias, and misleading marketing practices have weakened public trust. This paper examines whether current pharmaceutical practices align with core ethical principles such as justice, transparency, and patient welfare. Through the analysis of drug pricing models, including value-based pricing and the Average Lifetime Earnings standard, as well as comparative industry profit data, the study evaluates the ethical implications of affordability across a patient's lifetime. It further explores the impact of industry sponsorship on research integrity and the risks posed by publication bias and conflicts of interest. In addition, the paper assesses growing ethical challenges in digital marketing, particularly the use of social media influencers and algorithm-driven communication, and their effects on patient autonomy and health literacy. In response to these concerns, this research proposes the Patient-Centered Ethical Reform Model (PCERM), which is a three-pillar framework designed to strengthen ethical affordability, research transparency, and equitable communication. This model aims to restore trust and ensure that pharmaceutical innovation remains grounded in its primary obligation to prioritize patient well-being.

Seeing Saladin through Arabic and Latin Eyes

15-Minute Presentation

Austin Skoog David
Richard Heiser, Ph.D.
Department of History

My capstone project looks at how Saladin was described in Latin Christian sources and Arabic Muslim sources during the Crusades. By comparing these writings, I study how religion and culture shaped whether he was seen as a heroic and noble enemy or as a strong Muslim leader. The project shows why it is important to use different perspectives when understanding major historical figures during the Crusades.

Structure-CO Release Rate Relationship of ROS-Activated Carbon Monoxide Donors for Targeted Delivery

Poster Presentation

Antonio Alexander Davis
Kimberly De La Cruz, Ph.D.
Department of Chemistry and Biochemistry

Carbon monoxide (CO) has traditionally been regarded as a toxic byproduct of heme degradation, yet emerging research recognizes its therapeutic potential as an anti-inflammatory and cytoprotective gasotransmitter. However, safely delivering CO to specific tissues at controlled doses remains a primary challenge. Current strategies involving gaseous CO or transition metal-based CO-releasing molecules (CORMs) suffer from limitations such as poor targetability, complex administration, and unpredictable CO release rates. To address these challenges, particularly the unpredictability of CO release rates, we are designing and testing a library of small organic CORMs with a variety of structural features that activate in the presence of elevated hypochlorite (HOCl), a reactive oxygen species concentrated at sites of inflammation and oxidative stress. By investigating the structure-CO release rate relationship of these molecules, we can streamline the development of effective CO prodrugs. This approach leverages pathological HOCl levels as a trigger for localized CO release, enabling spatiotemporal control over CO release. Previous research has demonstrated enhanced CO release rates in organic CO donors with rigid amide linkers and terminal alkynes. Our initial findings suggest lower release rates than anticipated in CORMs with said characteristics, which might point to other unknown structural features that play a critical role in governing release kinetics, although further trials are necessary to draw conclusions. By establishing how subtle structural differences dictate CO release behavior, this work lays the groundwork for rational development of tunable, trigger-responsive therapeutics that capitalize on the body's own inflammatory signals to deliver CO precisely where and when it is needed.

Residue-Level Contribution of Elastin and Collagen in the Vocal Folds

15-Minute Presentation

Riley McKenna Deadwyler
Qi Wang, Ph.D.
Department of Chemistry and Biochemistry

The human voice relies on the ability of the vocal folds to vibrate efficiently and quickly recover their shape during phonation, particularly under high-demand conditions such as singing. This balance of flexibility and tensile strength is largely governed by the extracellular matrix proteins collagen and elastin. However, the specific amino acid residues responsible for their mechanical properties remain unclear. Using atomistic molecular dynamics simulations, we examined how key residues in elastin and collagen contribute to elasticity and molecular interactions. Our findings highlight GLY39, GLY40, GLY111 and PRO38 as critical to backbone elasticity and hydrogen bonding. These molecular insights may identify essential structural components of healthy vocal folds and inform future approaches to vocal fold repair, tissue engineering, and individualized voice therapy. Understanding these interactions is a crucial step toward enhancing vocal health and performance in both clinical and artistic contexts.

Physiological Effects of Depressants and Stimulants on the Developing Chick Heart

Poster Presentation

Peyton Brooke Duncan & Gracie Elizabeth DeCuir
Jim Wetzel, Ph.D.
Department of Biology

The developing heart of an embryo is extremely responsive to pharmacological agents that can affect cardiovascular function. This study explores the physiological effects of stimulants and depressants on the developing chick heart, which is an established model for examining cardiac development. Previous studies have demonstrated that stimulants, such as caffeine, nicotine and adrenaline can bring about changes in embryonic heart rate based on the dosage of the administered agent. Adrenaline and nicotine are linked to tachycardia and arrhythmias, while caffeine is associated with enhancing blood flow to the aorta. Conversely, depressants, such as acetylcholine demonstrate decreased output of cardiac activity and bradycardia. The majority of these results are dependent on the life stage of the embryo, emphasizing the critical and vulnerable position of the embryo during cardiogenesis. Ultimately, these discoveries highlight the susceptibility of the embryonic heart to the exposure of certain drugs, and emphasize the importance of understanding the effects that prenatal drug exposure can have on the developing heart.

A Preventative Approach for Geriatric Healthcare in Occupational Therapy

Poster Presentation

Grace Danielle Durham
Courtney Addison, DOT
Occupational Therapy Program

As the aging population grows, the need for preventative solutions in geriatric healthcare has become increasingly apparent. Currently, occupational therapy is primarily implemented as a form of tertiary care, following a diagnosis or injury. This leaves a critical gap in primary and secondary prevention methods. This paper explores the opportunity for a preventative occupational therapy model aimed at addressing the physical, cognitive, and social challenges that threaten the independence and quality of life of older adults. The proposed eight-week preventative program focuses on empowering older adults through education on assistive technologies and devices , home safety assessments, medication management, and functional movement techniques. By integrating these elements into a structured class format, the program also seeks to enhance participants′ knowledge and confidence while fostering a sense of community. This model emphasizes the value of preventative care in reducing the risk of accidents, chronic disease progression, and social isolation while also focussing on enhancing the participant's quality of life and self efficacy. Through this initiative, older adults can maintain their independence and age safely in place, reducing healthcare costs and improving their overall well-being. This paper calls for a shift in occupational therapeutic practice to include preventative care as a standard and ensuring that aging individuals receive comprehensive support throughout their lifespan.

Clinton Hall: A Comprehensive Interior Renovation

15-Minute Presentation

Keith Phillip Elmore
Frances Cashman, Ph.D.
Department of Physics

Clinton Hall is Presbyterian College's most notorious residential facility, renowned for its appalling conditions. Built in 1965, it is one of the oldest buildings on campus and has not experienced any major renovations or upgrades. Over the course of two months, we have devised a new layout and interior renovation for Clinton Hall. Using Revit and AutoCad, we successfully depicted a visual representation of our proposed models. We created three versions of Clinton Hall, each with distinct features that enhance the appearance and quality of the building which has called for the demolition of existing floors and ceilings. We emphasized student productivity and wellbeing as we developed these models. To ensure that students have access to secluded areas dedicated to studying, we enhanced existing study rooms and used vacant space to create more study areas. My team eradicated the existing laundry rooms on each floor and used this new space for study rooms, moving all laundry facilities to the basement. We added lounges and common areas to promote social interaction amongst peers. Students will have access to a communal kitchen, which includes amenities such as a refrigerator, range, and dining area. We also accounted for students with disabilities with the addition of ADA rooms located on the first floor. We added an elevator to two of the models up to the third floor. This will help residents on move-in day and will provide quicker access to the first floor. The overall project is estimated to cost approximately 5-8 million dollars. Presbyterian College is expected to earn funding from grants and capital campaigns. Our proposed models modify the existing state of the building's interior, all while maintaining a feasible budget for the College to build on.

Economic Impact of Presbyterian College on Laurens County *30-Minute Departmental Honors Presentation*

Emma Lewis Erwin
L. Scott Barker, MBA
Department of Economics and Businesss Administration

Objective: Presbyterian College has a significant impact on Laurens County through various channels. It provides employment opportunities for faculty, staff, and students, while also contributing to local businesses as students, faculty, and visitors spend money on food and retail. We will be looking and focusing on exactly how much Presbyterian College affects the economy in Laurens County.
Outline of Study: We will start by introducing Presbyterian College and Laurens County then move into data collection with surveys and interviews, then will further move into direct economic contributions, challenges and limitations, then conclusion.
Techniques and Resources: IMPLAN and data collected from students and faculty/staff sent through surveys for both the undergraduate and graduate schools. Using both of these we were able to measure the economic impact that Presbyterian College has on Laurens County.
Results: Presbyterian College faculty and staff and student spending has an annual direct effect of $29.4 million, an indirect effect of $3.9 million, and an induced effect of about $1.2 million. When combined this is a total annual impact of $34.6 million on Laurens County based on the survey results. Presbyterian College's operating expenses have an annual direct effect of $11.6 million, an indirect effect of $1 million, and an induced effect of $889,000 combining for an annual impact of $13.5 million.
Conclusion: Throughout the research we are able to validate the economic impact that Presbyterian College has on Laurens County. Ultimately after concluding all of the research Presbyterian College in its entirety has a total annual impact of $48.1 million on Laurens County.

Displacement-Based and de Novo Construction Approaches for Fluorescent Carbon Monoxide Detection and Monitoring

15-Minute Presentation

Lasha A Facey
Kimberly De La Cruz, Ph.D.
Department of Chemistry and Biochemistry

Fluorescent CO probes are useful tools in the study of biologically relevant concentrations of CO. Various designs of these probes have been described in the literature, for example HFCO-1 and CODP-102. HFCO-1 is a palladacycle based turn on probe which relies on CO binding to Pd and subsequently releasing benzimidazole benzoic acid, a fluorescent molecule. CODP-102, another Pd-based probe, relies on a de novo construction of fluorophores. In this project, HFCO-1 and CODP-102 were synthesized, characterized, and compared. HFCO-1 was synthesized via two steps while CODP-102 was synthesized via five steps. Based on the fluorescence studies, both probes were turned on in the presence of CO. However, CODP-102 was more sensitive and exhibited lower background fluorescence. Furthermore, CODP-102 required a higher excitation wavelength and exhibited green fluorescence, indicating that CODP-102 will be more appropriate for biological purposes. With these findings, CODP-102 will be utilized for evaluating a small library of potential hypochlorite-activated CO prodrugs designed for CO targeted delivery.

Turnover Margin and Offensive Performance: An Analysis of the Cincinnati Bengals (2021–2024)

15-Minute Presentation

Alexis Morgan Fornshell
Rachel Childers, Ph.D.
Department of Economics and Businesss Administration

Turnovers have traditionally been recognized as one of the key determinants of success in professional football. Ball security has often been recognized as a key factor for teams seeking success, and commentators often stress the importance of turnovers in winning games, although the link between turnovers and offensive production is often taken for granted, rather than being explored further. In the wider context of sports analytics and business analytics, the impact that specific measures have on key outcomes is often seen as a key driver for decision-making. This project seeks to explore the link between turnover margin and offensive production, using data from the Cincinnati Bengals. The purpose of this study is to examine the impact of turnover margin on points scored and total yards gained offensively during the 2021-2024 NFL regular season. The research questions to be answered in the study include: How does turnover margin affect the Cincinnati Bengals' points scored and total yards gained offensively? While turnovers have been established as determinants of winning and losing, my current study aims to determine if turnover margin affects productivity. Data collection for game-level data was obtained from Pro-Football-Reference.com and organized into a structured format that included variables such as season, week, opponent, home or away game, points scored, total yards gained, turnovers committed, takeaways, and a calculated turnover margin. Additional variables were created to identify games based on low-turnover games (0-1 turnovers committed) and high-turnover games (2+ turnovers committed). Cleaning of the data was performed using Microsoft Excel, as well as statistical calculations to examine relationships between variables using Excel′s built-in functions. Tableau was used to create data visualizations such as comparative bar charts and scatter plots to examine trends over seasons played. It is postulated that games with a positive turnover margin, or those with fewer turnovers, should be associated with more points

scored and total yardage gained. It is also postulated that games with a negative turnover margin, or those with multiple turnovers, should be associated with less offensive productivity. Preliminary observations indicate a marked variance in the average points scored between low-turnover games and high-turnover games, suggesting ball security to be a major factor in offensive efficiency. If the hypothesis is supported, the results will underscore the importance of turnover management in maximizing output on offense. Conversely, if the hypothesis is not supported, it may indicate other variables, such as opponent or game situation, are more significant in determining performance on offense. Overall, this study can be seen as a contribution to sports analytics in terms of isolating the relationship between turnover margin and offense, providing a clearer understanding of the impact of specific performance statistics on overall outcomes.

Crystallographic Control of Au Nanoparticles Electrodeposited on 2D Materials for Detection of Ascorbic Acid and Dopamine

Poster Presentation

Christopher Gallegos
Clay Wright, Ph.D.
Department of Physics

Ascorbic acid (AA), also known as vitamin C, is crucial for constructing and maintaining connective tissues and is involved with several other aspects of the human metabolism such as antioxidants, protection of the immune system, and healing metabolic functions. Dopamine (DA) is an important neurotransmitter that induces the feeling of satisfaction and plays a vital role in memory, concentration, and other body functions. Electrodepositing Au Nanoparticles on 2D materials will allow us to use Au characteristics to detect AA and DA more efficiently. However, electrodepositing Au on Cu or CuGr was difficult without the right chemicals as the Sulfate in the electrolyte, $HAuCl_4$-$3H2O$ in $H2SO_4$, would react with the Cu instantly creating a black sheet of $CuSO_4$. Based on this limitation and Eduards Ariasena findings on deposited Au nanoparticles with the detection of AA and DA, and Dr Wright's past research with the 2D material graphene, we decided to use Au nanoparticles on CuGr to detect AA and DA using electroless deposition and cyclic voltammetry to investigate how well deposited Au nanoparticles could detect AA and DA. With this approach, we hoped to see the Au on CuGr will detect AA and DA effectively. From the five different working electrodes, we identified three conclusive findings that were interesting between the different electrodes. We found that both Au on CuGr and Au on Cu was not able to detect AA however Au on CuGr was able to locate DA through oxidation with more ease. Using CuGr, we find that it too can locate DA with as much ease as Au on CuGr but still cannot detect AA. However, Cu on Cu and Cu on CuGr both detected DA with ease and could somewhat detect AA while also having a reduction in the process. These results suggest that the Cu on CuGr may be more sensitive for detecting AA and DA as well as a more affordable tool than gold nanoparticles.

Characterizing Complex M: A High-Velocity Cloud in the Milky Way Halo

30-Minute Departmental Honors Presentation

Constantine Alexander Gandis
Francis Cashman, Ph.D.
Department of Physics

The halo of the Milky Way is home to numerous complexes of clouds of uncertain origin. These clouds move at high velocities and move a considerable amount of mass onto and away from the Milky Way. Although multiple studies have attempted to determine the origin of these clouds based on their chemical composition and motion, no single model is able to explain the entire population. Complex M is a large, high-velocity cloud (HVC) in the northern part of the Milky Way's Galactic halo. We characterize the chemical composition, velocity, and density of Complex M by analyzing high-resolution spectra of Mrk 421 and PG1112+431 from the Hubble Space Telescope (HST) – Space Telescope Imaging Spectrograph (STIS). Complex M lies at a distance of only 150 pc and is observed at a radial velocity of −138 km/s. We measure both volatile (e.g., oxygen) and refractory (e.g., silicon) elements to determine the ionization of the cloud. Our analysis of the two sight lines through Complex M have revealed the HVC's low metallicity.

Molecular Dynamics Simulation of a Putative Transmembrane Anti-sigma Factor from Paracidovorax avenae ATCC 19860

Poster Presentation

Jennifer Godinez Perez
Qi Wang, Ph.D.
Department of Chemistry and Biochemistry

Paracidovorax avenae, a gram-negative bacterium, acts as a phytopathogen, causing bacterial stripe disease in cereal crops such as rice, oats, and maize. Previous studies have utilized a forward genetics approach using Tn5-RL27 to induce random mutagenesis on P. avenae ATCC 19860 and identify genes involved in pathogenic mechanisms based on phenotypic characteristics. Through this approach, a putative transmembrane anti-sigma factor gene was isolated from P. avenae ATCC 19860; however, an integrated protein model has not been proposed. This study aims to create a molecular dynamics simulation of the putative transmembrane anti-sigma factor in the inner membrane of P. avenae ATCC 19860 through CHARMM-GUI and AlphaFold applications. The simulation will predict the native state of the transmembrane anti-sigma factor and reveal its structural flexibility. Further research will be conducted to correlate protein structure and function in order to gain a better understanding of the potential virulence role of the putative transmembrane anti-sigma factor in P. avenae ATCC 19860.

The Effects of the Crusades on the Political Middle East from 1095 to the Career of Saladin

30-Minute Departmental Honors Presentation

Hannah Lee Hamilton
Richard Heiser, Ph.D.
Department of History

The purpose of this research project is to present the Middle Eastern experience of the Crusades, a perspective which is often overshadowed by Western narratives. Specifically, this research seeks to determine the political effects of the crusader campaigns in the Middle East from the beginning of the movement in 1095 through the career of Saladin. In particular, the progression of Sunni Shi'i sectarian division and how it both shaped and was shaped by the crusades will be analyzed. Through the use of primarily Muslim Chroniclers and other primary sources, of which is to be supplemented by modern historical analysis, the study will examine early Muslim responses to the Crusades, the impact of the campaigns on inner Muslim politics, the collapse of the Fatimid caliphate and the resulting Sunni consolidation, and the reign of Saladin. The findings of which would ultimately indicate that crusader advances intensified sectarian division in the Middle East thus leading the Islamic people through a period of broad political realignment during which the Shi'i caliphate lost their influence and the Sunni order became more prominent.

Nuclearization of Indiana's Electric Grid

15-Minute Presentation

Joshua James Martin Henderson
Frances Cashman, Ph.D.
Department of Physics

Currently, nuclear energy makes up 12% of Indiana's total electricity generation. However this is all imported, and nuclear energy is not utilized within the state. Additionally, the state's primary source of electric power comes from coal, which accounted for 61,437 thousand metric tons of carbon dioxide emissions in 2024. The state has the 7th highest rate of carbon dioxide emissions in the country, releasing 1393 lbs/MWh of electricity produced. Clearly, there exists major room for improvement in the state's grid in terms of sustainability. Using data from a variety of sources, this project proposes a way that Indiana could nuclearize its electric grid to reduce coal burning. We first evaluate the state's energy needs, looking at its electricity generation annually and monthly, as well as its annual consumption. We then use data on the total generation and total emissions from coal power to calculate the emission rate of 1.044735×10^{-3} thousand metric tons of carbon dioxide per MWh of electricity produced in 2024. Next, data was collected on the state's coal plants such as capacity and annual generation. This data was grouped with data ranking each plant on its viability for a coal-to-nuclear transition. We then compiled data on the types of nuclear reactors currently design certified in the U.S. and used their net capacities and capacity factors to calculate a potential yearly generation in MWh. This allows reactors to be matched to coal plants by capacity and determine which coal plants should undergo the transition. Once this is determined, generation from the plants not viable for a coal-to-nuclear transition will be accounted for through increased generation by converted plants and additional plants if needed. Finally, we determine the overall effects on the electric grid such as reductions in emissions.

A Forbidden, Forgotten Courtship: A Deep Dive into Queer Sexuality in Emma

15-Minute Presentation

Lauren Hobson
Lynne Simpson, Ph.D.
Department of English

Jane Austen's Emma is built on the basis of courtship in Regency society. We, the readers, follow Emma Woodhouse throughout a year when she learns about love and romantic connection within the confines of her small town of Highbury. She meets men who are interested in her, from the well-spoken minister, Mr. Elton, to the cad, Frank Churchill, but it seems Emma turns each away. This is where a problem arises. Within Austen's novel there is an undercurrent of homoeroticism and the restraints in exploring it which society has put on our leading lady. Knowing this, there has been much debate as to why Emma seems to interact with the men in her life in a 'one step forward, two steps back' approach, using her matchmaking for Harriet Smith as a way of experiencing courtship without having to face societal judgement or committing fully to a single man. While some scholars suggest that she abuses Harriet as her puppet, I would like to argue that this is not entirely the case; instead, through her relationship with Harriet, Emma also explores her interest in women, making Emma a queer woman. While our understanding of sexuality is quite different today than in Austen's time, there is a strong argument to be made that our heroine is more than simply a friend to Harriet Smith but is instead infatuated by her.

Creative Writing: Senior Portfolio
15-Minute Presentation

Lauren Hobson
Robert Stutts, Ph.D.
Department of English

Students in Creative Writing: Senior Portfolio revise previously written pieces for a professional portfolio.

Lauren's Artist Statement:
I make art because it is everything to me. I was not born with a pen and a paintbrush in my hand, but I've spent my life learning how to use them to the best of my abilities. I will sit down and write when I can or paint when I can, because that is how I express myself. Creating something, to me, is staring yourself in a mirror and asking your reflection what it thinks, but for once your reflection responds. My art and writing is deeply embedded into who I am and it means the world to me.

Development of an Electrochemical Cell for Studying the Nucleation and Growth of Metals on 2D Materials using In Situ Optical Microscopy

15-Minute Presentation

Jaden Johani Garrett Holder
Clay Wright, Ph.D.
Department of Physics

Electrodeposition is an industrial process used to control the thickness of metal layers and provide uniform coatings across an interface. This process is vital for safe battery technologies involving metal anodes. An electrochemical cell is used to carry out the electrodeposition of metals, which methodically, is a process where an applied current runs through an electrolyte allowing for the deposition of metal ions. The overall apparatus requires a three-electrode system: a working electrode, a counter electrode, and a reference electrode. The electrochemical cell used in our past research was sufficient in supporting the three-electrode system; however, we could not perform in situ optical microscopy concurrently with data collection. The main flaw of the previous design is that it required the reference electrode to be suspended from above, which disables any form of optical microscopy. Previously, in order to achieve in situ optical microscopy, a different apparatus was used, where the counter and working electrode were set up side-by-side on a glass slide, and no reference electrode was present. The new electrochemical cell, designed using Autodesk Fusion 360 and printed with a Flashforge Creality Max 3D printer, amends the combined problems of the previous two separate apparatuses by providing a side entry for the reference electrode. Polypropylene was chosen as the desired material for the electrochemical cell for its chemical-resistant properties with sulfuric acid, as $ZnSO_4$ is the electrolyte in our research. The new cell promotes uniform metal deposition across the electrode interface and allows for the collection of viable electrochemical data during in situ optical microscopy.

How do Pro Israel Lobbying organizations Influence U.S. Electoral Outcomes and Policy Decisions Through Campaign Contributions and Lobbying Expenditures?

30-Minute Departmental Honors Presentation

George Robert Hopkins
Daniel Bailey, Ph.D.
Department of Political Science

In recent history we have seen an increase in the amount of monetary aid United States politicians receive from pro Israel lobbying groups. These groups like AIPAC make hard pushes to put pro Israel politicians in power in a hope to further the United States' relationships with Israel. This comes in the form of securing votes on bills that provide direct aid to the nation of Israel, which has become a point of recent controversy in United States domestic politics. Due to this, a divide has begun to form in the American population over the amount of power that these lobbyists hold on United States politicians and their voting actions. This research hypothesizes that any amount of funding from pro Israel lobbying groups will increase the likelihood of a positive vote, and that as funding increases so will the chances that a politician will vote in favor of a pro Israel bill. Analysis will be done on senators elected from 2007-2014 and then compared to senators from 2019-2024 who received money from pro Israel groups and their voting habits on bills that provide direct support to Israel. These numbers are compared to investigate potential change in lobbying effort and voting behavior across time periods pre and post covid. Additionally data will be compared to sets of senators who didn't receive any funding from pro Israel groups in order to see if there is any difference in how votes were cast between the two groups. Null hypothesis theorizes that there is no substantial correlation between the votes cast regardless of if any aid was received and how substantial that aid was.

Comparative Metagenomic Profiling of Killifish Gut Microbiome Using Illumina and Oxford Nanopore Sequencing Across Salinity Gradients

30-Minute Departmental Honors Presentation

Elyse I Hutchinson
Austin Shull, Ph.D.
Department of Biology

The gut microbiome is the community of microorganisms inhabiting the digestive tract it plays critical roles in host metabolism, immune modulation, and pathogen resistance. Metagenomic profiling has emerged as a tool in drug development, disease prevention, and ecological research. However, the resolution and accuracy of microbiome profiles are influenced by the sequencing platform used, and experimental comparisons across organisms and conditions remain limited. Illumina short-read sequencing is the current standard for metagenomic sequencing, but the taxonomic resolution capabilities are limited. Oxford Nanopore Technology (ONT) offers long-read sequencing capable of species-level identification, although it has higher error rates between 5-15%. A recent comparison in rabbit gut microbiomes found ONT achieved ~29% higher taxonomic resolution than Illumina at the species level, though inter-platform inconsistencies persisted and many species-level assignments remained unknown. We compare Illumina and ONT 16S rRNA gene-based metagenomic profiling using killifish as a controlled model organism. Fish were acclimated to low (5 PPT) or high (50 PPT) salinity under standardized conditions. Gut DNA was extracted using a protocol applied to both platforms to eliminate sample bias. PCR amplification will be performed and ONT libraries will target the full-length 16S gene (V1–V9) using an in-house MinION device. Illumina will target the V3–V4 region at ~20,000 reads per sample and will be completed externally. Taxonomic profiles and platform-specific differences in genus- and species-level resolution will be compared. This project will aim to clarify how platform choice shapes microbiome taxonomy interpretation and broaden our understanding of host-microbiome dynamics under varying environmental conditions.

Characterization of Mutation in Acidovorax avenae

30-Minute Departmental Honors Presentation

Maggie Elizabeth Jones
Stuart Gordon, Ph.D.
Department of Biology

Anti-sigma factors are a critical part of bacterial gene regulation. These molecules prevent the cell from wasting limited resources on genes that do not need to be active at that time by binding to the sigma factor which greatly reduces the binding efficacy of the Polymerase enzyme. Previously a transposon insertion mutant of Acidovorax avenae showed reduced growth in lower pH media than the wild type, and whole-genome sequencing of the mutant revealed the transposon insertion to be in a presumed anti-sigma factor gene. Given these results, we hypothesized that stress-response genes are differentially regulated in the mutant vs. wild-type. To test this hypothesis, we performed a RNAseq experiment in which mutant and wild type samples were grown up for 48 hours in neutral pH and 6 pH LB liquid media, before the RNA was extracted. RNA was sequenced and the resulting transcripts will be preprocessed and a differential analysis performed to compare gene expression. Optical Density growth curves were established to compare growth rates across the different environments along with other biological classification tests. We report on results of RNAseq analysis of the mutant and wild-type strains grown under pH stress.

Microhabitat Effects on Biodiversity in the Clinch River

15-Minute Presentation

Gigi Marton Kannenberg
Sabrina Moore, Ph.D.
Department of Biology

The Clinch River is one of the most important streams for ecological conservation in North America. There are macrophyte beds found in the shoals of this stream dominated by American Water Willow (Justicia americana (L.) Vahl.). This macrophyte was found to modify stream environments increasing stability and reducing velocity and adding microhabitats. This section of Clinch River has been deemed an important location by TWRA due to the populations of critically endangered freshwater mussels. Therefore our study answers the question of what biodiversity is supported in these microhabitats helping to aid in conservation efforts. We are comparing benthic macroinvertebrates from four surber samples collected from the Clinch River (36.537507, -83.127582) in June 2025. The sample depth and microhabitats were recorded and insects preserved for identification. We expect that the samples with more microhabitat variation (stems, empty shells and rocks) will support higher biodiversity and abundance. We identified macroinvertebrates, representing 10 Orders, including sensitive insect larvae from Ephemeroptera (mayflies), Plecoptera (stoneflies) , and Trichoptera (caddisflies) or EPT taxa. The highest abundance was associated with samples with the highest amount of microhabitats in the sample, specifically macrophyte stems. These stems supported the highest EPT taxa diversity. Microhabitats with aquatic vegetation have the ability to sustain more benthic macroinvertebrates indicating its importance to support insects and fish food webs. Most importantly, insectivorous fish that these endangered mussel populations rely on to complete their life cycle are supported by the diversity determined from this study.

Mr. Knightley and the Misters Wrong

30-Minute Presentation

Isabel Lasota
Lynne Simpson, Ph.D.
Department of English

Jane Austen is revered as one of the most influential female writers in literary history, a pioneer of the novel as a genre whom readers, particularly women, have for centuries enjoyed. While she is notable for her dramatic love stories, there is a deep complexity below the romantic surface. Three of her most popular novels, Pride and Prejudice, Persuasion and Emma, present their heroes against fools and players as they vie for the heroine's affection. Austen purposefully utilizes her wrong men as foils to show the merits of the right man and sets them as a test for her heroines. Across these novels, she also establishes her right man with a recognizable standard template of possessing economic independence, emotional depth, along with a sense of duty and humility. However, in her most intricate novel, Emma, Austen elevates Mr. Knightley as more than a simple romantic lead but also a moral guardian. Unlike his counterparts, Mr. Darcy and Captain Wentworth, both of whom must overcome their pride, Mr. Knightley already embodies the qualities of a true gentleman. Introduced initially as Emma′s moral critic in a society that pictures her as perfection, Mr. Knightley′s enduring concern and guidance for our heroine gradually matures into a deep romantic love. Mr. Knightley becomes the quintessential vision of Mr. Right, the true 'knight in shining armor.'

Multiomics of Triple Negative Breast Cancer

30-Minute Departmental Honors Presentation

Margaret Victoria Leonard
Austin Shull, Ph.D.
Department of Biology

Breast cancer is the most common cancer diagnosis in women, but also the deadliest (1). This is partly due to its ability to metastasize and spread throughout the body. This can occur in malignant breast cells when a mutation happens in the genome, causing the normal cell to become basal-like and easily metastasize . This is called the epithelial to mesenchymal transition (EMT). The MCF10A cell line contains epithelial breast cells that cannot easily spread throughout the body. However, when the p53 and PTEN genes are deleted from its genome, an EMT occurs. This causes the cell to develop basal-like characteristics and become more aggressive in the body. This transition causes patients to have a worse disease-free and relapse-free prognosis when diagnosed because targeted drug therapies are not always successful. This is because their epigenetic functions are dysregulated and target therapies cannot work in the ways that they normally do. Two of these epigenetic changes that occur due to a change in the genome are histone modifications and DNA methylation. These changes limit transcription of DNA, which stops cell growth suppression. In order to fully understand this mechanism, we will be deleting two tumor suppressor genes, p53 and PTEN, from the genome in order to genetically alterate the MC10FA. Not only will this cause the cell line to gain a cancer-stem cell like phenotype, but we believe that genomic changes will occur as well. Our hope is that by deleting two tumor suppressors from the MCF10A cell line, we will be able to see the downstream effects in the genome. In order to analyze these patterns, we will be using 450k data, Atac-seq, and Whole genome bisulfite sequencing (WGBS). This Honor's Research Proposal aims to integrate different analyzing techniques to understand the full impact of epithelial to mesenchymal transition in normal breast cells.

Short-Term Electricity Demand Forecasting at the Substation Level

15-Minute Presentation

Cade Lewis
Rachel Childers, Ph.D.
Department of Economics and Businesss Administration

Electricity demand forecasting plays a critical role in how electric cooperatives plan their daily operations and manage power purchasing costs. When a cooperative underestimates demand, it is forced to buy the shortfall on the open market at spot prices that can be significantly higher than contracted rates. When it overestimates, it pays for power it does not need. Either way, the members absorb the cost. Despite this, most forecasting in the cooperative space is still done at the system level rather than at individual substations, which limits the ability to identify localized demand patterns and make more targeted operational decisions.
This study asks how accurately short-term electricity demand can be forecasted at the individual substation level using local weather and calendar variables, and whether forecast performance varies across different substations. The dataset consists of 33,514 hourly observations collected from 10 substations in the Seneca, South Carolina area between August 2025 and January 2026. Two of the substations operate at the transmission level and eight at the distribution level. Hourly weather data including temperature, humidity, and cloud cover was collected from a local weather station and merged with the meter data by timestamp. The analytical approach followed a five-step pipeline. First, the two datasets were cleaned, merged, and all substation names were anonymized. Second, several features were engineered from the raw data, including a temperature-squared polynomial term to capture the nonlinear relationship between temperature and demand, a temperature-humidity interaction term, calendar features such as hour of day and weekend flags, and lagged demand variables representing the prior hour and the same hour from the previous day. Third, a separate linear regression model was built for each of the 10 substations using an 80/20 chronological train-test split. Linear regression was chosen deliberately for its interpretability, since an operations team needs to understand why a model makes the predictions it

does. The results were strong across the board. The average R-squared across all 10 substations was 0.960, meaning the models explain 96% of demand variation. Mean Absolute Percentage Error averaged around 4%, with every substation coming in under 6%. Temperature and its squared term were the two most important predictors, confirming the U-shaped relationship observed during exploratory analysis where demand increases at both hot and cold extremes and is lowest in the mild range around 60 to 65 degrees. The approach worked equally well for both transmission and distribution substations despite roughly a five-times difference in average load. Error analysis revealed that forecast errors concentrate during temperature extremes, which are the same conditions that produce peak demand. This finding has direct operational value because it identifies exactly when a cooperative should build in a wider safety margin for its purchasing decisions. This study demonstrates that a relatively simple and interpretable modeling approach can produce highly accurate substation-level forecasts using data that most cooperatives already collect. The methodology is portable to any service territory with hourly meter and weather data.

Fraud Analysis of The Holy See
30-Minute Departmental Honors Presentation

Peter Edmond Lipscombe
Karen Mattison, Ph.D.
Department of Economics and Businesss Administration

This study explores the history of financial fraud and mismanagement within the Holy See, focusing specifically on the Institute for the Works of Religion (IOR), commonly referred to as the Vatican Bank. Over the past several decades, the IOR has been connected to major financial scandals that have raised concerns about accountability and oversight for both religious and lay people. The research examines these historical issues and then analyzes the reform efforts introduced under Pope Benedict XVI, which were later expanded and more heavily implemented under the late Pope Francis. These reforms aimed to increase financial transparency and compliance while rebuilding global trust in the Vatican's financial system. The project also compares these changes to the Sarbanes-Oxley Act of 2002 in the United States, which was passed in response to corporate accounting scandals. By comparing the Vatican's reforms to Sarbanes-Oxley, this paper evaluates similarities and differences in how institutions respond to financial misconduct. Overall, the analysis considers whether or not the Holy See's reforms represent meaningful structural change.

Using Wildlife Wonder to Teach About Lesser Known Animals

15-Minute Presentation

Harryson Jacob Rogers Lott
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

This game is an investigative game that is integrating the thoughts of animal knowledge into the mechanics of a video game, where the player character goes out to track and observe animals. Though your character will be observing animals that are more uncommon, not your typical animals like a wolf or tiger. Think more lesser known animals like an oarfish for example. So your character will explore different parts of an area to track the animal to observe. Items can be collected by the player to enhance the search and be able to identify the animal correctly. The player can also interact with the animals in the area to also get clues.

ROI Between Universities and Liberal Arts Colleges

15-Minute Presentation

Ryan W Luna
James Allen, Ph.D.
Department of Economics and Businesss Administration

Higher education in the United States continues to evolve amid shifting economic conditions, demographic challenges, and changing perceptions of the value of a college degree. Students, families, and policymakers are increasingly focused on return on investment (ROI) as a metric by which to determine the worth of a bachelor's degree (Humphreys, 2014). Liberal arts colleges, once widely regarded as central to developing informed citizens and versatile professionals, have faced heightened scrutiny as tuition prices rise and some employers and political figures question whether non-vocational majors lead to financially sustainable careers (Hartocollis, 2023). This study examines the top 150 national liberal arts colleges and the top 150 regional universities as ranked by the 2024 U.S. News & World Report. ROI data were obtained from PayScale's 2024 findings, while graduation data were retrieved from CollegeSimply.com. Two-sample t-tests assuming unequal variances were performed to determine whether there were significant differences between institution types in terms of average ROI and average graduation rates. F-tests were also performed to compare the variability of outcomes across institution types. The standard significance level of $\alpha = 0.05$ was applied to evaluate all test statistics. The results of the independent samples t-test indicated a statistically significant difference in average ROI between the two institution types. Liberal arts colleges demonstrated a higher average long-term financial return of approximately $475,184, compared to regional universities of approximately $414,285. With the difference being statistically significant at the $p < 0.05$ level. These findings suggest that attending a liberal arts college may yield stronger lifetime financial benefits for graduates. However, the F-test results revealed that the variability in ROI among liberal arts colleges regional universities ($p < 0.05$ level). This indicates that while some liberal arts colleges provide exceptionally high ROI, others perform well below the average. In contrast, ROI outcomes at regional universities are more consistent, though generally lower.

Graduation rate analysis also showed a statistically significant difference in average performance between the institution types. Liberal arts colleges had higher mean graduation rates of 75.44% than regional universities of 60.66%. The t-test confirmed that this difference was statistically significant ($p < 0.001$). These results suggest that students attending liberal arts colleges are more likely to complete their degree programs in a timely manner. Unlike the ROI results, the F-test for graduation rates showed no statistically significant difference in variability between the two groups ($p = 0.29$). While liberal arts colleges perform better overall, both groups exhibit similar consistency in graduation outcomes among institutions.

Using HBot to teach Types and Operators

15-Minute Presentation

Eaint Kyal Syn Lynn
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

Introduction / Background

Many children in Myanmar have lost access to school due to ongoing conflict, leaving them without opportunities to learn basic STEM and programming skills. This project addresses that gap by creating a learning app that teaches foundational programming concepts through a simple, supportive game, integrating types and operators with the game mechanics of a video game. The core question is how to teach data types and operators effectively to children with limited resources and no internet access. The project matters because it provides a safe, low-pressure way for children to build logical thinking skills during a difficult time

Purpose / Aim

The goal is to design a child-friendly game that teaches two core programming concepts. The app focuses on:

-Data types

(1)Integer

(2)Boolean

(3)Double

-Operators

(1)Arithmetic operators (+, −, ×, ÷)

(2)Logical comparison operators (<, >, <=, >=, ==, !=)

(3)Boolean operators (AND, OR, NOT, NOR)

Tutorial scenes introduce each concept, and a quiz system checks understanding by awarding points. The game is designed to be calm and non-competitive, helping children learn through exploration rather than pressure.

Do Consumers in Developed and Developing Countries Exhibit Different Spending Adjustment Patterns During Periods of Inflation?

15-Minute Presentation

Eaint Kyal Syn Lynn
Rachel Childers, Ph.D.
Department of Economics and Businesss Administration

Inflation is a common economic issue that affects the prices of goods and services, but many people do not fully understand how it changes consumer spending behavior. This topic is important because consumer spending is a major part of economic activity, and rising prices may affect households differently depending on a country's level of development. This study examines whether consumer spending responds differently to inflation in a developed country and a developing country. The main research question is: Do consumers in developed and developing countries exhibit different spending adjustment patterns during periods of inflation? The purpose of this study is to better understand how economic development influences household spending behavior when inflation rises. The study mainly uses data from the World Bank World Development Indicators. The dependent variable is household final consumption as a measure of consumer spending. The independent variables are inflation, GDP per capita, unemployment rate, and exchange rate. The study will use multiple linear regression to examine the relationship between these variables, prediction modeling to estimate future spending changes, and K-means clustering to identify patterns in economic conditions over time.
The study expects to find that consumer spending behavior differs between developed and developing countries during periods of inflation. It is anticipated that households in developing countries will show greater changes in spending because they often have fewer financial resources to absorb rising prices, while households in developed countries may show more stable spending patterns.

The Effect of Estrogen on Tendons and Ligaments

Poster Presentation

Lindsey Marie Malyszek
Jim Wetzel, Ph.D.
Department of Biology

Estrogen is known to affect connective tissue structure and may play a role in tendon and ligament biomechanics. Investigating how estrogen alters collagen organization can improve understanding of sex-related differences in connective tissue injury risk. This study examined the structural effects of estradiol on collagen organization in tendons and ligaments dissected from a pig foot. This provided us with connective tissues with structural similarities to those found in humans. Samples were divided into control and estradiol-treated groups to examine the structural effects of estrogen exposure. Tissue specimens were fixed and embedded to preserve the structural integrity. Embedded samples were sectioned with a microtome to produce thin slices suitable for viewing under a microscope. Histological sections were mounted onto microscope slides and examined to assess collagen fiber orientation, bundle structure, and tissue organization. Additionally, electron microscopy was used to visualize features of the collagen matrix at higher resolution. This study aims to determine whether estradiol exposure alters the organization of collagen fibers within tendon and ligament tissue. My hypothesis was that samples exposed to estradiol will show measurable differences in collagen bundle morphology and fiber alignment compared to untreated control tissues, which suggests that estrogen may influence the structural properties of connective tissue.

Revenue, Debt, and Wins: An Analysis of Financial Impact on MLB Team Success

Poster Presentation

Ashley Elizabeth McAtee
James Allen, Ph.D.
Department of Economics and Businesss Administration

This study investigates the relationship between MLB franchise revenue, debt- to value ratios, and on-field success. The study utilizes data made publicly available by Forbes as well as data made publicly available by Major League Baseball (MLB). The data was used to investigate the relationship between franchise debt and team success as measured by win to loss ratio. Additionally, the study examines the relationship between franchise revenue and team success. Pearson Correlation analysis was used to assess the relationships between team revenue, team debt, and winning percentage. The results showed a statistically significant positive correlation between team debt and revenue. The correlation between team debt and winning percentage was negative and not statistically significant. These findings show that while financial strength is related to on-field performance, debt alone is not a reliable predictor of team performance.

Using HBot to Teach Security Concepts

15-Minute Presentation

Chale Yvette Mccalpin
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

Technical security measures are only as effective as the individuals operating within the digital environment. In an era where a single ransomware attack can paralyze global supply chains or healthcare systems, the necessity for robust, engaging user education has never been more critical. This capstone project addresses the ″human element″ of cybersecurity by developing a high-impact learning model centered on three primary digital threats: Malware, Trojan horses, and Ransomware. Unlike traditional, passive compliance training, this project implements an interactive, game-based learning approach through a custom-designed cybersecurity simulation game called Hbot. The Hbot game immerses users in realistic cyber-attack scenarios where they must identify, analyze, and respond to simulated threats in real time. Through structured levels focused on malware detection, Trojan horse recognition, and ransomware response, players experience the consequences of security decisions within a controlled, risk-free environment. Scenario-based challenges, decision-making tasks, and instant feedback mechanisms reinforce both the ″why″ and the ″how″ behind each attack method. By teaching users to recognize the subtle markers of a Trojan infection and understand the rapid lifecycle of a ransomware event through interactive gameplay, the framework transforms users from passive targets into proactive defenders. The modular design of Hbot allows the training to be accessible, repeatable, and adaptable across various skill levels. This project demonstrates that an informed and engaged user base—developed through experiential, game-driven learning—serves as the ultimate deterrent against cybercrime, shifting the organizational focus from reactive damage control to proactive digital hygiene.

A Study of the Effect of the N185D Mutation in NPC1 on Cholesterol Transport, and the Development of a New Algorithm (OrthoNet): A Self-Correcting Graph Algorithm to Select Orthologous Sequences from a List of Homologs to Improve the Prediction of Mutation

30-Minute Departmental Honors Presentation

Bethany Elaine McManus
Margo Petukh, Ph.D.
Department of Biology

Niemann Pick Disease type C (NPC) is an autosomal recessive genetic disorder that affects lipid metabolism by damaging the ability of Niemann Pick type C2 (NPC2) to properly transfer cholesterol (CLR) to Niemann Pick type C1 (NPC1), causing a buildup of cholesterol and glycolipids in the endosome/lysosomes of cells. N185D is a single nucleotide variant in NPC1 that has been connected to Niemann Pick type C disease. The pathogenicity of the N185D mutation was proven through computational evolutionary analysis, clustering analysis, and molecular dynamic simulations. Through this process, the issue of inaccuracy among existing evolutionary-based mutation prediction software was observed. The inclusion of paralogs in predictions appeared to greatly skew the data, leading to a focus on creating OrthoNet: a self-correcting graph-based algorithm that separates orthologous from paralogous sequences, creating cleaner evolutionary conservation profiles that provide more accurate classification of mutations as pathogenic or benign. The program first collects all homologous sequences using Blastp. Next, an in-house Python code was written to implement a self-correcting graph-based clustering algorithm to collect orthologous sequences only from the list of all homologs. The accuracy of the method was compared with a more traditional phylogenetic tree-based approach for identifying orthologs. OrthoNet can be used as a powerful tool to predict the pathogenicity of novel mutations especially in case of proteins with multiple paralogs. An established database of well-studied and reviewed proteins containing a variety of missense mutations collected from ClinVar was created. The proteins in this database were run through Orthonet, and the results are

actively being compared to those of existing sequence conservation-based methods, including SIFT, PolyPhen-2, and REVEL, as well as existing AI prediction methods. Performance metrics will be computed using standard classification measures (e.g., ROC curve, AUC values) to determine how well OrthoNet classifies a mutation as benign or pathogenic compared to the existing methods listed above.

Using HBot to teach Loops

15-Minute Presentation

Carlos Gabriel Mercado Jimenez
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

Learning to code can be challenging for beginners, particularly when understanding loops as a core programming concept. This research presents an interactive video game designed specifically to teach iterative logic through gameplay mechanics. Players implement loop structures to control repeated in-game actions and timed behaviors, allowing them to directly observe how iteration affects outcomes. The experience emphasizes practical application of for-loops and while-loops, reinforcing how repetition automates processes within a system. A built-in debugging component requires players to identify and correct loop-related errors, such as infinite loops and incorrect conditions, further strengthening conceptual understanding. By embedding loop construction and troubleshooting into core game mechanics, this project provides an engaging, focused approach to learning one of the most fundamental principles in programming.

Powering Bailey Memorial Stadium and Practice Fields Using Dual-Axis Solar Tracking Photovoltaic Systems

15-Minute Presentation

Mackenzie Aaron Mikko
Frances Cashman, Ph.D.
Department of Physics

Athletic facilities consume a substantial amount of power to run facilities, which is why many complexes are turning to renewable energy, like photovoltaic (PV) systems. The type of PV system plays an important role in this process; different systems consume different amounts of UV energy. Dual axis solar trackers are systems that are able to follow the sun's path and are known to absorb more UV energy than the average fixed tilt solar panels. Bailey Memorial Stadium and nearby practice fields exhibit high electricity demand, for example, the use of concession stands, the press box, stadium lighting, locker rooms, and training equipment. Implementing solar tracking PV systems can reduce operational costs over time with an average reduced payback period of 1.48 years relative to fixed tilt PV systems. Additionally, they lower carbon emissions, saving up to 198 metric tons per acre of CO_2 annually in the US, which will budget more money towards the teams' needs. Relative to fixed tilt solar panels, these tracking systems can increase yearly energy yield anywhere from 20-35% depending on geographical location and weather conditions. The estimated time used in the stadium is about 120-200 hrs/year ±50 hrs for other events with an average estimated load of 180kW. Annual energy use would be around 27,000kWh ±5,000 per year using E=Pt. Based on the capacity of the trackers used to collect data, it would take anywhere from 2,000 to 2,500 trackers, or approximately four 5kW industrial-sized dual-axis tracking systems. For Bailey Memorial Stadium, these systems can be installed all around the tailgating area, on top of the press booth, field house, stadium lights or even on the hills of the visitor seating area. These installations could provide reliable, clean power as well as other benefits like added lighting to the tailgate area or shaded comfort to visitor stands.

Revenue Sharing: Mid-major Schools

15-Minute Presentation

Emma Claire Mills
James Allen, Ph.D.
Department of Economics and Businesss Administration

This presentation evaluates the induction of revenue sharing in the NCAA for mid-major schools, which are not included in the Power 4. This in summary is the sharing of the athletic department's revenue with their student-athletes. Student-athletes now have the opportunity to receive revenue from the school, as well as through scholarships and NIL deals. The addition of revenue sharing affects student-athletes, faculty and staff of the school, as well as non-athletes attending the school. The benefits to revenue sharing include creating more opportunities for athletes, creating a professional sports environment, and incentivizing athletes to play at a certain school. The negatives to revenue sharing include a higher tuition cost for non athletes, the negative impact on lower revenue generating sports, and an increase in the disparity between higher revenue generating schools and lower revenue generating schools. The factors considered in this presentation when deciding to share revenue with student-athletes will include, endowment, enrollment, athletic conference, and if the school is public or private. There is overlap with each factor, but the major factor for schools deciding to participate in revenue sharing has to do with being a public school that has a large endowment.

Teachers Perspective of Assistive Technology Use for Students with Dyslexia

Poster Presentation

Caroline Emily Murphy
Julia Wilkins, Ph.D.
Department of Education

Dyslexia is a neurological language-based processing disability that can impact students' academic performance. Assistive technology (AT), including text-to-speech, speech-to-text, audiobooks, and closed captioning can be used as tools for increasing access to grade-level content. However, there is little research on how teachers perceive, implement, and navigate the practical realities of students' AT use in and out of the classroom. This qualitative study explored teachers' perspectives on the benefits, challenges, and instructional implications of assistive technology for students with dyslexia. This study was guided by three research questions: 1. What do teachers perceive as the benefits of students with dyslexia using assistive technology in and outside of the classroom? 2. How do teachers implement assistive technology during reading instruction for students with dyslexia? 3. What challenges or limitations do teachers encounter when using assistive technology to support students with dyslexia? I conducted interviews with three teachers who work with students with dyslexia. NOTE TO REVIEWERS: This study is in progress and I have just completed my first and second interview. While the participant supported AT as a tool to promote general reading skills, enhance proofreading accuracy, and provide access to classroom texts, she described institutional barriers such as limited training time, perceptions of teacher training inequities, and student reluctance to appear different from peers. She saw cost as a diminishing barrier due to technological advancements. Overall, it was the school culture and policies that determined whether AT could be effectively implemented.

Creative Writing: Senior Portfolio
15-Minute Presentation

Matthew Thomas Nelson
Robert Stutts, Ph.D.
Department of English

Students in Creative Writing: Senior Portfolio revise previously written pieces for a professional portfolio.

The Contract Effect: Why NHL Players Perform Differently When Money Is on the Line

30-Minute Departmental Honors Presentation

Vanessa Palisin
Suzie Smith, Ph.D.
Department of Economics and Businesss Administration

Literature has shown that athletic performance fluctuates across the years of a long-term contract [1] [2] [3]. This variability may be attributed to a range of factors, both uncontrollable – such as injuries, mid-season adjustments, or unforeseen complications – and controllable, like opportunistic behavior. Players are incentivized to perform at their highest level in pursuit of a long-term, lucrative contract; After this is signed and official, certain players may exhibit a tendency to experience diminished motivational incentives to keep pursuing their all [1]. This phenomenon is commonly referred to as strategic and shirking behavior [3]. Building upon Rosen and Sanderson's (2001) marginal revenue product model [2], more research is needed to determine whether player compensation accurately reflects player performance over the entire contract cycle. This study focuses on the National Hockey League (NHL), which Bruggink and Williams (2011) heavily analyzed [3]. Bruggink and Williams found significant increases in offensive contributions just before free agency status. With statistically significant data indicating short-term statistical spikes, the research also found performance often regressed to prior levels once contract deals are solidified. All in all, this study found that players produced approximately 5.6 fewer production units, representing a statistically significant decline relative to projected trends. Understanding these behavioral patterns is critical for teams and general managers seeking to optimize contract structures, mitigate moral hazard, and align incentives with long-term organizational goals.

Comparing Breast Cancer Subtypes in African American and European American Patients Using TCGA.
30-Minute Departmental Honors Presentation

Natalie Anne Paxton
Austin Shull, Ph.D.
Department of Biology

Triple Negative Breast Cancer (TNBC) affects African American (AA) patients, who experience worse metastasis and survival compared to European Americans (EA). Using The Cancer Genome Atlas (TCGA) to directly compare comprehensive expression signature and immune cell estimates between AA and EA patients across basal and luminal subtypes. Our data reveals that AA basal tumors are marked by a chronic immune stress signature with elevated expression of the stress transcription factor CEBPD as well as increased enrichment of eosinophil estimates. In contrast, EA tumors display an active proliferative signal with immune pathways that indicate a more responsive immune microenvironment. Taken together, these preliminary findings suggest that AA patients correspond with a stress-associated tumor microenvironment and provide context toward the epidemiological correlation of worse treatment outcomes in AA women.

Tardigrades or "Water Bears" as Potential Environmental pH Indicators

Poster Presentation

Morgan Isabella Perez
Jim Wetzel, Ph.D.
Department of Biology

Tardigrades, also known as "Water Bears" are small, microscopic animals known as microzoans. They are a member of the taxonomic phylum named Tardigrada. Tardigrades have a cosmopolitan biogeographic distribution– meaning that these microscopic creatures inhabit most, if not all biomes and the habitats within them. Tardigrades are noted for having the capability of handling extreme environmental stress. The means in which they handle this is through a process called cryptobiosis. Cryptobiosis is a state of dormancy that is ametabolic, which means that the chemical processes that occur within their body to sustain life are paused, and these organisms are not alive, but also not deceased. The final product of cryptobiosis is a shriveled husk of the Tardigrade that does not contain any water within the cells, known as a "tun". The recent rise in urbanization has resulted in an increase in the occurrence of acid rain events. In the long term, increased acidity of ecosystems can lower, or acidify, both freshwater and soil pH levels, thus negatively affecting autotrophs (terrestrial and aquatic) and freshwater organisms. Given the cryptobiotic responses of Targidrades with regard to changes in environmental conditions, there is a possibility that these physical responses could be used to gain insight on ecological conditions within specific areas given the wide distribution of Tardigrades on the planet. A significant response would mean that organisms within the phylum Tardigrada could be used as environmental pH indicators.

Academic Benefits of Game-based Apps for Elementary Students

Poster Presentation

Alexandrea Polinario
Julia Wilkins, Ph.D.
Department of Education

Game-based technology has become an increasingly popular tool in elementary school classrooms. Teachers frequently use gamified learning to motivate students due to students' out-of-school interests in video games, interactive graphics, and earning digital rewards such as points, levels, and badges. However, teachers may not know how to differentiate between apps that contribute to students' academic achievement and apps that are fun, but not educationally beneficial. The purpose of this project was to distinguish between apps which have no evidence of increased learning and those that contribute to students' content knowledge and provide opportunities for young learners to develop problem-solving skills. I created a brochure for teachers to describe the characteristics of gamified learning and provide a list of apps and resources that can be used to enhance students' academic achievement.

The Effects of Testosterone on Tendon and Ligament Histology

Poster Presentation

Jasper Alonzo Powell
Jim Wetzel, Ph.D.
Department of Biology

Previous studies have shown that testosterone is beneficial to collagen bundles responsible for structural integrity in both tendons and ligaments. The evidence for this is based on how testosterone interacts with muscle, specifically looking at its role in maintaining growth and repair. Testosterone increases collagen synthesis, which should, in turn, increase the tensile strength of both tendons and ligaments. However, most of these studies are based on the question of what happens to collagen when the body has too much testosterone, and the ones that are based on normal levels lack any substantial histological evidence. In this study, we sought to see how normal levels of testosterone affect tendons and ligaments by performing several microscopy procedures. The sample tendons and ligaments were obtained from the foot of Sus scrofa domesticus, also known as the domestic pig. Samples were treated with a 100 ppm testosterone buffer solution and run through standardized dehydration protocols to prepare them for both electron and light microscopy. This study's results aim to improve the histological basis of the effects of testosterone on tendons and ligaments by looking specifically at how collagen composition is affected. The hope is to increase the understanding of the effect of testosterone on tendons and ligaments, and how that may improve future therapeutic strategies for injuries to these structures.

Examining Health Equity in the World Health Organization's Global Influenza Surveillance System

Poster Presentation

Yasmeen Rasasi, Niy'Asha Myers, & Andrew Hayes
Carmen Hall, Ph.D.
Department of Economics and Businesss Administration

The World Health Organization's Global Influenza Surveillance and Response System (GISRS) is a long-standing global health network established in 1952 to monitor, prevent, and respond to influenza and other respiratory threats. Operating across 136 member states, GISRS facilitates international collaboration through the collection, analysis, and sharing of epidemiological and virological data, playing a critical role in outbreak detection and vaccine development. This study examines the structure and function of GISRS, with a focus on its surveillance design, global health infrastructure, and use of data and emerging analytical tools, including artificial intelligence. Drawing on peer-reviewed literature and World Health Organization sources, this analysis highlights GISRS as a model of global cooperation while also identifying key challenges related to disparities in surveillance capacity, data access, and technological infrastructure. Differences in income, geographic accessibility, and digital connectivity influence how effectively countries can contribute to and benefit from the system, leading to gaps in data and delays in outbreak detection. These findings demonstrate that while GISRS remains essential to global influenza preparedness, addressing structural inequities is critical to improving the efficiency, accuracy, and equity of global health surveillance systems.

Nerve-Induced Regeneration in Lumbriculus variegatus and Dugesia dorotocephala

30-Minute Departmental Honors Presentation

Shelley Christine Ricks
Jim Wetzel, Ph.D.
Department of Biology

Regenerative ability varies broadly between species due to several factors, including the nervous system. This experiment uses the model organisms Lumbriculus variegatus (California blackworm) and Dugesia dorotocephala (Brown Planaria) because of their ability to regenerate from even small fragments of their body. This ability involves the proliferation of a new mass of undifferentiated cells called blastema. These cells later differentiate and create the tissues needed for the regeneration of the lost structures. Innervation of this blastema acts as the director of regeneration, signaling differentiation and growth. Lumbriculus has a ventral nerve cord that extends from head to tail and is composed of three fibers; brown planarians have a ladder-like nervous system made of transverse and longitudinal nerve cords. Both species have extensive regenerative abilities; therefore, understanding the patterns, mechanisms, and nervous system structure will clarify the involvement of the nervous system in regeneration.

The following methods: microsurgery, photomicrography, scanning electron microscopy, and histology, were used to document the regeneration process in detail. Through comparative analysis of Lumbriculus and brown planaria, regeneration methods, patterns, nerve extension into the blastema, and cell differentiation were recorded over various lengths of time. These observations provided insight into nerve-induced regeneration, such as epimorphosis and cell reorganization methods, morphallaxis. By comparing Lumbriculus and brown planarian regeneration mechanisms, this study shows how the nervous system and its organization are directly involved in regeneration methods.

A Biomechanical Analysis of the Human Punch

Poster Presentation

Ayden Wayne Rudder & Gage Eugene Hatcher
Jim Wetzel, Ph.D.
Department of Biology

Our research concerned the neuromuscular dynamics involved in generating punching force and how fatigue and conditioning affect output over time. Punch force (kg) was measured for three types of strikes: jab, straight, and right hook, over multiple training sessions. In each session, the participant performed 12 punches of each type before a workout and again right after the workout to compare pre- and post-exercise force output. Initial observations showed a clear decrease in punch force after exercise, likely due to muscle fatigue and temporary ATP depletion. However, as training continued over several weeks, the difference between pre- and post-workout averages started to decrease. This suggests an improvement in neuromuscular efficiency and fatigue resistance. These findings indicate that repeated training may lead to physical changes such as increased blood flow, oxygen delivery, and glucose availability in working muscles. This boost in metabolic resources may enhance ATP production, allowing muscles to maintain higher force output even when fatigued. Overall, this study analyzed how neuromuscular and metabolic factors affect punch mechanics and how training adaptations may improve performance over time.

Glenohumeral Joint Biomechanics

15-Minute Presentation

Anna Corena Ruiz
Jim Wetzel, Ph.D.
Department of Biology

The glenohumeral joint is a synovial ball-and-socket joint composed of the humeral head and the glenoid fossa of the scapula. There are three degrees of freedom that allow for circumduction as one composite motion. Because of the extensive range of motion in the glenohumeral joint, instability and impingement are common issues. Procedures such as the Latarjet and dynamic anterior stabilizer with Bankart repair help correct instability of the joint via bony augmentation or capsulolabral repair. Techniques of restoring scapular control while strengthening dynamic stability via neuromuscular control in the mid-end range should be prioritized throughout the rehabilitation process. Dissections of animals with similar glenohumeral joint anatomy and building a clay model allows for a hands-on learning experience with joint manipulation leading to a deeper understanding of structure-function relationships.

Using HBot to Teach French cusine

15-Minute Presentation

Morvens Saint Jean
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

This project examines how French cuisine—widely recognized as a cornerstone of national identity, cultural heritage, and social practice—can be taught more effectively through interactive learning. While scholars emphasize that French gastronomy encompasses tradition, pleasure, and communal meaning rather than mere lists of dishes, classroom instruction often relies on passive methods that limit engagement and retention. Research on intangible cultural heritage highlights the importance of experiential, participatory approaches that reflect the lived nature of culinary traditions, suggesting that static teaching tools fail to support meaningful categorization skills or cultural understanding. To address this gap, the project introduces a 3D Unity-based educational game in which players sort French food items into their appropriate categories using a conveyor-belt mechanic. By integrating game-based interaction with culturally grounded content, the system transforms abstract gastronomic knowledge into an active learning experience. This approach aligns with studies showing that visual classification and ingredient recognition are central to understanding culinary identity, offering a more immersive pathway for developing cultural literacy, memory retention, and deeper engagement with French cuisine.

A Soft Robotic, Prosthetic Gripper Utilizing Magneto-Granular Materials

15-Minute Presentation

Hunter Drake Satterfield
Eli Owens, Ph.D.
Department of Physics

Around the world, there is a growing need for low-cost prosthetics, particularly for individuals living in underdeveloped countries, as well as athletes and small children. To address this issue of accessibility and functionality, we previously established a functional universal gripper that operates three rigid arms via strings wired through the gearing system. This gripper utilizes jamming of soft granular material, allowing each rubber membrane to conform around objects. This project focuses on improving the overall functionality of the gripper. To achieve this,we modified two primary components of the prosthetic: (1) the gripping pad and (2) the gearing system. Optimization of the gripping pad involved both redesigning the electromagnet holder and identifying the most effective membrane material. We systematically evaluated membrane combinations by designing and 3D printing a testing device that mimics the functionality of a scissor lift (linear, vertical motion). This apparatus was used to assess key parameters, including grip strength and adaptability across various materials. Preliminary results emphasized the importance of membrane thickness and flexibility in achieving optimal gripping behavior.
In addition to material optimization, we redesigned the gearing system that controls the opening and closing of the gripper, which is now driven by three meshing 120° bevel gears. Furthermore, replacing the normal arms with metal mortise-and-tenon arms improved both the durability and overall performance of the gripper. Moving forward, we plan to refine the testing process and continue evaluating membrane configurations via the testing apparatus in order to determine the optimal membrane material for long-term prosthetic use.

Marriage in Emma

15-Minute Presentation

Maggie Shavo
Lynne Simpson, Ph.D.
Department of English

In his introduction to the fourth Norton critical edition of Jane Austen's 1815 novel, George Justice writes that "no experience of Emma, even multiple readings, will allow you full confidence of your interpretation." Currently, there is a sizable crowd dedicated to a progressive reading of the book. Readers note how Emma critiques elitism and revolves around the wiles of a woman who possesses the same power and agency that Regency society allocated strictly to men. However, despite its progressive aspects, I assert that the novel cannot be classified as anything other than conservative because it is founded upon the fundamental notion that one can only reach maturation by marrying properly, meaning to someone of equal social status. This essay examines the institution of marriage as it relates to social class, friendship, and the reign of the imagination, all of which substantiate an ultimately conservative reading of Emma.

Parental Involvement in Children's Early Learning

15-Minute Presentation

Victoria Elizabeth Smith
Julia Wilkins, Ph.D.
Department of Education

Research demonstrates that parental involvement plays an important role in supporting children's academic achievement and social development, particularly during the transition into Kindergarten. However, many families may not fully understand the extent of skills students are expected to acquire before starting school. The purpose of this study is to examine kindergarten teachers' perspectives on parental involvement in preparing children for kindergarten and to explore how families support school readiness at home, particularly in cases where children did not attend pre-kindergarten programs. Findings from this study may help educators, administrators, and families better understand the types of home-based activities and partnerships that support successful transitions into kindergarten.
NOTE TO REVIEWERS: Interviews with teachers and parents have not been conducted as my exempt IRB proposal submitted in January has not yet been reviewed.

Reducing Nuclear Waste Through Advanced Fuel Cycles

15-Minute Presentation

Ryan Patrick-Edward Sullivan
Frances Cashman, Ph.D.
Department of Physics

Today nuclear energy remains one of the most efficient large-scale, low carbon sources of electricity. However, one of the biggest problems with nuclear energy is the waste it produces. The United States produces approximately 2,100 metric tons of nuclear waste every year. This waste is then coated in concrete and buried hundreds of meters underground. We examined the structure of the US's once-through fuel cycle, where the fuel is used once and then buried as waste, in order to better understand the challenges associated with the spent nuclear fuel. We compared the American nuclear energy approach with France's closed fuel cycle, where they incorporate fuel reprocessing to reduce the volumes of highly radioactive waste from the reactors. We evaluate advanced reactor technologies, including non-light water reactors and small modular reactors (SMRs), and their potential role in repurposing retired coal plants. In addition to the technical analysis, we explored possible adaptation to the Nuclear Regulatory Commission (NRC) Rule 10 CFR Part 53 – which establishes a voluntary, risk-informed, and technology-inclusive framework for licensing advanced nuclear reactors. We also explore the impact of the ADVANCE Act (which would allow for advanced nuclear reactors to exist in the US), ASME (American Society of Mechanical Engineers) certification requirements, supply chain localization, financing challenges, and first-of-a-kind costs. National security, nonproliferation concerns, and public perception around nuclear energy are also examined. Finally, we integrate economic, regulatory, and security aspects to evaluate the feasibility of expanding the use of renewable nuclear energy into the United States while also improving waste management strategies.

Crusader Motivations

30-Minute Departmental Honors Presentation

Carter James Anthony Szydlowski

Richard Heiser, Ph.D.

Department of History

My project aims to answer the question "did the crusaders motivations change from their first expedition to its last of the era at the Fall of Acre". Throughout my presentation I will provide context to those times in history to give listeners the ability to understand what's taking place while these motivations are in action. I will also consider sources in a historiographical context and also dissect some other ones to help explain how to come to a healthy conclusion to the question asked. My Thesis is that the motivations did change, but we see different changes depending on the class of participants.

Heridas que Enseñan: Cómo el Pok-a-tok Moldeó la Medicina Maya

30-Minute Departmental Honors Presentation

Brooklyn Shepard-Wheelon
Sharon Knight, Ph.D.
Department of Modern Foreign Language

This research explores how the ancient Maya developed medical knowledge through lived physical experiences rather than formal scientific study. Focusing on warfare and the ritual ball game Pok-a-tok, it examines how these physically demanding practices shaped the way the Maya understood the human body, injury, and healing. By placing medicine within a broader cultural and physical context, this research challenges modern assumptions about where medical knowledge comes from and how it develops.

Occupational Deprivation in the Correctional System: How Occupational Therapists Can Support Through Rehabilitation

Poster Presentation

Ivy Brooke Veneziano
Courtney Addison, DOT
Occupational Therapy Program

Occupational deprivation is a common occurrence in institutional settings that causes adverse effects on an individual's health and well-being. Evidence has shown that incarcerated individuals receive minimal support and are held in restrictive environments that strip them of their occupational needs, resulting in occupational deprivation and loss of autonomy. Long-term effects in incarcerated individuals without the proper support result in increased mental health challenges, substance use, and recidivism. The purpose of this research is to gather information about the obstacles incarcerated individuals face and how healthcare professionals can best support them in the least restrictive environment possible. Hypothesizing that rehabilitation in the least restrictive environment will help reduce mental health challenges, substance use, and recidivism in prisoners. This study aims to develop an occupational therapy curriculum that could increase the support from occupational therapy practitioners (OTPs) working in the correctional system to provide rehabilitation and combat these adverse effects on their health and well-being.
Keywords: incarceration, occupational deprivation, mental health, substance use, rehabilitation, stigma, prisoners, occupational therapy

The Cage of Filial Love: Genuine Devotion and its Limiting Effects in Emma

15-Minute Presentation

Madelyn Lauren Wilkie
Lynne Simpson, Ph.D.
Department of English

This paper examines the relationship between Emma Woodhouse and her father in Jane Austen's Emma, a dynamic that complicates traditional interpretations of parental authority. Critics have often emphasized the unusual inversion of roles at Hartfield, where Emma assumes responsibilities that are typically associated with the patriarch of the Regency Era, while Mr. Woodhouse remains passive and dependent on his daughter. However, these interpretations frequently overlook the genuine affection that motivates Emma's behavior throughout the novel. By analyzing key scenes and engaging with critical perspectives from scholars Marilyn Butler, Claudia Johnson, Edmund Wilson, and Richard Jenkyns, this paper argues that Emma's authority within the household arises not solely from Mr. Woodhouse's inadequacy but also from her sincere devotion to her father. This devotion grants Emma unusual autonomy while simultaneously limiting her independence and shaping her judgment throughout the novel. Ultimately, the relationship between Emma and Mr. Woodhouse demonstrates how genuine filial love can function both as a source of empowerment and as a subtle constraint on personal growth.

Building an Empire: United Fruit Company's Habitual Influence Over Politics, Infrastructure, and Labor in Panama and Costa Rica, 1910s-1950s

30-Minute Departmental Honors Presentation

Madelyn Lauren Wilkie
Jaclyn Sumner, Ph.D.
Department of History

The United Fruit Company (UFCo), today Chiquita, was a massive transnational fruit corporation which began its operations in Latin America in the 1900s. The UFCo is infamous for its outsized role in the coup to overthrow a democratically elected president in Guatemala in 1954. While the coup has been well examined by scholars, less studied is how the UFCo came to influence politics and economics throughout its countries of operation leading up to the 1954 coup. Through the examination of documents held in the United Fruit Company Papers Archive at the University of Toronto Mississauga, this thesis argues that the UFCo relied on three everyday methods of control to consolidate its power in the region: political interference, infrastructural development, and labor control. By tracing these forms of power in Panama and Costa Rica from the 1910s to the 1950s, this research shows the larger corporate agenda implemented by the UFCo to build the influence that ultimately made the coup possible.

Histone H3K14 Acetylation in EMT-Driven Breast Cancer Progression

30-Minute Departmental Honors Presentation

Ella Grace Williams
Austin Shull, Ph.D.
Department of Biology

Basal-like breast cancers are often highly metastatic and are frequently driven by epithelial-mesenchymal transition (EMT), a process in which epithelial cells acquire migratory and invasive characteristics. Although genetic alterations contribute to EMT progression, the role of epigenetic regulation in this process is not fully understood. Previous work in our laboratory used data-independant acquisition (DIA) mass spectrometry to analyze histone modifications in an isogenic panel of MCF10A breast epithelial cell lines with deletions of tumor suppressor genes TP53 and PTEN. This analysis identified several histone modifications that were differentially enriched between non-EMT and EMT-induced cell lines, including a significant increase in histone H3 lysine 14 acetylation (H3K14ac) in the MCF10A $p53^{-}$/$PTEN^{-}$ double deletion cells. H3K14ac is a histone modification associated with open chromatin structure and increased transcriptional activity and has been implicated in tumor progression and gene regulation in breast cancer. The objective of this study was to validate the observed upregulation of H3K14ac in EMT-associated breast epithelial cell lines. Histones were extracted from parental MCF10A cells, p53 deletion cells, PTEN deletion cells, and $p53^{-}$/$PTEN^{-}$ double deletion cells. Western blot analysis was then used to compare relative levels of H3K14ac across the cell line panel. Validating this epigenetic change may provide further insight into how histone acetylation contributes to EMT and the progression of metastatic breast cancer.

Creative Writing: Senior Portfolio
15-Minute Presentation

Eris Wilson
Robert Stutts, Ph.D.
Department of English

Students in Creative Writing: Senior Portfolio revise previously written pieces for a professional portfolio.

Hbot to Teach Alphabet

15-Minute Presentation

Marcel Jamari Wood
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

This project presents the design and development of an educational ABC game aimed at improving early literacy skills through interactive gameplay. The game allows players to control a character that runs through and collects alphabet letters displayed throughout the environment. As players successfully collect letters, they receive points, reinforcing letter recognition and encouraging active participation to learn the entire alphabet. The scoring system motivates continued engagement while promoting cognitive development, hand-eye coordination, and familiarity with alphabetical order. It gives feedback for getting the collection correct and recieve points. Designed with simplicity and accessibility in mind, the game integrates learning objectives with entertainment to create an engaging educational experience for young learners.

Using HBot to Teach Security Concepts

15-Minute Presentation

Denim Yadav
Olivia Mambo Nche, Ph.D.
Department of Computer Sceince

Technical security measures are only as effective as the individuals operating within the digital environment. In an era where a single ransomware attack can paralyze global supply chains or healthcare systems, the necessity for robust, engaging user education has never been more critical. This capstone project addresses the ″human element″ of cybersecurity by developing a high-impact learning model centered on three primary digital threats: Malware, Trojan horses, and Ransomware. Unlike traditional, passive compliance training, this project implements an interactive, game-based learning approach through a custom-designed cybersecurity simulation game called Hbot. The Hbot game immerses users in realistic cyber-attack scenarios where they must identify, analyze, and respond to simulated threats in real time. Through structured levels focused on malware detection, Trojan horse recognition, and ransomware response, players experience the consequences of security decisions within a controlled, risk-free environment. Scenario-based challenges, decision-making tasks, and instant feedback mechanisms reinforce both the ″why″ and the ″how″ behind each attack method. By teaching users to recognize the subtle markers of a Trojan infection and understand the rapid lifecycle of a ransomware event through interactive gameplay, the framework transforms users from passive targets into proactive defenders. The modular design of Hbot allows the training to be accessible, repeatable, and adaptable across various skill levels. This project demonstrates that an informed and engaged user base—developed through experiential, game-driven learning—serves as the ultimate deterrent against cybercrime, shifting the organizational focus from reactive damage control to proactive digital hygiene.

Forecasting Financial Markets: A Comparative Study of Machine Learning and Statistical Models

15-Minute Presentation

Denim Yadav
Rachel Childers, Ph.D.
Department of Economics and Businesss Administration

Financial markets produce large amounts of daily data, yet predicting stock price movements remains a difficult and debated challenge. With the rise of machine learning in business analytics, researchers are increasingly testing whether modern predictive models can improve upon traditional statistical forecasting methods. This project, positioned within business analytics and financial modeling, examines whether machine learning techniques can meaningfully improve short-term stock price predictions. The central research question is: Can machine learning models more accurately forecast daily closing prices and price direction for Google (GOOG) stock compared to traditional statistical models? While financial theory suggests markets are largely efficient and difficult to predict, recent advances in data modeling raise the possibility that certain short-term patterns may be captured using advanced algorithms. To investigate this question, historical daily stock data for GOOG is collected using the yfinance API and analyzed in Python. The dataset includes key variables such as Open, High, Low, Close, and trading Volume. Additional features, including moving averages and measures of price volatility, are created to enhance predictive power. Several forecasting approaches are then implemented and compared: Linear Regression and ARIMA serve as traditional baseline models, while Random Forest and Long Short-Term Memory (LSTM) neural networks represent machine learning approaches. Model performance is evaluated using standard accuracy metrics and walk-forward validation to simulate real-world forecasting conditions. The hypothesis is that machine learning models, particularly Random Forest and LSTM, will outperform traditional methods because they can better capture nonlinear relationships and time-based patterns in the data. However, given the inherent uncertainty of financial markets, improvements may be modest. The significance of this research lies in its practical application. By directly comparing classical statistical techniques with modern machine learning

models in a real-world financial setting, this study contributes to a clearer understanding of when advanced analytics provide meaningful forecasting advantages—and when they do not. The findings offer insight for students, analysts, and decision-makers interested in applying data-driven methods to financial markets.

An Analysis of Life Expectancy Trends in Developed and Developing Countries

15-Minute Presentation

Denim Yadav
Suzie Smith, Ph.D.
Department of Economics and Businesss Administration

This project explores the factors influencing life expectancy across developed and developing countries using global health and economic data. Data visualizations were created in Tableau, including scatterplots, comparative charts, and time-series graphs, to analyze relationships between life expectancy and key development indicators such as education levels, healthcare expenditure, and vaccination rates. The analysis reveals a historically significant gap in life expectancy between developed and developing nations. However, longitudinal trends show that this gap has gradually narrowed over time as many developing countries improve access to healthcare, education, and public health infrastructure. Scatterplot analyses indicate strong positive relationships between life expectancy and variables such as average years of education and national spending on healthcare. In contrast, countries with lower vaccination coverage tend to experience higher mortality rates, particularly from preventable diseases. The project also includes modeling scenarios that estimate potential lives saved through increased vaccination rates, demonstrating the significant impact that preventative healthcare can have on population longevity. A focused case study on Rwanda illustrates these broader trends. Over the past two decades, Rwanda has experienced a dramatic rise in life expectancy due to improvements in vaccination programs, healthcare access, and public health initiatives. While developed nations continue to maintain higher life expectancy on average, the findings suggest that global disparities are gradually decreasing. These results emphasize the importance of continued investment in education, healthcare systems, and vaccination programs as key drivers of improved life expectancy worldwide.

Model System for Phase Changes

30-Minute Departmental Honors Presentation

Veby Nagi Youssef
Latha Gearheart, Ph.D.
Department of Chemistry and Biochemistry

Granular materials, formally known as athermal macroscopic particles, are widespread around us, both in nature and human-designed systems. For instance, sand on the beach can hold your weight, yet it can also flow like a liquid through an hourglass or behave like a gas in a sandstorm. Granular materials, which are not influenced by temperature, undergo three phase changes: solid, liquid, and gas. The solid-liquid phase change, formally known as jamming transition, can be manipulated in various ways, aiding in understanding and visualizing phases of matter. In the proposed experimental model system, I designed a triangular-style container, which holds the magnetic iron filings (granular materials). These filings' liquification and solidification will be controlled by a magnetic field, specifically by controlling the three electro-permanent magnets (EPMs) located around the container; EPMs are by default "on," but their magnetic field can be turned off by the external power source. An Arduino, with input code, was used to manipulate the magnetic field to achieve the most efficient liquification and solidification. To measure the "hardness" of the granular materials, which correlates to liquification and solidification, the Meyer's scale, a materials-science standard testing protocol, was integrated. While the jamming transition focuses on the solid/liquid phase transition, granular systems can also exhibit gas-like behavior. Our experiments with granular gases illustrate the nature of the gas phase, with direct correlation to the ideal gas law:

$$Pv = nRT \quad (1)$$

Overall, a model experimental prototype visualizing the three phases of matter was designed. Further testing and improvements will be done to improve the experimental design. Beyond functioning as a model system, my design has applications in soft robotics involving the jamming transition, improved understanding of physical/geographical systems, biological cell movement, and beyond.

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