Three Minute Thesis Competition
University of South Carolina
November 6, 2026

Competition Schedule: Preliminary Round

Presenters and Heats (Presentation Order)

Heat A (Close-Hipp 350)

- Cara Vandergriff (Communication Sciences and Disorders)
- Mary Mitchell (Biological Sciences)
- Jiarong Xu (Computer Science)
- Dana Azar (Language and Literacy)
- Sarah Deloach (Biomedical Engineering)
- Mehak Bhatia (Chemistry)
- Sabih Ahmad Khan (Mechanical Engineering)
- Ehsan Fasihi Moghaddam (Physics)

Heat B (Close-Hipp 364)

- Rachael Lanning (Anthropology)
- Maria Geueke (Language and Literacy)
- Sravanthi Avula (Biological Sciences)
- Mina Karami (Communication Sciences and Disorders)
- Harshita Negi (Biological Sciences)
- Larissa Sands (Mass Communications)
- Ebenezer Seesi (Mechanical Engineering)
- Mamata Naik (Chemistry)

Heat C (Close-Hipp 502)

- Devadharshini Kathan (Chemical Engineering)
- Khushboo (Environmental Health Sciences)
- Reza Tavasoli (Computer Science)
- Chloe Weyer-Nichols (Biomedical Sciences)
- Xinnan Shi (Chemistry)
- Chinwendu Akalonu (Journalism and Mass Communication)
- Kezia Owusu Nti (Clinical Pharmacy and Outcome Sciences)
- Ademar Fernández (Geophysics)

Heat D (Close-Hipp 534)

- Emma Dixon (Chemistry)
- Zenawi Hagos Gufue (Epidemiology)
- Rafid Enayet (Mechanical Engineering)
- Alireza Mashreghi (Civil and Environmental Engineering)
- Sarah Wilson (Linguistics)
- Nandana Goswami (Geology)
- Maggie Gu (Clinical Pharmacy and Outcome Sciences)
- Sweety Ramnani (Computer Science)

Heat E (Close-Hipp 535)

- Zachery Burzee (Health Promotion, Education, and Behavior)
- Benedicta Senior Nashiff (Drug Discovery and Biomedical Sciences)
- Courtney Bailey (Linguistics)
- Ozgur Altintas (Physical Education)
- Yunping Zhoujin (Chemistry)
- Emily Baumann (Marine Science)
- Diego Villafañe Ortiz (Biomedical Sciences)
- Siavash Karbasizadeh (Physics)
- Kayla Kozak (Management)

HEAT F (Close-Hipp 584)

- Hunter Cox (Biomedical Sciences)
- Koryo Kwao (Chemistry)
- Morgan Sharbaugh (Marine Science)
- Mahtab Ghasemi Dogaheh (Drug Discovery and Biomedical Sciences)
- Kevin Enyekwe (Chemical Engineering)
- Katherine Stenning (Sport and Entertainment Management)
- Bereket Alano (Health Services Policy and Management)

Heat A Presenters and Abstracts (Alphabetic Order)

Dana Azar
Title: English Proficiency or Bureaucracy? The Hidden Barriers Facing Graduate Teaching Assistants
Abstract: Graduate teaching assistants play an important role in undergraduate education, yet for those whose first language is not English, demonstrating English proficiency can present additional challenges.

South Carolina's English Fluency in Higher Learning Act requires public universities to ensure that instructors have adequate English proficiency but allows institutions to determine how that proficiency is assessed.

At the University of South Carolina, graduate teaching assistants who are required to complete an oral English assessment must deliver a short lesson before evaluators and fellow graduate students. According to the university's published assessment rubric, pronunciation accounts for 50% of the evaluation.

This raises important questions about the relationship between pronunciation, accent, and intelligibility, as well as how the pressure of a live assessment may influence students' performance and experiences.

To explore alternative assessment approaches, this project compares USC with two universities selected for specific reasons. Clemson University operates under the same South Carolina law, making it a valuable local comparison. Purdue University ranks among the ten U.S. universities hosting the largest international-student populations, making its assessment practices particularly relevant. Clemson offers online assessment options, while Purdue uses recorded responses to academic questions rather than a live teaching demonstration.

This project proposes collaborating with USC's Graduate School to survey graduate teaching assistants about their experiences and use the findings to recommend clearer, fairer, and more supportive assessment practices.

Mehak Bhatia
Title: Dangling strands: A unique approach to design strong and recyclable rubber
Abstract: Millions of car tires clog landfills because traditional rubber or elastomer is held together by permanent chemical bonds, which makes recycling difficult. Removing these bonds makes the material eco-friendly but dangerously weak. This research solves this classic trade-off by breaking a long-standing textbook rule. Classical theory claims that "dangling" molecular strands attached to the rubber network at only one end are topological defects that soften rubber. Using computational molecular simulations, we proved the exact opposite: increasing the fraction and chain length of dangling strands doubled the material's stiffness. Advanced tracking showed that these free-moving dangling strands naturally thread themselves through the network in collapsed globular conformations to form entanglements. These additional entanglements act as temporary load-bearing connections, providing immense strength when pulled. Since these connections are

physical rather than chemical, they can be undone during processing, allowing the material to be recycled with ease. This breakthrough offers a new blueprint to engineer next-generation materials that are exceptionally tough on the road, yet effortlessly recyclable.

Sarah Deloach
Title: Under Pressure: A New Approach to Protecting the Heart
Abstract: Cardiovascular disease is the leading cause of death worldwide. Global projections estimate 20.5 million cardiovascular deaths in 2025, and annual deaths are projected to reach 35.6 million in the year 2050 alone. More than half of the deaths projected for 2050 will be attributed to high blood pressure, which places chronic strain on the heart and can eventually lead to heart failure. This strain contributes to inflammation, scarring, and harmful structural changes that progressively impair heart function.

Our research explores the protective properties of alpha-calcitonin gene-related peptide (α-CGRP), a naturally occurring peptide that helps blood vessels widen. Although α-CGRP has shown therapeutic potential, it breaks down quickly in its native form.

To address this limitation, our laboratory developed NMEG-CGRP, a modified peptide designed to improve stability while preserving its biological activity. In a mouse model of heart failure caused by sustained pressure overload, we began treatment after cardiac dysfunction had developed. We then evaluated whether NMEG-CGRP could improve heart function and reduce harmful structural changes.

NMEG-CGRP improved heart function and reduced harmful structural changes, oxidative stress, and cellular injury. These findings support further investigation of NMEG-CGRP as a potential treatment to slow heart failure progression after dysfunction has begun.

Ehsan Fasihi Moghaddam
Title: Can an Atom Disappear? Using Muonium to Search for New Physics
Abstract: Muonium is a short-lived exotic atom made of an electron and an antimuon, the antimatter partner of the muon. Unlike ordinary atoms, it contains no protons or neutrons. Because its constituents are elementary leptons, muonium provides a relatively clean system for testing the Standard Model of particle physics and searching for possible new interactions.

Our research investigates rare muonium annihilation decays, with a particular focus on an invisible decay in which the electron and antimuon annihilate into a neutrino and an antineutrino. Neutrinos interact very weakly with matter and usually pass through detectors without leaving a visible signal. The Standard Model allows this decay, but predicts that it happens extremely rarely.

We use effective field theory to describe the particle interactions, while taking into account the quantum-mechanical structure of the muonium bound-state. Our goal is to calculate the expected decay rate and investigate how interactions beyond the

Standard Model could modify it. We also study other rare muonium decay channels to obtain complementary theoretical predictions.

These predictions could guide future experiments and be compared with experimental measurements. A significant difference between measurements and Standard Model predictions, after uncertainties are accounted for, could suggest new physics. Comparing several decay channels may also help identify promising experimental signatures.

By studying how an unusual atom can disappear without a visible trace, this research addresses a broader question: Is our current understanding of fundamental particles and their interactions complete?

Sabih Ahmad Khan
Title: An Engineered Pattern to Measure Material Stretch
Abstract: Digital Image Correlation (DIC) measures strain, deformation, and motion by tracking surface contrast patterns. Conventional random speckle patterns, typically applied with spray paint, lack precise frequency control. This causes aliasing errors and low-contrast regions, which raise uncertainty, limit spatial resolution, and add computational cost. This research introduces a contrast pattern defined by three superposed sinusoidal gratings with controlled frequency content, ranging from roughly 200 times below the Nyquist frequency to the Nyquist limit. Wavelength, amplitude, and rotation angle define each grating, producing high pixel-to-pixel intensity gradients without aliasing. A Covariance Matrix Adaptation Evolution Strategy (CMA-ES) framework tuned these parameters to minimize uncertainty across subset sizes. We evaluated robustness at signal-to-noise ratios (SNR) of 30, 40, and 50 dB, plus a noise-free case. At a 9×9 pixel subset, the root-mean-square error (RMSE) stays below 0.5 mPx without noise and reaches about 7.5 mPx at 30 dB SNR. Parametric analysis shows grating wavelength and amplitude strongly govern uncertainty. RMSE rises with wavelength and falls with amplitude. At a 9×9 pixel subset, the optimized pattern nearly halves the error of a traditional optimal dotted speckle pattern. These patterns allow DIC analysis with 9×9 pixel subsets instead of 21×21, running about six times faster while preserving deformation detail. The new RMSE-wavelength relationship also estimates measurement error for any speckle pattern from its frequency content. The patterns print directly onto test articles or transfer via adhesive films for simple, repeatable application. This work links computational optimization, optical design, and experimental mechanics, and shows how pattern wavelength composition governs DIC precision.

Mary Mitchell
Title: Cannabinoids and Crohn’s disease: CB1 signaling promotes overgrowth of an opportunistic pathogen
Abstract: Up to one in six patients with Crohn’s disease (CD) use cannabis for pain management. CD is a life-long condition that alternates between “flares” of intestinal inflammation and “remission,” when inflammation is controlled. Even in remission, pain persists and affects quality of life. Unfortunately, pain remains difficult to treat, as painkillers can directly aggravate inflammation or become addictive, leading

patients to self-medicate with cannabis. Active components of cannabis bind cannabinoid receptors, dampening pain signals in nerves that extend into the gut. Patients report significant relief of abdominal pain with cannabis use. However, endoscopic measures of intestinal damage remain unchanged, and one study reports that long-term use predicts a five-fold increased risk of bowel surgery.
My thesis work proposes the gut microbiota, a resident community of microbes in the gut, as an explanation. CD develops when the immune system mistakes the resident gut microbiota for a threat, resulting in significant inflammation that damages the intestines. In mice, we pharmacologically raised the body's own cannabis-like molecules, termed endocannabinoids, which act on the same cannabinoid receptors. Remarkably, activation of cannabinoid receptor 1 (CB1) led to the overgrowth of Escherichia coli, an opportunistic pathogen implicated in CD. We additionally found that this overgrowth can be blocked by using a CB1 inhibitor. Notably, the primary active component of cannabis, THC, binds CB1 with high affinity. Cannabis may therefore relieve pain but promote disease through CB1 in a subset of patients harboring an opportunistic pathogen, which might explain why patients report symptom relief without intestinal healing.

Cara Vandergriff
Title: Let's Get on the Same Page about Readability Versus Reader Ability
Abstract: Despite advances in text processing in the era of large language models, readability formulas largely continue to grade text complexity on surface features such as word and sentence difficulty or length. The formula most commonly used today appeared in "A New Readability Yardstick" (1948) by Rudolf Flesch, who stressed that the stakes are higher and the frustration threshold lower among adult readers, "whose main business is not learning but living."

Grade-level equivalencies developed in the decades since have also failed to close the gap. Even if school standards specified what, specifically, "sixth-grade level" text should look like (they don't), developing readers fail in ways that look different from their more mature counterparts, to say nothing of the harm these comparisons pose to adult readers' dignity.

With each large-scale survey of literacy skills showing a continued decline for cohorts of aging readers across the globe, one possibility offers hope: LLMs can fine-tune text at extraordinarily granular levels. But these tools rely on an as-yet indeterminate understanding of what stumbling blocks threaten an adult reader's understanding on any given sentence.

This presentation offers a walkthrough of a few such sentences, stimuli drawn from the self-paced reading task administered to more than 300 adults aged 20 to 80 as part of the University of South Carolina's Aging Brain Cohort (ABC@USC). A preliminary analysis points the path forward for ongoing development of AREA, Adult Reading Efficiency and Adaptation, a transparent tool meant to change only what stands between an adult reader and the words on the page.

Jiarong Xu
Title: Teaching AI to Help the Power Grid
Abstract: Keeping the power grid stable is becoming harder as renewable energy, extreme weather, and equipment failures create rapidly changing conditions. Grid operators can sometimes prevent overloads and blackouts by changing how electricity flows through the network—for example, by switching transmission lines or reconfiguring substations. But deciding which action to take is like finding the best option in a haystack: a computer may need to simulate thousands of possible actions before identifying a safe one.

My research makes this decision process dramatically faster. I develop a “smart shortlist” that groups similar grid-control actions and learns which groups are most promising under current grid conditions. Instead of testing every possible action, the system simulates only a small, high-potential subset, while retaining nearly the same decision quality. On a realistic power-grid benchmark containing more than 120,000 operating states, this approach selected safe actions up to 121 times faster than exhaustive search.

I also explore whether small quantum circuits can improve the final ranking of shortlisted actions. The results show that quantum-enhanced reranking can more precisely identify the best action, although it currently adds computational cost.

By combining reliable classical simulation with quantum-inspired search and quantum-enhanced scoring, this work offers a practical path toward faster, scalable decision support for resilient and sustainable power grids.

Heat B Presenters and Abstracts (Alphabetic Order)

Sravanthi Avula
Title: The Alarm That Won’t Turn Off: An Overactive Stress Sensor (PKR) in Inherited Dystonia
Abstract: Dystonia is the third most common movement disorder, after Parkinson's and essential tremor, affecting roughly 500,000 people in North America. It twists muscles into painful, uncontrollable postures, and there is still no cure, largely because we don't understand what goes wrong inside the cells.

My research follows a clue from the clinic. Clinicians have reported that in two inherited forms of dystonia, several patients were healthy children until a fever. Weeks later, their symptoms began and never went away.

These two dystonias are caused by mutations in two different genes, but both disrupt the same cellular alarm system. Every cell carries a sensor called PKR that detects viral infection and other stress. One mutation damages PKR itself; the other damages PACT, the protein that activates PKR. Normally the sensor sounds the alarm, pauses the cell's work while the threat is cleared, and then switches off. If it stays on too long, the cell self-destructs.

I asked whether these mutations leave the alarm stuck on. Using skin cells from patients and healthy donors, I mimicked a viral infection and measured the response. Patient cells switched the alarm on several times more strongly, kept it on, and died at far higher rates than healthy cells.

This may help explain why dystonia symptoms can emerge after a childhood fever. It also points to a target: if we can turn the alarm back down, we may be able to protect these cells and change how inherited dystonia is treated.

Maria Geueke
Title: Worldviews about Multilingualism and Giftedness: An Autoethnography Investigating Language and Whiteness
Abstract: To address the gap of the lack of a whiteness lens in ability naming contexts where multilingualism is the majority (Migliarini & Stinson, 2021), I engaged in an analytical autoethnographic research study from my experiences teaching at two secondary schools in New England. In this study, I drew on discourse analysis and critical theories on the study of language to engage in questions about the ways the mind, discourse, and site planning operate when racially diverse multilingual students are marked with disabilities.

One outcome of the study is that both my application and my reading of the disability linguistic landscape played a role in both passive and active site planning. This was layered with my investment in race evasive discourses. Whiteness also showed up through my unproductive struggle to isolate whiteness events as forms of racial domination. Race evasiveness intertwined by the active production of disengagement from racial literacies (Lyiscott, 2019) left whiteness events unmarked, allowing them to exist like a form of normalcy.

The outcomes of this study further complicates the connections between psychological and sociological elements of linguistic ecologies (Brown, 2022) and asks for more attention on whiteness in the context of teacher worldviews in ability naming contexts where multilingualism is the majority. A tool for teachers to avoid race evasive discourses is mapping immediate, in vicinity, distant, and historical actors centered in whiteness, naming the interaction these actors have with each other and noticing their interaction with ability naming linguistic landscapes.

Mina Karami
Title: Listening to the Heart: What Heartbeats Reveal About Attention?
Abstract: Attention is fundamental to everyday cognitive functioning. Heart rate variability (HRV), particularly vagally mediated HRV, reflects autonomic regulation and has been associated with prefrontal processes involved in executive functioning, including attention, inhibition, and working memory. The neurovisceral integration framework provides a theoretical basis for examining whether individual differences in autonomic regulation are associated with cognitive performance.
This study examined the relationship between HRV and attention-related cognitive performance in adults over 50. Participants completed attention-related cognitive tasks while their cardiac activity was recorded continuously. Behavioral task performance was examined in relation to HRV indices to determine whether

individual differences in cardiac autonomic regulation were associated with attentional performance.
Preliminary findings indicated that participants with higher HRV tended to perform better on attention-related tasks. These findings suggest that HRV may represent a promising physiological correlate of attentional performance in adults over 50. By integrating behavioral and physiological measures, this study contributes to understanding the relationship between autonomic regulation and cognitive functioning across adulthood.

Rachael Lanning
Title: Exhibit Alternatives: Creative Public Engagement at Archaeological Sites in South Carolina
Abstract: The interpretation of archaeological projects often requires a material component. In the American South, especially South Carolina, interpreting archaeological sites associated with marginalized histories is difficult, as extant structures relating to said histories may not exist. At places like Sesquicentennial State Park in Columbia, rich archaeological evidence of African American communities exists, but the space is not dedicated to history-telling. There is no museum space for artifact display and the landscape is absent of historic structures beyond State Park history. Before becoming a State Park, enslaved and freed African Americans lived on the land. Using multi-modal and creative approaches to the interpretation of archaeological work, a successful platform for telling the stories of these underrepresented communities can be achieved. In this project, I will analyze the success of other historic sites in South Carolina that skillfully tell stories of marginalized histories and display that the same success can be achieved for Sesquicentennial State Park.

Mamata Naik
Title: Switching Copper's Role with Light: Making Medicine through Adaptive Catalysis
Abstract: Making a medicine often requires several chemical steps, with different catalysts helping each step along. What if we could use light as an external stimulus to switch one catalyst between different roles? And could we achieve this control within a solid catalyst that can be recovered and reused?
My research explores this possibility using copper housed inside a porous crystalline material called a metal–organic framework. I incorporated light-responsive molecules into this framework to act as molecular switches. Under ultraviolet light, these switches transfer electrons to copper, reversibly changing its chemical state and catalytic behavior. This provides access to two forms of copper with complementary roles: one helps join three starting molecules, while the other helps transform the resulting intermediate into a ring structure found in medicines.
Using this light-responsive catalyst, we synthesized twelve compounds, including the sleep medicine zolpidem, with high yields. The solid catalyst could also be recovered and reused for at least five consecutive batches while retaining its structure and catalytic activity.
This work provides the first example of a light-responsive solid catalyst that uses molecular switches to control copper's oxidation state and drive a three-component coupling reaction. By combining molecular switches with copper, we establish a

strategy for adaptive catalysis, allowing one material to support different steps in building a molecule. Beyond making a medicine, this research establishes a design principle for reusable catalysts whose chemical roles can be controlled with light, opening new possibilities for assembling complex molecules.

Harshita Negi
Title: Danger's in the air – and plants can sense it
Abstract: Green leaf volatiles (GLVs) are a group of small volatile organic compounds characterized by the smell of freshly cut grass. They are released upon herbivore or pathogen attack and play a role in plant-plant communication. Plants can detect GLVs emitted by wounded neighboring plants and use this information to activate their own defenses, e.g., the synthesis of toxic compounds that harm herbivores. Although this plant-to-plant communication system has been observed for decades, surprisingly little is known about how these GLVs are perceived by receptor proteins and how perception translates to a defense response inside cells. Our research focuses on how plants perceive two different GLVs. The major objective is to identify receptors and signaling proteins by employing forward and reverse genetic approaches in Arabidopsis thaliana, a model plant widely used in genetics research. We found that GLVs inhibit root growth and activate MAP kinases, proteins that help plants respond to stress. These GLV responses can be measured easily to determine whether mutant plants have gained or lost sensitivity to GLVs. By uncovering how plants smell and interpret chemical warnings from their neighbors, this work can advance our understanding of plant communication. In the long term, it may support crop-breeding or treatment strategies that strengthen natural pest defenses and reduce dependence on harmful pesticides.

Larissa Sands
Title: Creative Strategy: Designing Visual Agility
Abstract: Modern social/digital environments reward real-time participation, subculture adoption, and meme literacy. However, strict brand guidelines often slow response times or result in forced, performative engagement. This line of research explores governance models, adaptive design systems, and creative permission frameworks that allow brands to act dynamically in culture while maintaining brand recognition.

Ebenezer Seesi
Title: Giving Waste Heat a Second Life with Tiny Metal Particles
Abstract: Every day, engines, factories, and power plants release heat that goes unused. What if we could give some of that wasted energy a second life as electricity? Thermoelectric materials can do this directly when one side is hotter than the other. My research explores how to improve a heat-resistant ceramic for this purpose. The challenge is that electrical charge does not move through it easily enough, limiting its potential to generate useful power. Our approach starts with an ingredient already inside the ceramic: nickel. We make an extremely thin layer of ceramic and heat it in hydrogen. During this treatment, some nickel atoms move to the surface and gather into tiny metal particles. Instead of adding particles from outside, we grow them from within the material itself. Our experiments show that the treated film allows electrical charge to move much more easily. This improvement

addresses one important barrier to developing ceramic materials that can turn waste heat into electricity. Better electrical flow is one part of the solution. The material must also maintain its ability to generate voltage from a temperature difference. Our findings provide a promising step toward that goal by showing how a controlled treatment can improve electrical flow while producing tiny metal particles on the ceramic's surface. Ultimately, this research could help us recover energy that would otherwise be lost and make better use of the energy we already consume.

Heat C Presenters and Abstracts (Alphabetic Order)

Chinwendu Akalonu
Title: We Need Contextual Theories: Building a Representative AI Adoption Framework for Journalism
Abstract: This study examines artificial intelligence (AI) adoption among journalists across five (5) African countries: Ghana, Kenya, Nigeria, South Africa, and Tanzania. Although research on AI and journalism is expanding, existing scholarship remains predominantly Western, limiting understanding of adoption within African organizational, economic, cultural, and professional contexts. Guided by the Unified Theory of Acceptance and Use of Technology (UTAUT), the study extends conventional adoption models by incorporating journalistic-values alignment, ethical awareness, perceived African representativeness, trust in AI output quality, organizational requirements, and cost barriers. An embedded mixed-methods design combines a cross-national survey of practicing journalists with in-depth interviews to identify predictors of AI adoption and explore the contextual reasoning shaping journalists' attitudes and practices. The analysis examines how UTAUT constructs interact with professional norms and structural conditions to influence behavioral intentions and actual use. By situating AI adoption within African news production, the study contributes to scholarship on technology acceptance and journalism while challenging universalist assumptions. Its findings offer implications for responsible, equitable, and context-sensitive AI integration in African newsrooms.

The study will evaluate whether professor characteristics, including research field, academic rank, profile-photo presentation, student-focused webpage content, visible publications and accomplishments, and student–professor demographic similarity, are associated with faculty selection. Student characteristics and prior research interests will also be considered. The second assignment will be used to determine whether students retain their original professor or research-field preference and how faculty responsiveness and availability affect final interactions.

Quantitative analyses will compare faculty selection rates, research-field preferences, student–professor similarity, and meeting outcomes. Regression-based models will be used to identify characteristics associated with professor selection. Findings may help clarify how approachability, similarity, research interest, professional accomplishment, and faculty accessibility shape early student connections with engineering faculty and research.

Ademar Fernández
Title: Crustal Structure Underneath South Carolina Determined by Receiver Function Analysis
Abstract: South Carolina (SC) is a geologically complex region formed by the accretion of multiple terranes, resulting in a diverse array of crustal configurations across the state. In this study, we analyze the crustal structure of SC from the coast to the Appalachians, across the Eastern Piedmont Fault System, which marks a tectonic boundary between the predominantly sedimentary southeast and the cratonic northwest of the state. We computed teleseismic receiver functions (RFs) for 47 seismic stations across SC between 2012–2023. We inverted the observed RFs in a probabilistic framework to infer the crustal structure beneath each station. To extend RF inversion across the Atlantic Coastal Plain, where thick sedimentary cover produces strong reverberations, we correct the observed RFs for sediment reverberations prior to inversion. We produce a collection of Vs profiles from the surface to the Moho beneath each station. Our findings suggest that the crust at the coast is ~30 km thick, increasing rapidly toward the northwest and reaching ~54 km beneath the edge of the Appalachians over a distance of roughly 465 km. By providing a station-scale characterization of crustal structure, our results will help improve constraints on earthquake location in SC and offer new insights into the composition and heterogeneity of its major terranes.

Devadharshini Kathan
Title: Unlocking the Energy Left behind-Making Alkaline Batteries Last Longer
Abstract: Zn-MnO2 alkaline batteries are widely used and reliable primary energy sources due to their cost-effectiveness, good safety characteristics, long shelf life, and ability to deliver sustained power for continuous usage. These properties make alkaline batteries an ideal option for remote controls, smoke detectors, wireless mice, toys, and many other long life, intermittent-use portable electronic devices. Alkaline batteries generate electricity through an electrochemical reaction where zinc at the anode reacts with hydroxide ions, releasing electrons that power the device. Despite their widespread utilization, alkaline batteries are routinely discarded before all of their stored energy has been delivered. In fact, U.S. consumers discard alkaline batteries with approximately $80 million worth of unused energy each year. A major limitation to battery performance arises from the Zn slurry anode. During discharge, zinc oxide (ZnO) forms as a reaction product, and can accumulate around the unreacted Zn. Over time, this zinc oxide creates a dense, electrically insulating layer that restricts electron and ion transport, and prevents the remaining zinc from participating in the reaction, resulting in catastrophic failure. In my research, I focused on unlocking this trapped energy by engineering the Zn slurry to increase its ionic conductivity and incorporating additives to delay ZnO precipitation, thereby improving ion transport and increasing Zn utilization. Enabling alkaline batteries to extract more energy could reduce material waste, extend battery service life, and make the everyday batteries we rely on more efficient and sustainable.

Khushboo
Title: From Fresh Scent to Harmful Radicals
Abstract: Environmentally persistent free radicals (EPFRs) are long-lived, highly stable radicals found on particles that affect human health. Although they are known

to form from combustion sources, their potential formation through atmospheric processes remains poorly understood. This study investigates whether atmospheric oxidation of volatile organic compounds (VOCs), the main precursors of secondary organic aerosol (SOA), can generate EPFRs. Eight representative VOCs were exposed to simulated sunlight, O3, or both under controlled laboratory conditions. Electron spin resonance (ESR) spectroscopy showed that all VOCs formed EPFRs, with yields varying by VOC structure and oxidation conditions. Carvacrol, a phenolic VOC, produced the highest EPFR levels, while α-pinene produced the lowest. X-ray photoelectron spectroscopy revealed a sequential increase in oxygen-containing compounds, which was consistent with known SOA formation pathways. This work identifies atmospheric VOC oxidation as a potential secondary source of EPFRs. The results will inform understanding of how VOCs may evolve into EPFRs and their health impacts, particularly in regions with high VOC emissions and active photochemistry.

Kezia Owusu Nti
Title: When the Last Pharmacy Closes: Finding the Pharmacies South Carolina Can't Afford to Lose
Abstract: Objective: This study assessed geographic pharmacy accessibility in South Carolina (SC) and identified keystone pharmacies, defined as pharmacies for which all, or a specified portion, of residents within their modeled geographic catchment had no other pharmacy within the applicable distance threshold. Unlike pharmacy-desert measures, which identify populations located far from pharmacies, the keystone concept identifies pharmacies whose closure could leave nearby residents without another pharmacy within the selected geographic threshold.
Methods: We mapped 1,021 active licensed pharmacies listed by the SC Board of Pharmacy for 2025 and classified each as independent (n=351), large chain (n=599), or other pharmacy settings (n=71). Census tracts with Rural-Urban Commuting Area (RUCA) code 1 were classified as metropolitan core; all other tracts were classified as non-metropolitan core. Using 2020 Census block-level population data, we applied straight line distance thresholds of 1 mile in metropolitan-core tracts and 5 miles in all other tracts. We assigned block populations to pharmacies within the applicable distance threshold. A pharmacy was classified as a keystone if residents in its modeled catchment had no other pharmacy within the applicable distance threshold. We described pharmacies by ownership and setting and calculated residents per pharmacy for each of the 46 counties.
Anticipated Implications: This study will identify where pharmacy closures could leave residents without nearby access to immunizations, naloxone, chronic disease management, and urgent medication needs. Findings will inform pharmacists, payers, and policymakers on the geographic consequences of closures and reimbursement decisions when designing access programs.

Xinnan Shi
Title: Radioactive Cation Capture and Release by Photochromic Molecular
Abstract: Radioactive cations, such as thorium ions and uranium cations, have high risks to human health and the environment, which highlights the need for effective separation methods. However, the current methods are costly and rely on materials that are disposable or difficult to regenerate. This project aims to develop a reusable

heterogeneous photochromic system that uses light to control the selective capture and release of radioactive cations from solution. The system is based on reversible switching between spiropyran (SP) and merocyanine (MC) under ultraviolet (UV) and visible light. UV irradiation converts SP into the open MC form, which contains a positively charged nitrogen center and a negatively charged oxygen site. This oxygen site binds target radioactive cations, allowing their capture even in the presence of competing metal ions. Preliminary observations suggest that complex formation occurs rapidly. Incorporating the photochromic molecules into a solid support allows the material and its bound cations to be recovered from the original contaminated solution by filtration. Later, exposure to visible light converts MC back to the closed SP form, releasing the captured cations into the separate solution. The material can subsequently be reactivated with UV light and reused for more capture cycles. This system will be evaluated for capture selectivity, sensitivity, release efficiency, and recyclability. By combining reversible molecular switching with simple physical separation, this approach offers a practical strategy for controlling radioactive cation capture and release. Ultimately, this work could reduce the use of disposable sorbents and support the development of reusable materials for radioactive contaminant removal.

Reza Tavasoli
Title: Contactless Body Composition Assessment Across the Lifespan with Millimeter-Wave Radar
Abstract: Body composition, the division of body mass into fat and fat-free components, is a stronger indicator of health than weight or body mass index. Excess body fat in childhood often persists into adulthood and raises the risk of chronic disease. However, current methods have drawbacks. Dual-energy X-ray absorptiometry (DEXA) involves ionizing radiation and requires lying still on a scanning table. Air displacement plethysmography requires an enclosed chamber, a swim cap, and tight-fitting clothing. Bioelectrical impedance analysis (BIA) is inexpensive but requires skin contact, is sensitive to hydration, and is less accurate in children. 3D optical scanners are contactless, but also require minimal clothing, are affected by lighting and shadows, and capture identifiable images of the body. This research presents a contactless system that assesses body composition using millimeter-wave radar. The person stands on a rotating platform for about thirty seconds. Radar signals pass through lightweight clothing, are unaffected by lighting, and do not produce identifiable images, which preserves privacy. A deep learning model trained on simulated radar data first estimates height and body circumferences, and a second model converts these measurements, along with age, sex, and weight, into fat mass, fat-free mass, and body fat percentage.
In a study conducted in collaboration with the Clinical Exercise Research Center (CERC) at USC's Arnold School of Public Health, the system's estimates for children closely matched DEXA, with accuracy comparable to 3D optical scanners. We are now extending the system to adolescents and adults toward radiation-free, privacy-preserving assessment across the lifespan.

Chloe Weyer-Nichols
Title: The *Veni, Vidi, Vici* of Superantigens: Why do Superantigens Conquer Some, But Not Others?

Abstract: Acute respiratory distress syndrome (ARDS), which can result from severe infections, is characterized by lung injury, vascular leak, pulmonary edema, and, in some cases, death. Mortality remains at approximately 38%, yet treatment is largely supportive, including oxygen, mechanical ventilation, and corticosteroids. With no approved therapy specifically targeting the uncontrolled inflammation that drives ARDS, it is critical to understand why the same infectious trigger can produce dramatically different disease severity.
Staphylococcus aureus produces staphylococcal enterotoxin B (SEB), a CDC select agent and superantigen. Unlike conventional antigens, which activate small populations of antigen-specific T cells, superantigens activate large numbers of T cells by cross-linking MHC class II molecules with specific T-cell receptor Vβ families, potentially triggering a cytokine storm. Our laboratory found that mouse strains exposed to SEB develop strikingly different degrees of lung inflammation despite sharing major SEB-reactive T-cell targets. SEB was lethal in C3H/HeJ mice but not in C57BL/6J mice.
Using high-parameter spectral flow cytometry, single-cell RNA sequencing, and T-cell receptor sequencing, we found that susceptible strains selectively expanded activated CD8+ Vβ8+ T cells and developed greater pulmonary myeloid inflammation. MHC-congenic mice demonstrated that exchanging MHC haplotypes was sufficient to transfer susceptibility or resistance across genetic backgrounds. Structural modeling showed that the resistant I-A^b molecule binds SEB efficiently, indicating that resistance is not simply due to poor toxin binding.
These findings provide insight into why genetically distinct individuals may respond differently to the same inflammatory trigger and may inform studies of differential susceptibility to severe inflammatory diseases such as COVID-19.

Heat D Presenters and Abstracts (Alphabetic Order)

Emma Dixon
Title: Overcoming Cellular Overdrive: A New Drug Target for ALS/FTD
Abstract: The hexanucleotide repeat expansion in C9orf72 gene is the most common genetic cause of amyotrophic lateral sclerosis (ALS)/frontotemporal dementia (FTD). The C9orf72 protein forms a complex with SMCR8 and WDR41 (CSW), which functions as a GTPase-activating protein (GAP) regulating ARF1 and RAB small GTPases. While these findings implicated ARF1-GAP dysregulation in ALS/FTD and supported ARF1 suppression as potential intervention, small molecules that modulate ARF1-CSW interactions are lacking. In this study, we demonstrated upregulation of tyrosine-phosphorylated (Tyr-782) ASAP1 (also known as AMAP1, DDEF1, or Centaurin β4), an ARF-GAP, in human motor cortex of both sporadic ALS and ALS with C9orf72 mutations. Ectopic C9orf72 expression partially mimicked the effects of a known ARF1 inhibitor brefeldin A to disperse Golgi apparatus. Computer-aided rational drug design with high-throughput in-silico screening identified MCULE-5,095,997,944 (Named as SCC944) as a ARF1-CSW modulator. SCC944 binds directly to ARF1 and reduced GTP-bound ARF1 levels upon ARF1 activation. SCC944 demonstrated brefeldin A-like ARF1-dependent alteration of organelle organization including Golgi, microtubules, and mitochondria, but also a protein trafficking pattern that is distinct from brefeldin A mechanism.

These studies identified the first small molecule targeting ARF1-CSW interaction and further support ARF1 modulation as a potential therapeutic approach for ALS/FTD.

Rafid Enayet
Title: Towards Enabling Machines to Detect Defects in Real Time
Abstract: Wire Arc Additive Manufacturing, or WAAM, is a promising technology that can build large metal components layer by layer, like 3D printing on an industrial scale. However, defects can form inside a part during printing, and these defects may remain hidden until the component is inspected after the entire manufacturing process is complete. By that point, considerable time, material, and energy may already have been wasted.

My research explores whether we can recognize the warning signs of these defects while the part is being manufactured. During printing, the WAAM process continuously produces different types of information. The electrical signals tell us how the welding process is behaving, while the sound of the process provides another window into what is happening at the deposition point. Instead of relying on only one source of information, I combine these different signals and use artificial intelligence to learn patterns associated with defect formation. I then compare these predictions with defects identified through detailed 3D X-ray inspection of the finished part.

The results show that combining information from multiple sources can provide a clearer picture of defect formation than relying on a single type of signal. My research also investigates which signals are most important to the AI's decisions, making the predictions easier to understand and trust. Ultimately, this work moves toward a future where metal 3D printers do more than simply manufacture a component—they can also monitor their own quality, recognize when something is going wrong, and help prevent defective parts before valuable resources are lost.

Nandana Goswami
Title: Hell's Kitchen: The Extraordinary Life of Hot Ancient Rocks
Abstract: Earth's oldest continental crust holds important clues about how our planet evolved and how its earliest continents formed. However, billions of years of geological activity have altered many ancient rocks, making their original history difficult to reconstruct. The Pikwitonei Granulite Domain (PGD) in Manitoba, Canada, offers a rare opportunity to investigate this history because its rocks preserve evidence of extreme heating deep within Earth's crust approximately 2.6 billion years ago.

This study investigates how these rocks reached temperatures approaching 1,000°C and what tectonic processes could have produced such extreme conditions. We examined four rocks - two mafic granulites and two metaironstones - from different parts of the PGD. By combining computational thermodynamic models of mineral formation with chemical analyses and mineral thermometry, we reconstructed the conditions these rocks experienced. We also accounted for the effects of partial melting, which can remove material from rocks and obscure their original compositions.

Our results indicate that these rocks experienced temperatures of approximately 950-1,000°C at pressures 0.8-0.86 GPa. Dating garnet minerals suggests that metamorphism began at least 2.6-2.7 billion years ago, providing a timeline for these ancient processes.

A key question remains: what supplied the heat necessary to produce these extraordinary temperatures? Possibilities include hotter early Earth conditions, heat generated within unusually thick crust, or the addition of hot magma from below. Ongoing work on zircon minerals will help refine the timing of these events.

By reconstructing the thermal history of this remarkably preserved ancient terrain, this research aims to improve our understanding of how plate tectonics on earth started and evolved.

Maggie Gu
Title: Digital Twins: Informing Care through Another You
Abstract: Digital twins (DTs) are virtual representations of a physical system created through the continuous input of real-time data. Originally developed for aerospace applications, DT technology has gained increasing attention in healthcare because of its potential to virtually model organs and patients in their entirety and to support the development of precision medicine and personalized care. To examine recent applications of digital twins in pharmacy and healthcare, we reviewed published articles applying DT to real-world data to investigate non-surgical, personalized patient care.

A search query was conducted for articles published between January 2019 to April 2026. Articles were screened in two stages: title and abstract screening, followed by full text review. Information from eligible papers regarding the study's population, disease conditions and DT application were extracted.

Through this process, we identified 20 eligible articles. Publication years ranged from 2021 to 2026 with half being published in 2025. Cancer and diabetes were the most frequently studied conditions. Applications of DTs varied, ranging from predicting lab biomarkers to expanding existing patient cohort data with most papers focusing on its predictive capabilities. This review identifies emerging trends in DT applications and highlights gaps for future research.

Zenawi Hagos Gufue
Title: Who Will Keep Returning to the ER after Breast Cancer?
Abstract: Importance: Unplanned emergency department visits and hospitalizations are common among patients with breast cancer and are associated with treatment disruptions, worse patient experiences, and increased health care utilization. Accurate identification of patients at elevated risk for recurrent acute care use could support targeted supportive care interventions and resource allocation.

Objective: To identify patients at increased risk for recurrent unplanned acute care utilization during the first year after breast cancer diagnosis using routinely available clinical, sociodemographic, and geographic characteristics.

Design, Setting, and Participants: This retrospective cohort study linked South Carolina Central Cancer Registry data, multi-payer claims, and census tract socioeconomic indices. It included non-Hispanic Black and non-Hispanic White female patients younger than 65 years with a first primary breast cancer diagnosis between January 1, 2000, and December 31, 2018.

Exposures: Clinical, sociodemographic, geospatial, and baseline health care utilization parameters documented at or before breast cancer diagnosis.

Main Outcomes and Measures: The primary outcome was the incidence rate of unplanned acute care events (emergency department visits or inpatient admissions) within one year after diagnosis. Model performance was evaluated using discrimination (C-statistic) and calibration metrics (observed-to-expected [O/E] ratio, calibration slope).

Results: The analytical cohort included 8,721 patients (median age, 52.0 years [IQR, 45.0–57.0]; 5,228 [59.9%] non-Hispanic White and 3,493 [40.1%] non-Hispanic Black). Overall, 5,069 patients (58.1%) experienced at least one unplanned acute care event, totaling 15,477 events. Significant predictors of increased acute care utilization included mastectomy vs breast-conserving surgery (adjusted incidence rate ratio [aIRR], 2.02; 95% CI, 1.89–2.16), distant vs in situ stage (aIRR, 2.13; 95% CI, 1.83–2.49), Type 1 vs private insurance (aIRR, 1.69; 95% CI, 1.55–1.84), and non-Hispanic Black race (aIRR, 1.20; 95% CI, 1.13–1.28). The validated model demonstrated good calibration (O/E ratio, 0.95; calibration slope, 0.87), with the highest-risk quintile capturing 38.52% of all acute care events.

Conclusions and Relevance: In this cohort study, a rigorously validated prediction model accurately identified patients at high risk for recurrent acute care utilization, highlighting the impact of surgical morbidity and systemic marginalization. This algorithm provides a reliable triage tool to help oncology practices proactively allocate navigation resources under value-based care models.

Alireza Mashreghi
Title: How We Built an Infinite River in a Small Room
Abstract: Rivers are dynamic systems that continuously adjust their shape in response to flowing water, sediment transport, and changing boundary conditions. These morphological changes influence flood behavior, landscape evolution, and human settlements that have historically developed along river corridors. Despite their importance, understanding how rivers evolve over time remains challenging, largely because rivers are long, open systems that are difficult to replicate under controlled laboratory conditions.
Traditional laboratory studies rely on straight flumes to simulate river flow. However, even the longest straight channels are spatially limited and cannot fully represent the continuous nature of real rivers. This constraint restricts the ability to observe long-

term channel evolution and sediment transport processes that depend on sustained flow over extended distances.
This research addresses this limitation by developing and utilizing an annular flume, a circular channel with no beginning or end—to simulate an effectively infinite river within a confined laboratory space. By transforming a linear channel into a closed-loop geometry, the annular flume allows water and sediment to circulate continuously, enabling extended observation of river-like processes such as sediment movement and channel adjustment.
A critical challenge of circular flow systems is the presence of centrifugal effects that introduce lateral forces not representative of natural rivers. To overcome this issue, a counter-rotating lid was designed and implemented above the flume. By carefully controlling the rotational speeds of the flume and the lid, these artificial forces are balanced, resulting in a stable, longitudinal flow field comparable to that of a straight river channel.
The resulting experimental framework provides a controlled and repeatable environment for studying river morphodynamics under near-natural conditions. By enabling realistic simulation of long river reaches within a laboratory, this approach enhances our ability to investigate how rivers evolve over time. The insights gained from this work contribute to a deeper understanding of river behavior and support improved approaches to river management, restoration, and hazard mitigation.

Sweety Ramnani
Title: Connecting What We See with How the Brain Responds
Abstract: What if studying the human brain took less time preparing data and more time making discoveries?

Neuroscientists use electroencephalography (EEG) to measure brain activity and eye tracking to understand where people look. Together, these technologies offer complementary insights into human attention and cognition. Often since both recordings are from different machines , it becomes tedious or even impossible , many researchers have attempted to do this manually where they may spend not just hours but weeks and even months aligning files, cleaning noisy signals, synchronizing timestamps, and preparing datasets before the real science even begins.

Meet SyneQxis: an open-source, automated pipeline that brings these complex steps together in one streamlined workflow. SyneQxis transforms raw brain and eye-tracking recordings into synchronized, standardized, analysis-ready data. It automates essential preprocessing, generates interactive quality-control reports, and uses high-performance computing to process large datasets efficiently with no manual efforts.

The result? Work that can take hours per participant can be reduced to minutes. Tool has been validated using huge data from the Q1K 1000 familial cohort, SyneQxis has demonstrated its application across three independent hospital sites internationally. Its modular design also allows researchers to adapt the workflow to different experimental tasks without rewriting the code.

Why does this matter? Because brain already has enough mysteries. Data and analysis should not have to be one of them. By reducing repetitive technical work and supporting reproducible data processing, SyneQxis helps researchers spend less time wrestling with data and more time investigating the human mind.

Sarah Wilson
Title: Do we align our phrase/sentence structure choices depending on the other person in the conversation?
Abstract: Humans are social creatures: conversation is the most natural environment for language yet is highly complex to study. Although everyone has a unique speech style, we tend to sound like the people we interact with most frequently. During a conversation, we often change what we say and how we say it depending on who we are conversing with. There are several possible reasons for this. First, matching our conversational partner's speech helps to conserve energy. It's easier to reuse a word or a sentence structure someone else has recently used than to think of another expression. Second, matching our conversational partner's speech serves a social function. Previous research shows that we often reuse the word choices used by people we like or want to like us. It is yet unclear whether we also change our sentence structure choices to match that of the other speaker. My dissertation investigates whether speakers change their sentence structure choices depending on the other person in the conversation. In my study, participants completed two rounds of a collaborative-dialogue spot-the-differences game. Some participants completed both rounds with the same conversational partner; other participants changed partners for the second round of the game. I am analyzing the language samples from both participant groups to test whether there are differences in word choice and sentence structure choice matching depending on conversational partner. This study aims to show that it is not only what we say that matters in conversation, but also how we say it.

Heat E Presenters and Abstracts (Alphabetic Order)

Ozgur Altintas
Title: Differences in Army Combat Fitness Test Performance and Autonomous Exercise Motivation among Army Reserve Officer Training Corps Cadets with Various Functional and Perceived Motor Competence Profiles
Abstract: We identified Reserve Officer Training Corps (ROTC) cadet profiles based on functional motor competence (FMC) and perceived motor competence (PMC) and examined differences in Army Combat Fitness Test (ACFT) performance, autonomous exercise motivation, and ACFT failure rates. Cadets (N = 161; 72.6% male; age = 21.75 ± 3.85 years) completed FMC, PMC, ACFT, and autonomous exercise motivation assessments. K-means clustering identified FMC-PMC profiles. ANCOVAs, controlling for sex, compared ACFT performance and motivation across profiles; chi-square analysis examined ACFT failure status. A stable four-profile solution ($\kappa = .95$) explained 76% of FMC and 72% of PMC variance: high-high, average-low, low-average, and average-average FMC/PMC. Profiles differed in ACFT performance (partial $\eta^2 = .20$, $p < .001$) and autonomous motivation (partial $\eta^2 = .07$, $p = .02$). The high-high profile outperformed all other profiles on the ACFT (ps $< .033$, $d = 0.43–1.34$), while the average-average profile outperformed the low-

average and average-low profiles (ps < .033, d = 0.53–0.91). The high-high profile also showed greater autonomous motivation than the average-low profile (p = .017, d = 0.74). Overall, 26.6% failed the ACFT; failure rates were 65% (low-average), 31% (average-low), 12% (average-average), and 7% (high-high) ($\chi^2 = 41.61$, V = .50, p < .001). FMC-PMC profiles were meaningfully associated with physical readiness and exercise motivation. Developing both FMC and PMC may support long-term military readiness.

Courtney Bailey
Title: Hear Me Out
Abstract: The way we speak shapes how others perceive us before they have fully considered what we are saying. Research has repeatedly documented that listeners judge accented speakers as less credible even when their speech is understood. What remains open is whether socially subordinated varieties of English carry the same penalty, a different one or none at all.

This proposed pilot study will examine how listeners evaluate speakers across four varieties of English: bilingual accented English, African American English, Appalachian English and standardized American English. Twenty listeners will hear forty-eight recordings in which every speaker reads the same context-neutral sentences. The words stay the same. The way they are spoken changes. Listeners will rate each speaker on comprehensibility, credibility, competence and authority, then say where they believe the speaker is from.

Bringing together second language acquisition and sociolinguistics, the study asks whether listeners judge different ways of speaking based on what they hear or on what those ways of speaking have come to mean socially. By comparing these varieties within the same listening study, the research will examine whether different ways of speaking produce distinct patterns of judgment.

Ultimately, this research shifts attention from how people speak to how others listen. If speakers are clearly understood and still judged less credible, competent or authoritative, the issue may not be how they speak. It may be how we have learned to listen.

Emily Baumann
Title: Tides of Anxiety: Is Math Causing an Ebb in Marine Science Majors?
Abstract: Marine science (MSCI) has been a popular degree for many students since the early 2000s; however, most people are not aware of the significant STEM requirements for an undergraduate degree. Enrollment at the University of South Carolina has shown a decline in recruitment and retention in the MSCI degree program over the last decade. Recent studies have begun focusing on math anxiety as a factor in STEM avoidance and attrition. Math anxiety (MA) is defined as feelings of apprehension and increased physical reaction when individuals deal with math and is a widespread, worldwide problem affecting all age groups (Luttenberger et al., 2018). This study aims to better understand MA among undergraduate students majoring in a MSCI degree and determine whether it is a leading factor in students' decision to pursue a different career path. We developed a short survey with items to

assess MA and self-efficacy. For MA, students are asked to rate twenty-five statements (e.g. I feel anxious when registering for a math course) on a 5-point Likert scale from Not at All to Very Much. For self-efficacy, students are asked to rate eight statements (e.g. I expect to do well in my math courses) on a 5-point Likert scale from Not at All true to Very true. We surveyed students in MSCI degree programs at two Universities (University of Delaware). Students at USC majoring in a similar degree program (geology, environmental science, and environmental studies) were also included in this study to compare MA between Earth science degrees.

Zachery Burzee
Title: Beyond the Uniform
Abstract: Depressive symptoms are associated with lower physical activity; however, most evidence derives from between-person comparisons that obscure how symptom fluctuations relate to behavior within individuals over time. This distinction is particularly important among military-affiliated adults, who experience elevated cardiometabolic risk and unique stress exposures related to combat deployment. Clarifying whether deployment history shapes the association between depressive symptoms and moderate-to-vigorous physical activity (MVPA) may inform more precise behavioral health and chronic disease prevention efforts. Service-affiliated adults (N = 99; followed for six weeks) completed repeated assessments of depressive symptoms using the Depression, Anxiety, Stress Scale (DASS-21) and moderate to vigorous physical activity (MVPA) using the International Physical Activity Questionnaire (IPAQ–Short Form). MVPA (minutes/week) was log-transformed to correct skewness. Multilevel mixed-effects models with random intercepts estimated within-person associations using person-mean–centered depressive symptoms, isolating week-to-week deviations from individuals' typical symptom levels. Combat deployments (0–3) were modeled categorically to test cross-level moderation. Models adjusted for age, gender, and BMI. Among participants with no combat deployments, weeks characterized by higher-than-usual depressive symptoms were associated with approximately 9% lower MVPA. Combat deployment history moderated this association. Individuals with two deployments demonstrated a reversal of this pattern, where weeks with elevated depressive symptoms were associated with approximately 22% greater MVPA. For 0 and 3 combat deployments, the n was too small to statistically analyze. Combat deployment history alters how depressive symptom fluctuations relate to physical activity. Rather than uniformly suppressing activity, increases in depressive symptoms may prompt adaptive behavioral responses among some veterans.

Siavash Karbasizadeh
Title: Perfectly Imperfect: Engineering Quantum Materials One Atom at a Time
Abstract: Imperfections are usually something we try to eliminate, but in quantum materials, a single misplaced atom can become a powerful tool. My research explores a layered material in which electrons naturally move between neighboring atomic sheets, and this movement of charge is connected to remarkable quantum behavior, including unconventional superconductivity. Experiments have shown that individual atomic defects can alter this electronic balance, but which defects are responsible—and how strongly they influence the material—has remained unclear. Using large-scale quantum-mechanical simulations, I created a virtual library of more

than 90 possible atomic imperfections and compared their predicted fingerprints with experimental observations. This approach allowed us to identify the most likely defects and revealed that certain imperfections can dramatically change, and even redirect, the movement of electrons between the layers. Rather than treating defects simply as damage, this work shows how they can serve as atomic-scale control knobs for quantum materials. By understanding how individual atoms influence collective electronic behavior, we move closer to designing materials whose properties can be deliberately tuned—one atom at a time.

Kayla Kozak
Title: What If Employers Judge Ability before They See It?
Abstract: Management research on neurodiversity and disability at work has grown rapidly over the last decade, generating important insights into how human differences shape workplace experiences. Yet these literatures have developed largely in parallel, while research within them often examines individual conditions separately and concentrates on a relatively narrow set of conditions. This fragmentation may limit what management theory can explain when multiple forms of neurodevelopmental difference and disability coexist within the same person, as they often do in practice.

This manuscript develops a framework for moving beyond these conceptual silos by examining Down syndrome as a theoretically revealing context. Down syndrome is a chromosomal condition associated with intellectual disability and recognizable physical characteristics, while individuals frequently experience additional neurodevelopmental, physical, and health conditions. Its place within existing neurodiversity and disability taxonomies therefore requires careful delineation, but this complexity also makes Down syndrome valuable for examining what happens when forms of difference that scholarship typically separates occur together.

I argue that considering these intersections can reveal workplace processes obscured by single-condition theorizing, including how combinations of observable characteristics, abilities, and support needs shape categorization, competence judgments, stigma, autonomy, support, and opportunity. By bringing an overlooked population into management scholarship, this project seeks to connect neurodiversity and disability conversations while developing theory that better reflects the complexity of employees' actual lives.

Benedicta Senior Nashiff
Title: Softening Tumor Walls: Making Cancer Treatments Work Better
Abstract: Cancer is not driven only by tumor cells, but also by changes in the surrounding tissue, making it stiffer and creating conditions that help cancer cells spread and resist treatment. An enzyme called lysyl oxidase, or LOX, contributes to this process by strengthening the protein fibers that form the body’s structural support network. Blocking LOX may therefore help make tumors more responsive to cancer therapy.

A promising LOX inhibitor, LXG6403, has shown potential to enhance the effects of chemotherapy. However, its exact mechanism is not fully understood. In particular, it

is unclear how LXG6403 binds to LOX and how it may irreversibly inhibit the enzyme. This question is challenging because an experimentally determined structure of human LOX is not yet available.

To shed light on this mechanism, computer-based molecular modeling was used to investigate the interactions of LXG6403 and closely related inactive compounds with LOX. First, a modeled human LOX structure was evaluated using a 1-microsecond all-atom molecular dynamics simulation to assess its stability. Next, Glide docking and induced-fit docking were used to predict how LXG6403 binds within the LOX active site, the region where the enzyme performs its function. Its predicted binding orientation was compared with those of known irreversible inhibitors and inactive compounds. Covalent docking was then used to model a possible irreversible LXG6403–LOX complex, followed by a 1-microsecond molecular dynamics simulation to assess the stability of the modeled adduct.

The results showed that the LOX model remained stable and that LXG6403 consistently positioned its amine group toward the enzyme's reactive cofactor, supporting a plausible mechanism for irreversible inhibition. Although the compound retained some flexibility, the overall modeled LXG6403–LOX complex remained stable in contrast to inactive compounds. These findings provide a structural hypothesis for how LXG6403 may inhibit LOX and establish a foundation for laboratory studies and development of improved cancer treatments.

Diego Villafane Ortiz
Title: Cancer Cachexia: A Wasting Syndrome That Demands Attention
Abstract: Cancer profoundly affects the cardiovascular system, leading to changes in cardiac muscle mass. The heart may weigh less than normal in a state of cardiac cachexia, whereas chemotherapy-induced cardiotoxicity can increase heart weight due to dilated cardiomyopathy. Additionally, left ventricular hypertrophy may rise as a compensatory response to anemia and hypoxia. To investigate these possibilities, we examined cardiac changes in adult C57BL/6J (wild-type) and ApcMin/+ (cancer) mice of both sexes. Body weight and heart mass were measured to assess the relationship between cancer progression and cardiovascular alterations. We found that colorectal cancer mice exhibited significantly increased heart mass, which correlated with decreased body weight. This heart enlargement is likely driven by pronounced anemia observed in advanced cancer cachexia. Future experiments will evaluate cardiac function in these mice, as we hypothesize that increased cardiac workload is necessary to maintain oxygen delivery. Ultimately, we aim to determine whether improving heart function or treating anemia can mitigate the severity of cancer cachexia.

Yunping Zhoujin
Title: Making a Safer Home for Nuclear Waste
Abstract: Monazite-based (LnPO4) materials have been shown to be excellent waste form candidates, and hence, their facile synthesis is of great importance to facilitate the sequestration of existing nuclear waste. The hydrated form of monazite, rhabdophane (LnPO4•xH2O), plays an essential role in the synthesis of monazite-type materials for nuclear waste applications. However, converting rhabdophane to

monazite requires inconveniently high temperatures near 1000°C. A low-temperature mild hydrothermal acid-promoted synthesis for producing a series of monazite phases will be discussed, with a focus on the pH and time dependence of the reaction. In situ X-ray diffraction studies, performed as a function of temperature, provide insight into the structure transformation process. In addition, to obtain structure information for use in Rietveld refinements, the crystal growth of monazite-type phases was pursued using high-temperature flux crystal growth, a very reliable method for the preparing high-quality single crystals. The synthesis of ternary, quaternary, quinary and monazite-type single crystals and bulk samples will be described. To demonstrate the applicability of these phases as nuclear waste forms, reaction conditions were scaled down for the crystal growth of $AmPO_4$, where americium oxide quantities are limited to 1 mg per crystal growth reaction. The results of these efforts, single crystals of $AmPO_4$, will be presented and discussed.

Heat F Presenters and Abstracts (Alphabetic Order)

Bereket Alano
Title: Counting Surgery: Are Rwanda's Hospital Records Ready?
Abstract: Background: The Lancet Commission of Global Surgery identified major gaps in access to essential surgical services in low- and middle-income countries and proposed core indicators for monitoring surgical system performance. Reliable electronic medical records (EMRs) are important for capturing these indicators, but their use remains limited by infrastructure, human-resource, and interoperability challenges. Rwanda's NSOAP provides an opportunity to integrate surgical indicators into national health information systems, strengthening accountability and improving surgical outcomes

Methods: A concurrent mixed-methods design was conducted in three purposively selected hospitals representing district, level II teaching, and tertiary referral hospitals in Rwanda. Quantitative data were collected using a structured EMR checklist to assess the availability of 11 key surgical indicators, which are are validated by an experts working in the field, while qualitative data were obtained through purposive key-informant interviews. Quantitative data were analyzed descriptively, and qualitative data were analyzed thematically, with findings integrated during interpretation.

Results: Among the 11 key surgical indicators, four were available in all hospitals. Availability was highest at District (54.5%), followed by Level 2 (45.5%) and Referral (36.4%). Documentation completeness was 26–50%, with 93.3% timely reporting and 66.7–100% register consistency. Key barriers were staff knowledge, workload, infrastructure, and EMR limitations, while training and leadership facilitated improvement.

Conclusion: This mixed-methods assessment found that key surgical indicators were partly available in the EMRs of the three Rwandan hospitals. Surgical volume, type of surgery, SSI, and length of stay were documented, while key safety and outcome indicators were largely missing.

Hunter Cox
Title: A Novel TCA-Cycle Derived Biomarker Predicts Inflammatory Status in Mitochondrial Disease

Abstract:
The tricarboxylic acid (TCA) cycle is a set of chemical reactions found within mitochondria that allow dietary molecules to be converted into energy. The TCA cycle molecule fumarate can react with the amino acid cysteine to form a new molecule called 2-succinocysteine (2SC). I have developed a mass spectrometry method to quantify free 2SC excreted from cells and circulating in the blood. 2SC increases in human and mouse diseases including diabetes, cancer, and the mitochondrial disease Leigh Syndrome. Leigh Syndrome is a rare mitochondrial disease that causes encephalopathy, failure to thrive, and motor and respiratory deficits. Patients with Leigh Syndrome often experience a decline in neurological symptoms following bacterial or viral infections. In our lab, we utilize the Ndufs4 knockout (Ndufs4-/-) model of Leigh Syndrome, deficient in Complex I function. WT and Ndufs4-/- mice were injected with the bacterial antigen lipopolysaccharide (LPS) for 6 hours to mimic mild, acute inflammation. In both genotypes, free 2SC levels increased in serum upon LPS administration, with an even larger increase in the Ndufs4-/- mice. 2SC levels also significantly positively correlated with the pro-inflammatory cytokine CCL2, which is involved in macrophage migration and activation. Overall, this data shows 2SC can serve as a biomarker of disease progression and inflammation in mitochondrial disease, with translational potential for predicting inflammatory responses and neurological decline in humans. 2SC provides a novel putative link between mitochondrial metabolic rewiring and immune signaling.

Kevin Enyekwe
Title: Advancing Natural Gas Utilization with Emerging Electrified Reactor Technologies
Abstract: What if the empty space inside a reactor changes what we think a catalyst can do? Natural gas is an abundant resource, but upgrading its main component, methane, directly into higher-value products such as C_2 hydrocarbons remains difficult. Oxidative Coupling of Methane (OCM) offers a direct route to products such as ethane and ethylene, yet the high temperatures required for methane activation also promote competing reactions in the surrounding gas space.
My research first examined whether the gas-filled spaces within a packed reactor influence this chemistry. Using controlled inert-bed experiments at elevated pressure, I showed that increasing reactor-bed empty space increased background gas-phase activity, demonstrating that empty space is an active reaction-engineering variable rather than a passive geometric detail.
Building on this finding, I investigated Radio-Frequency (RF) induction heating as a way to selectively generate localized heating within an OCM reactor bed with heat significantly confined to the FeCrAl monolith catalyst surface alone instead of heating the entire reactor volume conventionally. RF heating substantially reduced background gas-phase activity under the tested conditions, while retaining strong catalytic performance.
Together, these studies show that methane upgrading depends not only on catalyst chemistry, but also on where reactions occur and where heat/energy is delivered. By controlling both the reactor environment and heat delivery, this work provides a pathway toward more reliable catalyst evaluation and more selective methane conversion.

Mahtab Ghasemi Dogaheh
Title: The fight against cancer: Can peptides make a difference?
Abstract: Cyclin F is a unique cell cycle regulator belonging to the F-box protein family. Unlike canonical cyclins, Cyclin F does not associate with CDKs; instead, it functions as the substrate recognition component of the SCF (Skp1–Cullin1–F-box) E3 ubiquitin ligase complex, directing specific proteins for ubiquitination and subsequent proteasomal degradation. Dysregulation of the ubiquitin–proteasome system (UPS) has been implicated in the development and progression of several malignancies, including breast, hepatocellular, lung, renal, pancreatic cancers, and familial Hodgkin lymphoma. These observations suggest that Cyclin F may represent both a prognostic biomarker and a potential therapeutic target. However, strategies to directly interfere with Cyclin F–substrate interactions remain underexplored.
To interfere with Cyclin F substrate recognition, we designed a series of linear and cyclic peptides based on the structural features of the E2F1 binding motif and previous experience with peptide inhibitors of cyclin A. Cyclization was introduced to improve conformational stability and structural rigidity. In addition, molecular docking studies were performed using Glide to examine the binding interactions between the designed peptides and Cyclin F.
A series of linear and cyclic peptide analogs was successfully synthesized with high purity. Cyclization strategies were effective in generating conformationally constrained peptides with improved structural stability. Analytical HPLC and mass spectrometry confirmed the expected molecular masses and high purity of all synthesized compounds. Molecular docking studies indicated favorable interactions between the designed peptides and the Cyclin F binding site, supporting their potential as substrate recognition inhibitors. Further studies are planned to validate peptide binding using biochemical assays and to evaluate their biological activity in relevant cancer cell lines.
This work demonstrates the successful design and synthesis of peptide scaffolds targeting Cyclin F substrate recognition. Together, these findings establish a robust platform for subsequent biochemical and cellular evaluation.

Koryo Kwao
Title: Molecular Principles of Protein Fold Switching
Abstract: Proteins are key molecules that control digestion, immunity, and regulation of hormones in the human body. For a long time, scientists believed that a protein's sequence, that is the arrangement of its amino acid building blocks, contained all the information necessary to determine the protein's shape. The consensus was that each protein sequence folded into one preferred three-dimensional shape or structure. We now know that some proteins can break this rule. These proteins are known as fold-switching proteins. Here, I refer to them as shape-shifting proteins because that is essentially what they do. They change their three-dimensional shape with very subtle changes in external conditions or the sequence. My research involves the design and study of synthetic fold-switching proteins, which are essentially artificial shape-shifting proteins. Using chemistry, we hope to understand the actual rules that determine a protein's structure and function in a biological system beyond just the sequence. The findings of these studies will improve

computational prediction of protein structure and our understanding of certain diseases.

Morgan Sharbaugh
Title: Spatial variability of persistent organic pollutants in Tampa Bay
Abstract: Tampa Bay is the largest estuarine system in Florida and is home to ~3.4 million people. Furthermore, the bay is a high tourism area, filled with beachgoers and sport fisherman. Due to its highly urban nature, the bay has the potential to accumulate contaminants. Wastewater treatment plants fail to remove the entirety of pharmaceuticals, and personal care products leading to plasticizers, and pharmaceutical contamination in the environment. Beyond wastewater treatment, human activities can lead to other contaminants, persistent organic pollutants (POPs), entering the environment as well. POPs are resistant to degradation, and through the analysis of sediments, legacy pollutants, such as DDT can be observed. Most POPs are hydrophobic and bind to sediments instead of remaining in the water column, however, bottom dwelling organisms, and sediment resuspension can circulate POPs through the food chain, posing a risk beyond sediment contamination. Sediment characteristics such as the amount of organic matter present, pH, and surface charge affect the adsorption of POPs to the sediment, therefore, these characteristics should be examined as well. This thesis aims to quantify the concentration of POPs and the sediment characteristics that can impact them from Tampa Bay surface sediments, helping to focus future monitoring efforts to where they are needed most.

Katherine Stenning
Title: What Counts as Valuable? NIL and the Shaping of Athletic Identity in Women's College Sport
Abstract: Name, Image, and Likeness (NIL) policies have transformed collegiate sport, with women athletes accounting for 60% of non-football NIL activities (Opendorse, 2025). Yet commercial success depends on visibility, branding, and audience engagement rather than athletic performance alone (Cocco et al., 2023; Su et al., 2023). Women athletes have long been framed through appearance and femininity instead of competence (Cooky et al., 2015; Fink, 2015), and NIL research has focused on predicting commercial success rather than examining how commercial value is socially produced. This study examines how NCAA Division I women student-athletes understand what is commercially valuable within NIL, how they respond to marketplace expectations, and how this shapes the expression and negotiation of their athletic identities. The study adopts a critical postfeminist framework, which positions femininity as a project of self-management, visibility, and self-branding (Banet-Weiser, 2018; Gill, 2007) that individualizes responsibility for success and failure (Gill & Orgad, 2018; McRobbie, 2008). Toffoletti and Thorpe's (2018) "athletic labor of femininity" extends this to sport, capturing the work women do to balance athletic competence with marketable femininity, which are dynamics that are evident in women athletes' NIL branding (Scovel, 2025; Wanzer et al., 2025). Using a constructivist design, semi-structured interviews will be conducted with Division I women student-athletes and analyzed using reflexive thematic analysis (Braun & Clarke, 2019). The study shifts attention from what predicts

commercial value to how commercial value is constructed, and how gender inequality may be reproduced, negotiated, or resisted within the NIL marketplace.