UTC Spring Research and Arts Conference 2025 Online Program

Advancements in Gunshot Detection: AI, IoT, and Deep Learning for Real-Time Response
Vijayalakshmi Kumarasamy

Gun violence is a growing public safety concern, highlighting the need for fast and accurate gunshot detection systems (GDS) to support real-time law enforcement response. This review explores the integration of deep learning (DL), artificial intelligence (AI), and the Internet of Things (IoT) in enhancing GDS performance. It summarizes recent advances ranging from physics-based acoustic modeling to data-driven methods like CNNs, RNNs, and hybrid neural networks, along with edge-based IoT frameworks for low-latency alerts. The review also examines challenges such as differentiating gunshots from similar sounds, ensuring robustness across environments, and addressing surveillance-related privacy concerns. Case studies from urban, indoor, and wildlife deployments illustrate real-world applications. By synthesizing current methods and deployment strategies, this work identifies emerging research opportunities to guide the development of scalable, ethical, and real-time safety solutions.

YouYube Video Link: https://youtu.be/NNXk5iZ4idA

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Use of the RE-AIM Framework to Evaluate the Implementation of Public Health Strategies for COVID-19 in a Community Setting
Emily Holden

Health disparities, particularly among racial and ethnic minority populations, were exacerbated by the COVID-19 pandemic due to factors like social determinants of health, vaccine hesitancy, and pre-existing health conditions. Local government leaders within an urban city received federal funds to address these disparities by improving health literacy and engaging communities through culturally responsive outreach and education in Black and Latinx within a mid-sized city in the southeastern United States.

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A Comparison of Misbehavior Detection Systems forBasic Safety Message Attacks in VANET
Colby Cook

Vehicular Ad-Hoc Network(VANET) is the future of a better transportation system. The success of the network depends on the ability of vehicles and roadside units to be able to communicate and successfully detect and avoid potential dangers. With this network though comes vulnerabilities and the opportunity for one to infiltrate it and cause havoc. The Framework for Misbehavior Detection(F2MD) serves as a simulation of a VANET environment and attacks that can happen within it. The use of a Misbehavior Detection System (MDS) can help in detecting attackers by analyzing the Basic Safety Messages (BSMs) that are sent through the system. Machine Learning (ML) and Deep Learning (DL) models can be used as MDSs, and my research looks to
analyze and compare the two models' efficiency overall.

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A LEGO Based Low-Cost Autonomous Scientist: Using Machine Learning to Derive the Henderson-Hasselbalch Equation
Matthew Boone, Samuel Glandon, Ike Deitch, April Horn

The University of Tennessee-Chattanooga chapter of the Society of Physics Students (SPS) has constructed a LEGO-based, low-cost autonomous scientist (LEGOLAS). It is a robot built upon a cartesian gantry that uses machine learning techniques to autonomously derive the Henderson-Hasselbalch equation. LEGOLAS accomplishes this by via autonomous titration experiments, which reduces the tedious steps involved in typical acid-base experiments. Originally, it was developed in collaboration between NIST and UMD scientists as a teaching tool to introduce students to machine learning techniques and algorithms. This project was our 2024 Research Project and was funded by the SPS National Chapter Research Award. While working on this project, we learned about 3D printing, Raspberry Pi computers, Arduino computers, pH sensors, Bayesian statistics, Gaussian processes, and other topics that are not usually taught in undergraduate curriculum. We plan to use this model to introduce students to machine learning, to develop other autonomous experiments, and for departmental recruitment and outreach.

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A non-singular fractional-order logistic growth model with multi-scaling effects to analyze and forecast population growth in Bangladesh
Mohammad Sharif Ullah

This research is primarily concerned with data analysis employing the nonlinear least squares curve fitting method and the mathematical prediction of future population growth in Bangladesh. Available actual and adjusted census data (1974–2022) of the Bangladesh population were applied in the well-known autonomous logistic population growth model, and we found that all data sets of the logistic (exact), Atangana-Baleanu-Caputo (ABC) fractional-order derivative approach, and logistic multi-scaling approximation fit with good agreement. Again, the existence and uniqueness of the solution for fractional-order and Hyers-Ulam stability have been studied. Generally, the growth rate and maximum environmental support of the population of any country slowly fluctuate with time. Including an approximate closed-form solution in this analysis confers several advantages in

assessing population models for single species. Prior studies predominantly employed constant growth rates and carrying capacity, neglecting the investigation of fractional-order methods. Thus, the current study fills a crucial gap in the literature by introducing a more formal approach to analyzing population dynamics. Therefore, we bank on the findings of this article to contribute to accurate population forecasting and planning, national development, and national progress.

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A Study of Faculty-Course Assignments through a Mathematical Approach in the Data Analytics Department at UTC
TING GAO

In this project, we present an integer programming (ILP) approach to optimize faculty-course assignments in the Data Analytics Department at UTC. This optimal assignment model aims to minimize mismatches between course requirements and professor expertise. The optimization framework ensures that each course is assigned to exactly one professor while respecting faculty availability and qualification constraints. The model enforces an equitable workload distribution to avoid overburdening individuals. Historical data from the Data Analytics Department in the academic years of 2024 Fall and 2023 Fall in UTC is used to develop the model, and the results are compared with the actual course schedule and instructor assignment. By integrating these constraints and objectives, the proposed approach enhances facility utilization efficiency and faculty satisfaction.

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Achieving outcomes in analytical chemistry while focusing on active learning and self-care
Gretchen Potts

Pedagogy can support self-care and student outcomes in the chemistry classroom. In fact, intentional course design to support the whole student may improve overall student outcomes. A quantitative analysis lecture course that was designed synchronously online during COVID was transitioned to a face-to-face environment in an active learning classroom. Discussion boards were converted to daily group work that highlighted collaboration. Small adjustments were implemented to the course and syllabus design to help students manage stress and to encourage self-care. Frequent anonymous check-ins were used to monitor student learning progression. Additional anonymous prompts encouraged students to share study tips, how to de-stress, and where to get help. Though not mandatory, class-wide group messaging was available for student questions and to provide additional mental health support. Campus resources for mental health were shared and classroom activities included time for decompression. This talk will detail how small changes in course and syllabus design were implemented to support student self-care while incorporating active learning. These modifications also helped faculty to manage the student concerns more efficiently, providing self-care for the professor as well. Though implementing large course design changes can be overwhelming, these small adjustments improved student success without much faculty effort.

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Activated Carbon Derived From Ground Coffee Waste for Atmospheric Water Generation
Mohammed Mohammed

This study explores the production of activated biocarbon from spent coffee grounds for atmospheric water vapor capture through adsorption. Spent coffee grounds were selected due to their abundance, sustainability, and cost-effectiveness, offering a dual solution to global water scarcity and coffee waste management. The biocarbon production process involved pretreatment, carbonization, characterization, and chemical activation. The raw coffee waste was first washed, dried, and then pyrolyzed at 550°C in a tube furnace for 1.5 hours, yielding 14% carbon. This process enhances porosity and surface area, key properties for moisture adsorption.To further improve water capture performance, the biochar is chemically activated using KOH. Characterization techniques, including scanning electron microscopy for surface morphology and Fourier-transform infrared spectroscopy for functional group analysis, are employed to assess structural and chemical properties. Additional analyses, such as BET surface area, dynamic vapor sorption, and thermogravimetric analysis, will further evaluate adsorption potential and material stability. The findings are expected to provide insights into the feasibility of utilizing coffee-derived biocarbon as an efficient water adsorbent, contributing to sustainable
water harvesting.

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Adaptive Bowling - Design For Independence
Ava Johnson, Alex Caldwell, Abigail Laue, Ryan Schug, Nicholas Carreon, Graham Copeland

Jinlin Baker, a special education teacher at Red Bank Elementary School and the client for this product, has had trouble including her students in the school's bowling unit. Her 11 students, the users of the project, have multiple different disabilities including physical disabilities, cognitive impairments, and visual impairments. The current bowling devices available to Mrs. Baker are insufficient and burdensome for her and her students to use without much assistance. Due to this, she has requested an adaptive bowling device that allows her students to participate in bowling safely and easily. Design For Independence has tasked the project team with designing this device for Mrs. Baker and her students. Using the engineering design process, the team is able to produce such a design.

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Adulting in the Outdoor Industry: A state of the industry report from Chattanooga
Margaret Blevins

Adulting the Outdoor Industry: A state of the industry report from Chattanooga
For over two decades, the Outdoor Industry Association has provided data and reports on participation, trends, barriers and economic impacts of the outdoor industry in the United States. These reports have garnered much attention, even resulting in federal tracking of the industry as a satellite account through the Bureau of Economic Analysis (BEA). Increases in participation and diversity, as well as burgeoning economic revenues tell a promising story. While State and National data provide valuable information about the outdoor industry as a whole, these reports may be too

broad and abstract to affect change at the local level. As the outdoor industry matures, regional analyses will better inform local decision-makers about challenges, opportunities, and how policies and initiatives can promote sustainable growth.
As such, this presentation will provide a current state of the outdoor industry in the Chattanooga region. In the spring of 2024, a survey was distributed to all outdoor businesses (for profit and non-profit) in the vicinity of Hamilton County, TN. A 60% response rate was achieved, providing insight into employment, programming and services, diversity and equity, barriers, and industry standards. Findings indicate that the outdoor industry is very active, serving over half a million clients each year, evenly split between for and non-profit business models, though heavily reliant on part-time employees and volunteers. Diversity of employment and leadership is robust, though leadership of females ($F = 2.55$, $p = .09$) and people with disabilities ($F = 4.05$, $p = .038$) is significantly higher among non-profit companies. Non-profits are more likely to own gear and provide programming for environmental education and basic trail activities (e.g. hiking), while for-profit companies have water-based, vertical and biking gear. Some type of gear share is highly favored by non-profit partners, as a way to achieve access without purchasing or maintaining costly equipment. While programming is provided to a diverse clientele, it is often conducted in separate groups. A significant negative correlation between white and black clients ($r = -0.742$, p
These findings provide a baseline state of the industry for a specific region of the country that prides itself on the support and promotion of outdoor activities for all residents. The reliance on non-profits, part-time workers, and volunteers is indicative of the unsustainable nature of the leisure and hospitality industry at large. Maturation will be difficult without continuity of workers and services in such a transient industry. Diversity is a priority, and efforts for outreach and inclusion are evident. The unintentional separation of ethnic groups by program and location may be slowing the adoption of outdoor recreation into the regular routine of diverse populations. Gear and equipment are constant challenges that plague outdoor programmers, though community initiatives (e.g. gear libraries) may alleviate some of the pressure in that regard. As the industry develops, these baseline stats will provide invaluable data to measure trends and outcomes from which to measure long-term progress.

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African American Arts & Cultural Center Fountain Design
Ethan Bowden, Emily Severs , Damaris Ramirez, Kara Kimes, Landon Norman

The African American Art & Cultural Center in Tampa, FL features an aesthetic water element designed to resemble a traditional African community. From an engineering perspective, the project involves estimating the volume and initial target circulation flow, managing water level fluctuations, determining flow direction and discharge, and implementing appropriate water treatment systems. Additionally, the design must comply with standard codes and structural requirements to ensure both functionality and safety.

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Agroforestry From Above: A Case Study in Geospatial Applications at Sequatchie Valley Institute
Alex Garretson

Conventional monocrop agriculture requires immense amounts of additives in the form of pesticides and fertilizers, and has a homogenizing effect on landscapes. These factors lead to myriad detrimental environmental impacts including a decline in biodiversity and soil integrity, and increased eutrophication due to runoff. Agroforestry is an alternative approach to contemporary agricultural practices that integrates crops into the existing landscape, preserving biodiversity. Included among agroforestry's potential benefits is its tendency to preserve and promote existing ecosystem services rather than degrading ecosystems to the point of requiring chemical additives. Conversely, the heterogeneous nature of agroforestry landscapes makes their remote sensing and mapping inherently more difficult than that of homogenous monocrop landscapes that tend to lack tree cover. The Sequatchie Valley Institute (SVI) is a nonprofit organization on a land trust in Whitwell, TN of over 300 acres with an emerging agroforestry system (AFS) yet to be mapped. This study aims to use imagery acquired with an unmanned aerial vehicle (UAV) to provide, firstly, a map of the current AFS; and, a suitability model to classify SVI land according to its agroforestry potential. These deliverables will help guide AFS planning and implementation at SVI, and may provide a replicable workflow for AFS planning in similarly sized areas.

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AHEAD-RN: Addressing Health Equity, Access, and Diversity through Nursing Simulation Experiences and Partnerships
Brooke Epperson, Rosebelle Peters, Tessa Baker-Mullinax, Jenny Holcombe, Maggie Duckworth

Background/Intro:
Patient healthcare needs are becoming more complex, especially within specific populations experiencing aging, mental health difficulties, and/or homelessness. These experiences are exacerbated in medically underserved areas (MUAs) where residents face greater socio-economic disparities and poorer health outcomes than most US citizens.

Purpose:
Addressing Health Equity, Access, and Diversity through Nursing Simulation Experiences and Partnerships (AHEAD-RN) aims to increase the capacity and preparedness of BSN students to address the health care needs of MUAs in ten counties in the Southeast. Project activities addressing this purpose include expanding partnerships for diverse clinical experiences; recruiting diverse students and nurturing desire to enter MUAs upon graduation; implementing simulations using simulated patient actors (SPAs); and engaging students in culturally inclusive care scenarios.

Methods or Processes/Procedures:
In Y1 of AHEAD-RN, three new, clinically diverse partnerships were established allowing students to: (1) engage with chronic and acute health conditions, untreated mental health conditions, and homelessness; (2) provide basic wound care and/or identify available resources for homeless individuals; and (3) offer foot care and education via a mobile clinic.
All BSN students participated in simulations using SPAs. Topics included palliative care, care of older adults, and homeless patients. All participants completed post-simulation surveys evaluating the simulation experience, facilitators, and SPAs.

Results:
In Y1, 100% of eligible students (99) engaged in enhanced simulation activities and benefited from clinical placements in new/expanded sites. Initial simulation feedback has been positive with students reporting increased self-efficacy in treating aging populations and increased student confidence. AHEAD-RN will ultimately produce nine new simulations focused on aging, mental health, and homelessness. Faculty training for providing care to rural and low-income individuals took place in March 2024, and evaluations indicate a significant increase in confidence in caring for vulnerable populations and accessing resources for patients in MUAs.

Conclusions/Implications for Practice:
BSN students need to have the skills to address complex patient needs, specifically in aging, mental health, and homeless populations. Using a multi-method approach (clinical placements, simulations, learning activities), BSN students are challenged to engage with the intersection of patient needs and population-specific characteristics

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AI and Career Optimism
Aarna Srivastava

The general purpose of this research is to analyze whether the increased implementation of AI in various jobs creates fear in college students from three different majors: Pre-med, computer science, and business majors. The goal of the study is to understand whether or not AI in jobs makes college students think that they will have a harder time getting jobs, and essentially how it creates fear for them.

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Alternative Adsorber Swap Sequence
Wolday Abrha

The Distillation/Tank Farm Department at Wacker Polysilicon has been looking to improve its adsorber exchange process to enhance safety, sustainability, and reduce raw material costs. The goal is to design and propose new workflows that do not compromise product quality. After a thorough analysis of the current process based on existing data, an alternative process flow is provided and being considered for implementation.

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Ammo Can Bluetooth Speaker – Rugged, Affordable, and Built for Adventure
Landon Sims

In a market saturated with portable Bluetooth speakers, outdoor enthusiasts often face the challenge of finding a product that balances durability, performance, and cost. Many high-end rugged speakers come with price tags exceeding $300, yet still fall short when it comes to true outdoor resilience and customization. This project focuses on creating a budget-friendly, durable alternative, a homemade Bluetooth speaker built from a repurposed military-grade 50 cal. ammo can.
The core objective was to create a speaker that could withstand harsh outdoor environments, whether fishing, camping, or off-roading, without sacrificing sound quality or style. The ammo can offer the perfect starting point due to its rugged, water-resistant, and dustproof design. At a total cost of just $145, We was able to build a fully functional Bluetooth speaker that meets our specific needs and aesthetic preferences.
The final product is water and dust resistance, ensuring reliable performance in outdoor settings, and offers a Bluetooth range of up to 40 feet. The design also retains the original military look, giving it a unique, rugged appearance that stands out from mass-produced models.
This presentation will cover the entire design and build process, including the selection of components, modifications to the ammo can for optimal sound performance, and the challenges faced in achieving water and dust resistance while maintaining audio quality. We will also discuss the testing phase, where the speaker was put through real-world scenarios, exposure to dust, splashes, and outdoor conditions, to ensure it met the durability and performance standards we set.
By repurposing existing materials and focusing on cost-efficiency, this project highlights the potential of DIY tech solutions to outperform expensive market alternatives. It also serves as an example of sustainable innovation through upcycling and creative engineering.
Attendees will gain insight into the DIY fabrication process, material considerations, and problem-solving techniques used throughout the build. This project not only demonstrates how functional and durable tech can be built on a budget but also encourages others to explore hands-on approaches to create personalized solutions that align with their specific needs.

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An Intelligent Active Brace System for the Treatment of Scoliosis
Chase Guttu

Adolescent Idiopathic Scoliosis (AIS) is a spinal deformity affecting millions worldwide, often requiring bracing to prevent progression. Traditional rigid braces can be uncomfortable and limit mobility, leading to poor patient compliance.
This research focuses on developing an active scoliosis brace that dynamically adjusts corrective forces using a harness-based design. aiming to improve comfort, compliance, and treatment effectiveness. This approach demonstrates the potential of advanced orthopedic technology in scoliosis management.

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Analysis of Newly Acquired Stromatolite Samples from Northwest Georgia
Lyra Pala

During the spring and summer of 2024, we acquired several samples of silicified stromatolites from Cambrian-Ordovician system rocks of Northwest Georgia from an amateur rock and fossil collector from Resaca, Georgia and from a curator at the Tellus Science Museum in Cartersville, Georgia. Stromatolites are layered sedimentary structures produced by the actions of microbes and are sometimes more generally referred to as microbialites. A total of 12 samples were analyzed macroscopically during summer 2024 using illustrations and descriptions of microbialites published by a group of researchers from Australia in 2020. Seven of these samples were selected for thin sectioning and those thin sections were made by a commercial thin sectioning company in Utah. Those thin sections have been imaged using a sophisticated petrographic microscope and associated software package. The merged mosaic images of each whole thin section will be analyzed microscopically using a checklist written by the same Australian researchers. The morphological characteristics of these stromatolites will be compared to descriptions of other stromatolites from Northwest Georgia and from the broader literature. Describing the stromatolites using the checklist will allow descriptions to be made from a language to describe microbialites. There is no set universal language to describe microbialites. Little has been published about the early Paleozoic stromatolites from Northwest Georgia and we hope that these descriptions will help fill in a much neglected gap in our knowledge of these remarkable sedimentary structures.

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Appalachian Food in the American Imagination: White Trash Parties and Performative Ruralness, 1950 to 2016
Mark Johnson

I explore the origins and development of the White Trash Party, especially its apparent link to the Old South Weekends and the Robert E. Lee Balls that populated southern college campuses from the 1950s to the Present. The White Trash Party, which coincided with these formal affairs before spreading beyond campuses, allowed an opportunity for collegiate youth to revel in class distinctions and yet perform the white racial solidarity central to the theme of Confederate-themed events.

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Artificial Wetlands Provide Hope for Municipal Sewage Effluent Treatment and Biodiversity Declines
William Bryant

Wetlands provide habitat for a multitude of species worldwide and exist on almost every continent. They act as water filtration systems, cycle organic and inorganic nutrients, prevent flooding and mitigate storm damage. As the human population continues to expand and cities continue expanding, more infrastructure is needed for water treatment and providing green spaces for citizens to enjoy. This literature review analyzes the current data on the effectiveness of constructed wetlands in the treatment of sewage effluent and how they impact the biodiversity of the local ecosystem. The databases Web of Science, ProQuest and Agriculture, Ecosystems and Environment were utilized. The key words “constructed or artificial wetlands”, “effluent

treatment", "biodiversity", "land development", and "agricultural runoff" yielded 100 articles and were selected based on relevance and publish date of 2010. Most studies support the notion that constructed wetlands efficiently treat wastewater through biotic and abiotic nutrient cycling, decreasing water temperature and decomposition of solid waste. Constructed wetlands provide habitat for aquatic, terrestrial and amphibian species and may be utilized to re-establish native populations if a thorough history of the desired ecosystem is understood and considered during planning.

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Assessing the Adequacy of the Diagnostic Standard of Care for Congenital Syphilis and Associated Risk Factors and Legislation.
Bryce Danjou

* Congenital syphilis is the vertical transmission of syphilis (Treponema pallidum) from an infected pregnant woman to a fetus through the placenta or at the time of delivery. Current rates of congenital syphilis are increasing year over year nation wide and are particularly high in Tennessee which observed at 400% increase in the number of cases from 2017 to 2022. The CDC recommends testing for syphilis with both treponemal and non-treponemal antibody screening at the first obstetrical visit, in the third trimester, and at delivery regardless of patient risk category. Several studies have shown that the current criteria for those "at risk" is arbitrary and only testing individuals based on their risk category has resulted in delay in diagnosis and treatment.
* The goal of this project is to assess the data related to congenital syphilis nation wide and to provide a concise resource of compiled studies to show Tennessee legislators that state wide legislation for increased syphilis testing in pregnancy may result in a reduction in the number of cases.
* I am utilizing publicly available databases and public health reports to compile the case numbers and data that will allow for a larger scale review of policy relating to congenital syphilis testing criteria.

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Assessing the Effect of Social Media on Mental Health in Undergraduate Nursing Students
Erin Joiner, Bailey Rynor, Brieanna Tyler, Jenny Holcombe

Increased use of social media has been linked to increased anxiety, depression, and negative self-image. The purpose of the current study was to gain a better understanding of this relationship in undergraduate nursing students at UTC. Participants completed measures of anxiety (GAD-7), depression (PHQ-9), and social media use (BSMAS). Descriptive analyses and correlations were run to explore potential relationships. Results indicate a significant relationship between presence of anxiety symptoms and both presence of depression symptoms and social media use. However, overall levels of depression and anxiety were relatively low compared to previous studies with this population. Additional research is necessary for continued understanding of the interconnectedness between these three variables.

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Assessing the Fidelity of AI-generated Lessons for Elementary-grades STEM Topics
Deborah McAllister, Jennifer Lynberg, Jason Gordon, Anna Grace Sorrells, Taylor Behrman

Teachers collaborated using MagicSchool, an AI tool, for generating lesson plans for elementary-grades mathematics, science, and technology topics. The lessons were evaluated for fidelity to content and lesson plan components. The problem to be answered was two-fold: What is the fidelity of AI-generated lessons for elementary-grades STEM topics? What are teacher perceptions of using an AI tool? Teachers evaluated the standards-based, AI-generated lesson plans. Scores for lesson plans were compared by content area (mathematics, science, technology) and elementary level (lower versus upper) to determine if fidelity is better for a particular content area or level. Teacher perceptions, regarding the use of an AI tool, were surveyed. Results showed significant differences in score for science lesson plans, with lower elementary grades lessons scored higher than upper elementary grades lessons, and for technology lesson plans, with upper elementary grades lessons scored higher than lower elementary grades lessons. There were no significant differences in score of mathematics lesson plans, with regard to grade level. There were significant differences in score for lesson plans by content area, with science lessons scored higher than technology and mathematics lessons, and technology lessons scored higher than mathematics lessons. Qualitative results for the survey showed an increase in participants' confidence in their understanding of AI, participants learned more ways AI could aide them, and workshops were effective in dispelling common misconceptions about AI use in schools.

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Assistive Mobile Robot Design for Enhanced Elderly Mobility Safety
Isaac Wheeler, Trevor Kight, Ibrahim Al Quassar

Introduction:

Mobility challenges and the risk of falls significantly impact the quality of life for the elderly. Current mobility devices have many issues in regards to safety, quality, and price.

Project Goal:

This project introduces an Assistive Mobile Robot, an advanced walker that enhances mobility, safety, and user experience through motorized assistance and fall prevention mechanisms. Designed for simplicity, safety, and sustainability, the walker features lightweight construction and adaptive speed control.

Method Description:

Key components include a microcontroller, rear hub motors, 24-volt batteries, an accelerometer, and a gyroscope. This innovation advances assistive technology, promoting mobility, independence, and safety for elderly users.

Conclusion:

The Assistive Mobile Robot enhances mobility, safety, and independence for the elderly by integrating motorized assistance and fall prevention. Its lightweight design and adaptive speed control ensure ease of use and reliability. By addressing safety and quality concerns, this innovation improves the overall quality of life for users.

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Associations of Inertial Measurements with Pre-season Injury Occurrences among College Football Players

Alex Harrison, Rene Preciado

The association between workload and injury risk is poorly understood. It has been found that tissue failure occurs when the load exceeds tolerance, but tissues may also adapt to enhance tolerance, decreasing the overall risk of injury. Currently, there are two conflicting camps regarding player load and injury susceptibility in athletes. On the one hand, some studies find that a high average load may lead to increased susceptibility to sustaining an injury. However, other research states that an increased load can lead to resilience, effectively decreasing injury risk. Research is also lacking to determine whether wearable inertial measurement unit (IMU) data might provide useful metrics for predicting injuries. The purpose of this research is to analyze data collected during college football practice sessions from wearable IMUs across two separate seasons to assess a possible relationship between training load or monotony to occurrences of core and lower extremity injury (CLEI) across pre-season practice sessions and regular season games. Data was collected from 102 male Division 1 football players across two seasons using catapult IMUs. Additionally, injury documentation was done through Sportsware electronic injury documentation system. Data from the units, along with injury data, was then analyzed using SPSS software. Results of data analysis show a strong association between a low Player Load standard deviation, which is variability between practice sessions, and increased injury risk. Risk is also compounded when various other factors are implemented.

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Automated Trash Sorting Robot

Samuel Pindrock, Merrick Smith

Trash accumulation is a persistent and growing issue in large cities, negatively impacting both the environment and public perception of urban cleanliness. The presence of litter on roadsides, in parking lots, and even inside residential areas not only diminishes the aesthetic appeal of a city but also poses serious environmental and health hazards. At the University of Tennessee-Chattanooga (UTC), the department of Engineering Management & Technology Mechatronics program seeks to apply its expertise in robotics and machine learning to address pressing environmental concerns. Our project focuses on developing an autonomous trash-sorting robot that leverages advanced sensors and artificial intelligence to identify and separate different types of waste. This initiative serves multiple purposes: expanding our knowledge of machine learning, contributing to a practical environmental solution, and refining existing trash-sorting technologies. The research phase of our

project has involved extensive literature reviews on machine learning applications in waste management, as well as an analysis of similar robotics projects undertaken by other engineers. By studying previous implementations, we can build upon their successes while addressing existing limitations. We envision future research expanding the capabilities of environmental robotics, like LiDAR, conductive sensors, and GPS. Ultimately, our project aims to demonstrate how robotics and machine learning can be utilized to create practical solutions for real-world problems.

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Benchmarking Variational Autoencoders for Single-Cell RNA-Seq on PBMC Data
Caleb Hendren

Dimensionality reduction is essential for analyzing single-cell transcriptomics data, but standard methods such as PCA may miss nonlinear biological patterns in complex datasets. Generative AI models such as variational autoencoders (VAEs) have been shown to preserve these relationships, there are very few publications that benchmark existing models using a standardized dataset. This project benchmarks these models using PBMC data from 10x Genomics processed with Scanpy, testing if they better preserve biologically relevant variation than PCA. Methods include on normalized data, followed by UMAP visualization, Leiden clustering, and marker gene analysis.

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Beyond Force: Simone Weil's Ethics of Attention as a Framework for Postcolonial Development
Dustin Wilde

Simone Weil's concept of *la force* (force) and her proposed practice of *attention* offer a profound ethical framework for rethinking international development, particularly in postcolonial contexts. By centering the experience of the oppressed and rejecting collective identities that perpetuate power structures, Weil's philosophy provides a critical lens through which international development can be reimagined in the service of genuine human dignity.

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Beyond the Glass Ceiling: Career Advancement Strategies for Mid-level Women in Student Affairs
Jalonda Thompson

The specific aim of this paper is to provide an overview of the literature on the push and pull factors that influence women's choices to either opt in or opt out of career advancement in student affairs (Coetzee & Moosa, 2020; Harman & Sealy, 2017). Women, especially Black women, are underrepresented in senior level administrator positions in student affairs (American Council of Education, 2024). Student affairs as a field is at a critical point in history as the demographics of the United States (US) change to foster an inclusive learning environment that reflects the increasing racial and ethnic diversity in the US (Lopez, 2006). Hiring managers and key decision makers in colleges and universities have the opportunity to identify, develop, and advance women to fill senior level administrator positions historically occupied by White men (Shults, 2001). A literature review

was conducted using peer-reviewed research articles to identify factors influencing career advancement for mid-level women in student affairs. The preliminary findings reveal factors influencing career advancement, including barriers such as the glass ceiling phenomenon (Abbas et al., 2021), institutional factors (Gardner et al., 2014), support and engagement (Garza, 2019), work and life balance (Redmond et al., 2017), and gender and racial discrimination (Abbas et al., 2021). The results can provide strategies for institutions and women contemplating career advancement to work together in the decision-making process. These strategies can provide insight into ways for colleges and universities to invest in women, retain talent, and increase gender and racial diversity in senior administrator positions in student affairs.

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Beyond the Page:A Focus on Text-to-Speech Assistive Technology in Upper Elementary Education
Alyssa DiNitto

This literature review investigates the bridge between text-to-speech (TTS) software and specific instructional strategies to improve reading comprehension in upper elementary-aged students. Weak decoding, word recognition, and fluency inhibit students' understanding of texts. The review explores the efficacy of TTS and the integration of targeted instructional methods, such as vocabulary development, comprehension monitoring, and engaged reading strategies. A systematic search of ERIC and SAGE was conducted. Emerging themes indicate that explicit vocabulary instruction, use of graphic organizers, and repetitive reading attempts are frequently cited as key factors in the successful implementation of TTS. This review will provide practical recommendations for educators seeking to effectively integrate TTS into their reading instruction and support diverse learners. The reviewed literature reveals instructional implications that scholars are applying to various research methods to study issues related to TTS and instructional strategies, highlighting potential areas for future research.

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Bio-Inspired Model Based Design of an Amphibious Robot
Elijah Turman

In this project, the role of bio-inspiration in mobile robotics, the design of autonomous vehicles, and the economic benefits and challenges of autonomous and bio-inspired robotics applications will be researched.

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Biochemical changes in ampicillin-resistant *Escherichia coli* cell walls
Zayda Dominick

Bacterial drug resistance is increasingly recognized as a critical challenge to human health. Bacteria employ various adaptive mechanisms to circumvent the inhibitory actions of antibiotics, including mutation of drug targets, secretion of hydrolases, such as beta-lactamase, to degrade antibiotics,

and expulsion of antibiotics from the bacterial cell *via* efflux pumps. Previous investigations have documented the immediate response of susceptible *Escherichia coli* to ampicillin, revealing rapid weakening of their cell walls upon exposure. However, as susceptible *E. coli* become resistant in the presence of ampicillin, resultant possible changes to the biochemical properties of their cell wall are unknown. This project aimed to elucidate alterations in the biochemical properties of cell walls in ampicillin-resistant *E. coli* through enzyme assays, SDS-page analysis, microbial screening methods, and genotyping. Over the course of our project, we observed a gain in antibiotic-resistance in samples cultured in the presence of ampicillin; however, the resistant mechanisms remain unclear. Insights into these biochemical variations in antibiotic-resistant bacteria will enhance understanding of resistance mechanisms and their impacts on cell wall structure, in addition to providing key information to support the development of future strategies to combat drug-resistance.

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Biophysical Analysis of *Escherichia Coli* Grownin the Presence of Ampicillin
Kylie Flores

As the use of antibiotics has increased with the development of modern medicines, numerous bacterial strains are becoming prominently resistant, posing a threat to medical and agricultural industries worldwide. To supply the growing need for effective antibiotics, experts have tested how growing bacteria with antibiotics influences their ability to resist the effects of antimicrobials. Past studies have shown that antibiotics can induce changes in properties of bacteria like elasticity and cell size. We cultured four cycles of *Escherichia coli* (*E. coli)* starting with the K-12 strain, under increasing concentrations of ampicillin to analyze how the antibiotic influenced properties like elastic modulus and cell size. We hypothesized that antibiotic-resistant bacteria would be smaller and have less elastic cell walls when grown with ampicillin to combat the penetration of the antibiotic into the cell. In this experiment, we collected force-distance curves with an atomic force microscope and fit the Hertzian model of contact to the data to determine the moduli of each *E. coli* cell wall. In turn, we compared the elasticity and size data of non-resistant *E. coli* controls and the four cycles of *E. coli* cultures. The sample moduli for the *E. coli* cells ranged from 1.2-2.3 MPa on average. Although we hypothesized that the moduli would increase with ampicillin concentration, we found no visible trend in elasticity or cell height and a possible trend in length. The cell moduli and heights fluctuated but had no significant changes, while the cells exposed to the most ampicillin were shorter on average than in the first cycle. In future, we plan to culture additional cycles and have longer growing periods to optimize results. By measuring the effects of growing bacteria in the presence of antibiotics like ampicillin, we further clarify how the common use of antibiotics can affect bacterial properties.

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Bohr Electronics Electric Train Horn
Jett Bates, Samuel Watson, Kaidence Thomas

This proposal details the design of an electric horn for locomotives, which addresses critical operational issues such as high fuel consumption and unreliable performance during cold weather. The project aims to replace traditional air horns, which rely on energy-intensive air compressors, with a more efficient electric system that meets Federal Railroad Administration (FRA) standards. By

reducing air compressor load, this electric horn design promises significant fuel savings, improved reliability, and consistent operation regardless of weather conditions.
The electric horn system features a bidirectional sound output, customizable horn tones, and seamless integration with current locomotive systems. In addition to performance gains, the proposed solution aligns with environmental and economic goals, helping railroads reduce operational costs while enhancing safety at rail crossings.

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Boron Oxide Nanofuel Synthesis and Combustion
Gabriel Mejia

Alternative fuels have been studied to provide cleaner burning fuels to reduce emissions in transportation, as well as increasing power output and thrust production from fuel combustion compared to traditional fuels. Nanofuels are a potential solution to both problems. Nanofuels are a homogenous colloidal mixture between base fuel(s), and nanoparticles. Nanoparticles are nano sized, 1m x 10^-9, carbon or metal-based particles. The nanoparticles have high energetic potential when combusted, allowing for increased heat produced from the reaction as well as more complete oxidation of the fuel, among other beneficial thermodynamic characteristics. The more complete oxidation leads to less fuel by-products to reduce emissions, and the increased reaction energy in the form of heat leads to increased power production. One NP of interest is Boron Oxide, which has one of the highest gravimetric and volumetric energy densities of all metals, allowing a high energy output to be produced when combusted to aid fuels in increasing energy and reducing emissions. In this research, Boron Oxide is to be sonicated into a variety of base fuels to create boron oxide nanofuel. The purpose is to study the specific heat capacity, enthalpy of reaction, burning rate, droplet morphology, and suspension stability of the nanofuels. The use of the surfactant sorbitan monooleate will be used to aid the dispersion and suspension of the nanoparticles within the fuel. The nanofuels will be tested at different volume fractions to find an optimal fuel to nanoparticle ratio.

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Bramblett's Bamboozling Wack Black Rock
Joshua Pruett, Zachary Stuedemann, Zane Coley

We were tasked with identifying a unique rock that contained an interesting black mineral. Initially we hypothesized that it was graphite or some sort of asphalt. We used various methods to identify the material. Including testing for hardness, its reaction to HCl, how it reacts when heated with a polypropylene torch and used a JEOL-JSMIT500R Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS). Preliminary results indicated that the material is pure carbon or hydrocarbon.

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Bridging AI and Clinical Practice: A Hybrid Model for Predicting Large Vessel Occlusion Stroke
Lan Gao, Megan McCoy , Samuel Glandon

Rapid detection of large vessel occlusion (LVO) in stroke is crucial due to its high mortality and narrow window for intervention. Machine learning and deep learning-based AI tools show promise for LVO prediction, yet clinical use is limited by the inconsistent pre-hospital data with varying LVO rates, the hard-to-interpret "black box" nature of many ML algorithms, and high costs of the AI tools. To address this gap, this study proposes a novel hybrid neural network (HNN) model that integrates classical statistical methods with neural networks, combining the structured framework and interpretability of statistical learning with the flexibility and regularization of ML. To evaluate the performance of models, we simulate stroke data with different LVO rates and sample sizes using NIHSS scores, patient demographics, medical history as factors in the simulated model. Performance was evaluated by sensitivity, specificity, accuracy, PPV, NPV and AUC against base models including logistic regression, Naïve Bayes, Random Forest, Decision Tree, and Neural Network. Simulation study shows the HNN outperforms these, exceeding logistic regression and neural networks by at least 3% in sensitivity and positive predictive value. This hybrid approach provides a robust and interpretable tool for pre-hospital LVO detection, integrating AI with clinical practice to enhance decision-making and patient outcomes.

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Building a Convolutional Neural Network for Diagnosis of Diabetic Retinopathy/Macular Edema and Differential Diagnosis Between Wet and Dry Age-Related Macular Degeneration
Alisha Chandra

This project utilizes machine learning to further early diagnosis of the two most prevalent eye diseases in the world, age-related macular degeneration (AMD) and diabetic retinopathy, two diseases for which early diagnosis is critical to prevent irreversible progression. This project aims to utilize machine learning to create a tool that primary care providers can implement for early diagnosis. It uses a convolutional neural network for feature selection and prediction for one of four categories: Diabetic Macular Edema/Retinopathy, Wet AMD (Choroidal Neovascularization), Dry AMD (Drusen), and Normal, and has an accuracy of 85.1 percent on average. It was trained on a combination of publicly available images and IRB-approved images from a local ophthalmologist.

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Challenges in Analyzing Environmental Field Samples for Microplastics
Nishat Tasnim Nisha

With the growing concern over microplastics, accurately quantifying them has become extremely essential to assess the associated risks. Being diverse in size and composition, microplastic particles arise significant challenges when performing identification and quantifying techniques. From collecting samples from the environment to processing them in the laboratory there are several stages where errors can occur. Although some procedures for microplastic sampling have gained recognition, they still contain limitations that affect accuracy and reliability. This study examines the distribution of microplastics in sediment samples from Chattanooga and surrounding areas, identifying the key challenges encountered during sample collection and analysis. We highlight

potential sources of error and propose a standard operating procedure (SOP) aimed at minimizing contamination and improving the accuracy of microplastic quantification. By refining analytical methods, this research contributes to the development of more reliable and standardized protocols for microplastic assessment.

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Comparative Analysis of Toxicity Classification methods
Mani Sravani Kothapalli

Toxicity detection in online content is a critical challenge in NLP. In this work, we explore and compare three distinct approaches to toxicity detection: (1) Prompt Tuning, (2) Fine-Tuning BERT with Data Augmentation, and (3) Reinforcement Learning. Prompt Learning is a technique which can be used to train LLMs so that the same model can be used for different tasks without re-training. The second method fine-tunes BERT on toxic data augmented for better generalization. The third method formulates toxicity classification as a sequential decision making problem, where an RL agent trained learns through interaction with a reward-driven environment. This work evaluates the effectiveness of these methods in toxicity classification.

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Comparison of Static and Dynamic Methods on Malware Analysis
Fabion Walden

Malware analysis is essential in cybersecurity enabling the detection and classification of malicious software to develop effective defense mechanisms. This study compares two primary approaches, static and dynamic analysis. Static analysis inspects a program's code, structure, and signatures without execution making it efficient for identifying known threats but vulnerable to obfuscation techniques. Dynamic analysis on the other hand observes malware behavior in a controlled environment providing deeper insights into real-time execution patterns at the cost of higher resource consumption.
Using an experimental research approach, this study systematically analyzes multiple malware types within a controlled virtual environment including trojans, ransomware, rootkits, and bind shells. The evaluation assesses detection accuracy, efficiency, and resilience against evasion techniques. Results show that static analysis offers fast and lightweight detection for known threats, while dynamic analysis is more effective against evolving and obfuscated malware.
By leveraging the strengths of both methods, this research highlights the benefits of a hybrid approach to malware detection. Future efforts should focus on optimizing dynamic analysis for scalability and enhancing static analysis to counter obfuscation ultimately improving malware defense strategies.

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Connected Risk in Higher Education
Brian Daniels

Abstract
Connected risk can be defined as the integration and connections of people, processes, and systems collaborating to identify and manage risk to acceptable levels. The purpose of this commentary narrative literature review was to assess what research has been done on the idea of connected risk in higher education, although the concepts can be applied in any organization. Promoting connected risk is in recognition of the fact that communication and collaboration can greatly assist an organization in identifying and managing risk. Key stakeholders in the concept of connected risk include functions such as internal audit, compliance teams, information security, legal counsel, and others. These groups sharing information and risk assessment practices should lead to increased efficiency, but more importantly increased effectiveness in efforts to identify manage risks to levels acceptable within the organization. Even though connected risk is universal and not specifically exclusive to higher education, the idea of using the lens of higher education as a specific constituent group for analysis presents an opportunity. There is limited research published on the concept of connected risk in higher education, but the uniqueness of its governance and business model should allow for additional specific analysis for the application of the concept of connected risk.

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Contemporary Students – A Growing Importance
Corbin Hedges

Student retention remains a primary focus for higher education institutions, particularly in transitioning from the first to the second year for classic students, sometimes known as traditional students. However, the number of classic students is no longer outnumbering contemporary, sometimes known as non-traditional, students by the same margin (Maroney, 2010). This presentation examines how contemporary students interact with their institution and what is most important to them in their college experiences.

The goal was to determine whether Campus Recreation plays a role in contemporary student retention and to assess how program structures can better serve their needs. The results may indicate what institutions can do to enhance their contemporary students' experiences and help them become more invested and involved, which could lead to better retention rates and overall holistic health.

Preliminary findings suggest participation in Campus Recreation positively influences student retention by fostering life skills, social integration, and mental health support. Classic students benefit from structured programs that aid in social development and time management, while contemporary students require more flexible, accessible options tailored to their unique schedules. Institutions can enhance student engagement and persistence by expanding recreational opportunities, offering modular fitness programs, and creating inclusive events.

This study underscores the need for universities to adapt Campus Recreation to support contemporary students better, addressing an existing gap in retention strategies. Future research should further explore the accessibility of recreation programs and the financial barriers that may limit student participation, ensuring that all students—classic and contemporary alike—benefit from these essential services.

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Convolutional Neural Network for Human Identification In Natural Disaster Zones
Virginia Foster

Natural disasters are one of the deadliest events in the world. In 2023, over 95,000 civilians died from natural disasters, with many still unidentified. After fires and other disasters, there is an excess amount of carbon monoxide, polycyclic aromatic hydrocarbons, and sulfur dioxide left in the air, being partly responsible for the bad health effects firefighters get when rescuing trapped civilians. Currently, firefighters have twice the likelihood of dying from cardiovascular disease compared to an average civilian. Within natural disaster zones, there are many collapsed or toxic areas that are not worth the risk of searching for the sake of the rescuer's health. The average search lasts 7-14 days depending on the size and scale of the disaster before the searchers give up. A human may not survive the entire search period, so there needs to be a more efficient solution. Using a drone with a thermal imaging recognition system for human detection in natural disaster zones would save lives by eliminating unnecessary exposure for the rescuers, cutting down the search time, and allowing for better area coverage.This project is being completed on TensorFlow CoLab using Keras and a convolutional neural network (CNN) for human identification. So far in this process I have taken thermal images of objects and people around my school to use as data in my CNN. I have created a functioning CNN for human detection when tested with human and non-human images. By the end of this project, the CNN will be able to detect humans with a high enough accuracy to be used in real world disasters. Limiting the exposure time of the firefighters is important for lowering their chance of getting cardiovascular disease from less exposure to the toxic chemicals. Using a drone will bring down the search time needed for the first search, reducing the number of deaths from lack of time.

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Cooper's PPE
Luke Riggs, Ann McAbee, Reid Pettway, Josh Patrascu, Chloe Mondido

Cooper is a service dog trained to detect Alyssa's seizures, provide support during the seizures and assist with balance. Cooper's current PPE is inadequate for Chemistry lab use, as it fails to provide chemical resistance and accommodate his bulky frame.
The purpose of this project was to design and build PPE for Cooper that would provide adequate protection while in the Chemistry labs.

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Crafting Wellness: Establishing "Meditative Play" in Tutor Development
Sarah Madison Willis

While writing centers function as caring spaces for writers, we must also care for tutors as they balance their leadership roles. This presentation introduces my concept of "meditative play" as a creative outlet for tutor wellness. Meditative play, which utilizes interdisciplinary approaches to stress relief, can break down barriers and address tutor vulnerability. After defining my concept of "meditative play" and its utility in tutor leadership development, attendees will leave with practical strategies to engage their centers in this practice.

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Creating a Convolutional Neural Network to Classify Spiral and Elliptical Galaxies
Elizabeth Silva

Sky surveys have produced millions of images of galaxies, such as the Sloan Digital Sky Survey (SDSS), which has produced over 900,000 images. The substantial number of these images makes manually classifying each one nearly impossible. Machine learning, a subsection of artificial intelligence and computer science that focuses on processing data to identify and predict patterns, can provide an opportunity to classify these galaxy images with minimal human intervention. As more galaxy sky surveys are developed, the necessity for efficient, accurate machine learning systems to classify galaxies increases; in other words, more data requires better systems to process the data. The goal of my research project is to create a convolutional neural network (CNN) that can differentiate between spiral and elliptical galaxies accurately even when complex qualities are present in the images with an accuracy of 95% in less than 20 epochs. I am using galaxy images from the SDSS images of selected RC3 galaxies for training and testing data for the neural network. I am using the application TensorFlow through Google Research Colab to create the CNN. So far, I've created a CNN that can classify spiral and elliptical galaxies with a mean accuracy of 85% in less than 20 epochs. I have also learned that overfitting is the main issue when making adjustments to the CNN layers. I have also written code that can display the galaxy images with the results of the CNN to compare the actual and the predicted values and observe trends in the images the CNN incorrectly classifies. In the future, I plan on adding another galaxy type to be classified, irregular galaxies, or supplementing the process by adding another neural network. My research can help make galaxy classification for sky surveys more efficient and help deepen scientists' understanding of galaxy morphology and creation.

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Cross-Cultural Comparison
Makayla Garrett

With my research, my objective is to compare and contrast the cultures and countries of the United States of America and Vietnam. In this presentation, I explore how Vietnam and the USA juxtapose or complement each other. Some general comparisons being made in the following are: geography, government, economy, culture, education, healthcare, and military. I also wanted to include snippets from my own perspective, so I hope that this presentation feels personal and unique and maybe encourages more adventurers to explore the beauty of Vietnam like I had the opportunity to do.

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Design improvements for a solvent recovery column
Monica Ball, Hunter Loomis, Rachel Ostranderr

Our industry partner produces high-grade glycine for a variety of markets from a substitution reaction between monochloroacetic acid and ammonia gas. An anti-solvent used heavily throughout the process is methanol. This methanol is separated from precipitated product carrying impurities and byproducts where it is separated for reuse by a distillation column. "Saddles" are commonly used in distillation columns to increase surface area to increase opportunities for vapor-liquid contact. A proposed alternative to these is structured packing, which is commonly made of corrugated metal sheets or wire gauze. Due to their elevated materials of construction, they are less prone to damage and breaking, which promises to be more resilient in instances of abnormal events occurring within or to the distillation column. This project seeks to determine the size of structured packing required, the feasibility of its use not only in the rectifying section but the stripping section as well, and determine the overall probability of fouling occurring at various points in the distillation column.

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Design of a Flexible Raw Material Delivery System
Briana Mayes , Tyler Lynn, Diya Patel , Anastasia Koslofsky

Our industry partner wants to expand their current manufacturing operations to pump various materials from drums to tanks to meet increased production demands. The team has been tasked with designing a flexible raw material feed drive for to pump different materials, such as polymers, to a tank. The team is working with different regulations such as pump codes and ergonomic principles to design the safest and most efficient pump for sending various raw materials to the production line. Our industry partner has provided information pertaining to flow rates, material property data, etc. The pump requires an efficient clean mechanism to clean various latexes pumped through the system to prevent cross contamination. Our final design will include a process flow diagram and a generalized computer-aided design model for a pump achieving a flexible material feeding system to add to the current manufacturing operations.

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Design of a heat exchanger for a lanthanum chloride production process
Neka Long, Eamonn O'Bryant, Perla Martinez, Isaac Way

Specialty chemical manufacturing represents a significant portion of the chemical engineering industry. One such chemical is lanthanum chloride, a compound manufactured by our industry partner. This compound is used to produce fluid cracking catalysts (FCCs) that are used for the production of gasoline and diesel fuels. The reaction used to produce this compound is highly exothermic, which means that the use of a heat exchanger is necessary to control the reaction temperature. The primary goals of our project include sizing a heat exchanger and pump system for lanthanum chloride production, determining necessary equipment specifications, and providing a total installed cost estimate for our heat exchanger and pump. To determine all design parameters for the heat exchanger and pump, a stream table, process flow diagram (PFD), and piping and instrumentation diagram (P&ID) will be constructed. A project schedule detailing the estimated installation timeline for these design implementations will also be provided. An initial basis for the

design was provided that included reaction kinetics and component inlet and outlet stream concentrations. Additionally, our group is doing research to determine the best materials of construction for the piping, pump, and heat exchanger. Both will need to be able to resist highly corrosive fluid at hot temperatures. Once the overall design is complete, a cost estimate can be determined via estimation or prices provided by vendors.

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Design of Multigrasp Prosthetic Hand
Chase Guttu

Traditional prosthetic hands often use basic open-close mechanisms, limiting functionality. This project presents a Multigrasp prosthetic hand powered by twisted string actuators (TSAs), which offer strong grip force with reduced weight and complexity. A cost-effective, intuitive control system keeps the design accessible while supporting multiple natural grasp patterns. The result is a lightweight, affordable, and versatile alternative to conventional prosthetics.

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Designing a 3-D Environment for Robot Navigation and Pathplanning
Kuzey Tukel

Robots have a hard time planning movements on their own. Humans can help the robots by setting a predetermined path for the robots to follow. With the help of Virtual Reality (VR) humans can get a better understanding of the environment that the robot has to traverse through. My goal is to design a 3D environment in the Unity Game Engine to help robots navigate. Specific points could be inputted and the code will calculate the path the robot needs to take to go through the points as accurately as possible. I will use VR to enhance the experience and make it more immersive. The research is being done primarily with the Unity 6 Game Engine. The Engine uses C# as its default programming language. The calculations for the pathfinding will be done using splines, specifically Bézier Curves. I used Autodesk's Fusion 360 to create the 3D models of the Field and the Robot. In terms of VR, I'm using the Meta Quest 2 as my headset. The robot can move through human input with the WASD keys. Currently I am working on a point input system. The current method of inputting coordinates is using a mouse but I plan on changing it to the VR Hand Controllers. In the future, I hope people can implement my results onto actual robots elsewhere in the world.

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Designing an AI-Powered Lip Health Diagnostic System
Grace Chen

In the field of medical image analysis, deep learning techniques have shown great potential in diagnosing various health conditions. Existing studies have demonstrated the effectiveness of machine learning in oral health assessment. However, there is a lack of in-depth research specifically focused on accurately identifying and classifying different lip conditions. This research aims to fill this

gap by applying deep-learning methods to lip - condition diagnosis. The research methodology involves the use of computer learning, specifically Convolutional Neural Network (CNN). The Python programming language and Google co-lab framework are used for model development, data and language management. A wide variety of lip image datasets have been collected from medical databases, online repositories, and clinical resources. Standard metrics such as accuracy and precision are used to evaluate the model. At present, a certain amount of data collection has been collected and the part of model training and testing is being carried out. Preliminary experiments suggest that the deep learning model will show promising results in accurately identifying and classifying lip diseases. It is expected to be superior to traditional diagnostic methods in terms of convenience and efficiency, enabling better early detection and management of lip health problems. This study helps to apply deep learning techniques to the diagnosis of lip health, thereby improving the overall awareness and health level related to lip health. Future research will likely focus on expanding the dataset, further optimizing the model, and comparing to more traditional diagnostic methods in a real-world clinical setting.

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DEVELOPING A CHINESE LANGUAGE TONE TRAINING APP UTILIZING PITCH DETECTION
William Hubbard

DEVELOPING A CHINESE LANGUAGE TONE TRAINING APP UTILIZING PITCH DETECTION
William Hubbard
People learning to speak Mandarin Chinese often find mastering the pitch of their voice to be enormously challenging. Chinese is a tonal language, meaning the definition of a word is determined not only by consonants and vowels, as in non-tonal languages, but also by the pitch at which the word is said. Because of this, if a learner of Chinese makes tone mistakes while speaking, a native speaker will be unable to understand what they are saying. One of the best methods for tone practice is working with a pronunciation coach, but this is not feasible for many people because of monetary and time constraints. I seek to combat this issue by developing a Chinese language tone training app. The goal of this project is to create an application that will listen to a Chinese language learner attempting to speak a sentence or word and then give visual feedback informing the user of how to improve. To accomplish this, I am utilizing Python because it easily processes audio and is compatible with statistical libraries that will help me create understandable feedback for the user. The first sub-goal of this project is to create a program that can train a learner to correctly pronounce (mā; first tone ma; means mother) and (mǎ; third tone ma; means horse). Thus far, the program can successfully train users on (mā; first tone ma; means mother), and future efforts will be directed towards incorporating (mǎ; third tone ma; means horse) into the program's library. The overall purpose of this app is to create a more interconnected world by easing the process of learning to speak Mandarin Chinese.

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Developing a Framework to Assist with Flight Simulator Software Development
Aiden Saadeh

Developing flight simulator software is time consuming, complicated, and expensive. A facet of flight simulator development is the flight model which determines how an aircraft will fly. Creating a set of tools that simplifies and speeds up the process of creating an aircraft flight model would expedite testing, reduce costs, and lower the barrier of entry into the flight simulation field. There are other projects with similar goals. However, these projects each have issues such as prohibitive price, unrealistic simulation, difficult usage, and obsolescence. The goal of this project is to create a set of tools and systems for the Unity engine that will reduce the development time of an aircraft's flight model. The development goal is to maximize the accuracy of the tools by comparing simulated flight performance with actual flight performance. Currently, I have created various tools that allow for suspensions, control surfaces, wings, and a debug menu. The debug menu provides valuable information, while the suspension tool uses Hooke's law to simulate an aircraft's landing gear. The wing tool allows the creation of a wing with any shape, while the control surface tool allows articulation of wings to mimic control surfaces on actual aircraft. I've used these tools to simulate a Cessna 172 which can be flown with realistic lift and drag characteristic. Furthermore, these tools allow any (subsonic, single piston engine) aircraft to be simulated accurately in under 45 minutes, which allows developers to quickly prototype their flight software and expedite their development.

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Developing Models to Estimate Chlorophyll-*a* in the Tennessee River Using Remote Sensing
Anna Sherrill, Nicklaus Kuntzman

Remote sensing technology has been used for water quality studies for many years. Quantitative estimation of water quality parameters in inland water bodies has been a challenge due to variation in local topography, geology, land use/land cover, and complicated hydrodynamics. In response, models have been developed for different inland water bodies using remote sensing technology. Limited water quality studies have been conducted in the Tennessee River using remote sensing. In fact, there is no remote sensing based chlorophyll estimation model available for the Tennessee River. This study was designed to develop models to estimate chlorophyll in the Tennessee River along the City of Chattanooga, TN using satellite imagery acquired by NASA's Landsat program in conjunction with near real-time in situ measurements. Linear and non-linear regression-based models were developed using satellite images and concurrent in situ measurements of chlorophyll during different years and months. Models were developed using surface reflectance values obtained from single bands and multiple bands.

Chattanooga is one of the fastest growing cities in Tennessee. The rapid urbanization of this region has led to major environmental concerns. The successful development of the Landsat imagery-based chlorophyll estimation models would provide a useful tool to better understand the impact of urbanization on the water quality in the Tennessee River, leading to sustainable growth.

This is ongoing research. Preliminary results and analysis will be presented and discussed.

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Developing Tradespeople in Facilities Management to Avoid the Loss of Institutional Knowledge due to the Looming Retirement Boom
Rebecca Alcorn

Combatting the unavoidable reduction in institutional knowledge facing its Facilities Management (FM) department, one university evaluates how developing tradespeople through apprenticeship programs, partnerships with manufacturers and vendors, and leadership development programs can reduce the negative impact of the loss of institutional knowledge due to looming retirements. Professional development of tradespeople working in FM is an ideal way to prevent the loss of institutional knowledge due to the coming retirement boom. Evaluating knowledge sharing and professional development via a literature review will guide the FM department in preparing its next generation of operators. The process of this evaluation could lead the current department leadership to create a comprehensive tradesperson development program to support the university's growth well into the future.

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Development of a Central Unwinding Spool for Utilization in 2-DOF Cable Actuated Systems
Eric Zheng

Many mechanical designs use cable-actuated systems to facilitate force transmission and motion using spools. Despite their widespread use, existing pulley designs can run off the side of the pod, adding additional components to the system's control. This project aims to address this issue by developing a new pulley spool prototype that runs the string out of a center coaxially driven pod. The experimental approach involves design iterations, reviewing pre-existing control methods, and developing one that fits the custom spool pods. Data collected from further experimentation will provide a comprehensive understanding of the prototype's performance under varying loads and operating conditions for optimized pulley designs in real-world applications. The objectives of this project are to develop a custom coaxially-driven central unwinding cable spool and use a simple PID controller to drive all four pods individually. Currently, a motor and pulley mount is in the design phase, tailored specifically to fit over the 3D-printed frame mounts. This new mount aims to ensure compatibility with the existing structure while maintaining stability during operation. The motor and spool setup will be mounted on top of the extrusion, enabling controlled movements and reliable testing capabilities. Once complete, the test rig will serve as a versatile platform for various applications, emphasizing ease of use, adaptability, and precision in its design and assembly. The future objectives include designing a new control method that can control the rotation and translation of an end effector.

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Development of a Mechanical Shredder for a 3D Printer Filament Recycling System
Brandon Oakes

3D printing is increasingly common in homes, businesses, and schools, but its growth has led to a surge in waste, including leftover filament, failed prints, and support structures. This research addresses the challenge of managing this waste by developing a cost-effective recycling system that converts 3D-printed waste into usable filament. The research fills a gap by focusing on affordable

solutions to reduce financial barriers to 3D printing adoption. Central to this research is the creation of a system with three main components: a shredder, a filament maker, and a filament spooler. Initial efforts focused on building a test bed to assess different blade shapes and materials for the shredder, utilizing a high-torque motor due to the high strength needed to break down plastics. Preliminary results include the successful design and testing of a small-scale shredder prototype, capable of processing pieces up to 3 cm^3. The research seeks to identify the best combination of blade shape, material, and configuration for efficient and safe shredding. The significance of this research lies in its potential to enhance the sustainability and affordability of 3D printing, particularly for budget-constrained communities. Future work includes developing a full-scale shredder, optimizing the pellet-to-filament process, and finalizing the system into as close to a 100% yield recycling solution. This project contributes to sustainable manufacturing and offers practical implications for reducing 3D printing waste and costs.

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Development of New Tridentate NH2-C(carbene)-N(py) and NH2-N(py)-C(carbene) Mixed Donor Ligands

Chase Matusek

Two tridentate mixed donor N-N-C and N-C-N ligands based on pyridine, N-heterocyclic carbene (NHC), and tethered primary amine moieties were proposed to be synthesized for late transition metal coordination. The N-C-N ligand 1-(2-aminoethyl)-3-(pyridyl)-1H-imidazol-3-ium was prepared in its protonated form by refluxing 2-(1H-imidazol-1-yl)pyridine and 2-bromoethylamine hydrobromide in acetonitrile. The N-C-N ligand is protonated, at both the amine and the carbene, and has been characterized by 1H NMR spectroscopy. The N-N-C ligand [2-(1H-imidazol-1-yl)pyridin-2-yl]methylamine was prepared in its protonated form by the reaction of 1-phenylimidazole with (6-bromopyridin-2-yl)methanamine at 170 °C and has been characterized by 1H NMR spectroscopy. Attempts to deprotonate these ligands and coordinate to transition metals are ongoing. The bidentate ligands, Py-NHC-R (R = phenyl or n-butyl), 1H-imidazolium, 1-phenyl-3-(2-pyridinyl) and N-butyl-N'-2-pyridylimidazolium were also prepared, and attempts to coordinate these ligands to Pd(II), Pt(II), and Co(III) have been investigated. Synthetic routes to prepare the N-N-C and N-C-N ligands, attempts to deprotonate and coordinate these ligands to a metal, as well as synthetic routes to new square planar Pd(II) and Pt(II) and octahedral Co(III) complexes involving the Py-NHC-R ligand will be presented.

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Development of Selective Binders Targeting AUUCU Repeats, the Toxic RNA Causing Spinocerebellar Ataxia Type 10 (SCA10)

Grace Tang

Spinocerebellar ataxia type 10 (SCA10) is an autosomal dominant neurodegenerative disease characterized by poor balance and an unsteady gait, followed by a loss of upper limb control. Previous experiments have shown that the disease is caused by an RNA gain-of-function mechanism, in which the RNA, AUUCU, in intron 9 of the ataxin 10 pre-mRNA forms a hairpin structure that binds to and sequesters proteins involved in biogenesis. A potential therapeutic approach to this disease involves using small molecules that bind to the AUUCU RNA repeats, displacing the sequestered

proteins and restoring their normal function within the cell. A major advantage to using small molecules lies in their increased specificity, which can target specific disease-associated RNA secondary structures, minimizing unintended effects. Using the RNA motif-compound database INFORNA, followed by a compound library screening, four compounds were identified as potential binders to the mismatched internal loop structure of the AUUCU repeats. Thus, this research aims to analyze the binding affinities and selectivities of these four compounds towards the AUUCU repeats found in SCA10, a disease with no current effective treatments. By doing so, this study seeks to expand on the current understanding of RNA-targeted therapeutics using small molecules.

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Development of Sensor Platforms for UAVs
Bruin Webster

Implementation of UAVs for modular use and application will allow for the future to be unlike we've ever seen before. While drones have been implemented in many areas already, they may not have been utilized to their full potential. In this study I plan to construct first a smaller-scale way to have modular components and sensors attached to a UAV, depending on the task required. While many drones have been constructed to do specific jobs, such as agriculture, thermal imagery, law enforcement, and more, modularity has been largely ignored, resulting in super costly multi-drone fleets that one may be able to do with something as simple as an ability to swap out parts. I expect to find that doing so is quite difficult, since it has not really been done before. However, this small-scale idea would have the ability to show proof of concept and then allow for a more advanced UAV, capable of carrying more payload and sensors for more data gathering. This data will then show the gap in which UAV designers use in order to have more revenue, rather than making it more cost effective for completing many tasks instead of the one the drone was designed to do. In conclusion, this would allow a new era of data collection and implementation of a singular aircraft that could do it all, no matter what is thrown at it. In doing so, UAVs would be more available to civilians and business owners and transition our world into the future and beyond.

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Development of t*rans*-bidentate ligand systems involving either aryl-alkynyl pyridine or metallo-alkynyl pyridine donors
Lennon Learn-Houston

Our group is interested in using alkynyl based pyridine donors as a template to develop new trans-bidentate ligands for transition metal coordination. We started with 1,2-bis(2-ethynylpyridine)benzene (bpeb) and used its synthesis as a model to prepare 2,3-bis(2-ethynylpyridine)pyrazine (bpep), and 2,3-bis(2-ethynylpyridine)quinoxaline (bpeq) via the Sonogashira coupling of 2-ethynylpyridine with the corresponding 2,3-disubstituted aryl halide. Alongside these organic ligands, we have synthesized the metallohinged (*p*-cymene)Ru(PMe3)(C2-2-py)2 complex, where HC2-2-py is 2-ethynylpyridine, and investigated Pd(II) coordination exploiting the pyridine moieties attached to the Ru(II) complex. The synthetic details to prepare both the organic and metallohinged Ru-based ligands along with initial attempts to coordinate Pd(II) and Pt(II) to each species will be presented. In addition to the experimental results, a computational analysis of the organic and metallohinged Ru-based ligands coordination to {PdCl2} will be presented.

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Direct Simulation of Monte Carlo Surface Reaction Parameters for Chemical Vapor Infiltration of SiC Matrix Composites
Ege EK

Chemical Vapor Infiltration (CVI) is an important manufacturing technique for fabricating high purity SiC matrix composites for extreme conditions. The deposition quality and rate depend upon the surface reactions, which are influenced by the activation energy, adsorption and absorption parameter and surface coverage. Computational modelling is an important tool for parametric analysis, but that model should accurately describe transport mechanism, energy transfer, interfacial dynamics and surface reactions. In this study we employed Direct Simulation Monte Carlo (DSMC) technique to simulate the flow dynamics and surface-gas interactions occurring during CVI. DSMC is a particle-based probabilistic approach, and it is well suited for rarefied gas dynamics and enables the detailed molecular motion, intermolecular collisions, and surface reactions. The deposition rate depends on parameters such as preform structure, surface coverage and operating conditions such as temperature and pressure. To investigate these effects, we conducted sensitivity analysis on Fiber with varying size (1 -10 µm) and at a range of operating conditions This approach highlights how surface reaction parameter impact overall deposition rate, providing valuable insights for optimizing the CVI process.

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DragonVerse
Sarah Miller, Rutvi Shah, Anna Patel, Zihan Gao, Krushil Patel

The main goal of the DungeonVerse project is to create a system that works like a Dungeon Master (DM). This system automates tasks usually performed by a Dungeon Master in tabletop RPGs, like world-building, quest generation, and NPC interactions. The main feature of DungeonVerse is our use of AI-driven story generation, which enables the game to adapt to player decisions and ensure an engaging gameplay experience.

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Driving Simulation on Cognition: A Pilot Study
Shyla Khan

Cognitive impairments, such as deficits in attention, memory, and executive function, are commonly observed across a variety of populations. These impairments often impact daily functioning, social interactions, academic achievement, and overall quality of life. As such, there has been increasing interest in interventions that target these cognitive domains in a way that is both engaging and adaptable in individual needs. One promising approach is the use of driving simulators, which provide an immersive, interactive environment that challenges cognitive skills, particularly attention,

reaction time, and executive function (Casutt et al., 2014). The proposed study will explore the potential benefits of driving simulator therapy for a wide range of participants, including neurotypical individuals., neurodivergent individuals (e.g., those with ADHD, autism spectrum disorder), and cancer survivors. By examining the efficacy of driving simulators, we can establish baseline data on cognitive performance and identify trends that may be generalized to other populations, including cancer survivors and neurodivergent individuals. Additionally, by focusing on improving attention, memory, and executive function, this research will add to the growing body of literature on the benefits of interactive, action-based interventions in cognitive training. The findings from this study will provide valuable insights into the feasibility and potential benefits of using driving simulators as a tool for cognitive rehabilitation, which could lead to future interventions.

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Dual Clutch Shifting Experimental Setup
Evan Scannapiego, Taegan Baker

The automotive industry continuously seeks advancements in transmission technology to enhance vehicle performance and efficiency. This project focuses on the design and implementation of an experimental dual clutch transmission (DCT) setup to analyze its advantages over traditional transmission systems. The primary objective is to create a setup that effectively demonstrates the operational differences and efficiency improvements offered by DCT technology.

To achieve this goal, the setup features a fully functional DCT, with key components identified and performance metrics analyzed. Preliminary results indicate that the DCT significantly reduces shift times, enhances power delivery, and improves overall efficiency compared to conventional transmissions. These findings support the hypothesis that DCTs provide superior performance and contribute to advancements in automotive engineering.

This study highlights the importance of DCT technology in modern vehicle design, offering valuable insights for automotive researchers, engineers, and enthusiasts. By showcasing the efficiency and effectiveness of DCT systems, this project contributes to the broader understanding of next-generation transmission solutions.

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ECS 407 Podium Lift- Design for Independence
Isabella Riggs, Jack Smith, Tyus Brooks, Elijah Smith, Stephen Hamill

The current setup of the peripherals and monitor in ECS 407 do not allow for adjustable height to accommodate different users, which leads to uncomfortable use of the equipment by instructors, students, and other users. This limitation hinders effective use of the monitor, negatively impacting the class and presentations.

The team was motivated to create a solution that is

- Accessibility for all users
- Improved Ergonomics and Comfort for the user

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Educating Novice Certified Registered Nurse Anesthetists on the Focused-Assessed Transthoracic Echocardiography Protocol Using an Expert-Validated Video
Julien Deshler, Lynn Hudson, Jacob Wheat

Performing bedside transthoracic echocardiography (TTE) and point-of-care ultrasound (POCUS) is an increasingly important skill taught in nurse anesthesia programs. TTE can help diagnose and guide treatment for patients with weakened cardiac muscles and valves. The Focused Assessed Transthoracic Echocardiography (FATE) protocol is a form of TTE that is rapid, repeatable, noninvasive, and easy to learn relative to other protocols (Holm et al., 2012).

Though evidence supports TTE education in medical residency programs (Beaulieu et al., 2015; Edrich et al., 2016), limited evidence exists effectively incorporating TTE skills into nurse anesthesia education. Because FATE instruction to CRNAs is an unexplored area in POCUS literature, this performance improvement project aims to evaluate the effectiveness of a video teaching program for CRNA graduates of the past five years.

An expert-validated instructional video was developed to educate CRNAs on identifying basic cardiac pathologies and determining the appropriate use of the FATE protocol. The video's instructional effectiveness will be evaluated using pre- and post-educational surveys to evaluate CRNA knowledge and clinical application of the FATE protocol.

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Effect of antibiotic presence on the properties of *Escherichia coli*
Jeremiah Myers

Multidrug-resistant bacteria are becoming a global health crisis. One mechanism of resistance in bacteria is a change to their physical properties. Our study seeks to find how exposure to ampicillin changes an *Escherichia coli* cell's physical property. To do this we measured the change in the elasticity of a cell in response to ampicillin. We hypothesized that as the *E. coli* cells become more resistant to ampicillin the elasticity of the cell wall would be reduced. To test this hypothesis atomic force microscopy (AFM) was used. An *E. coli* K-12 strain in four cycles of four cultures in Luria-Bertani Broth with increasing concentration of ampicillin in each cycle. Survivors from previous cycles were transferred to the next. Then measurements of the cell's length, height, and force spectroscopy for each culture and cycle with AFM. The data showed a range of 1.2 - 2.3 MPa with no discernible trend for the elasticity of the cells. It also showed that the height of the cells stayed mostly constant. There was a slight trend of decreasing cell length; however, more testing will be necessary to further elucidate the data. A Kirby-Bauer Disk Diffusion Susceptibility Test was also run to visualize how resistant the cells are to different antibiotics. The cells were then plated onto Mueller-Hinton agar plates and four different antibiotics were placed onto the plate. These antibiotics created a zone of inhibition where susceptible cells could not grow. The results showed that the cells had a heightened resistance to ampicillin, but they were still susceptible to the other three antibiotics. In the future, we will culture for a longer period of time over more cycles to determine the changes in the *E. coli.*

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Effect of ɣ- Aminobutyric Acid (GABA) and β-Alanine on Accumulation of Reactive Oxygen Species (ROS) in Response to Heat Stress
Willem Dryden

Reactive Oxygen Species (ROS) are compounds that have the potential to damage several cellular components by acting as reducing agents. They are produced by normal metabolism in plant cells, primarily in relation to the photosynthetic electron transport chain (Asada 1994). ROS levels in a healthy plant are regulated by anti-oxidative activity, both enzymatic and non-enzymatic, and ROS are known to play a role in cell signaling. One pathway ROS are known to play a role in is stress response where they are accumulated. This accumulation can pose a danger to the cell but is thought to be a part of stress response pathways (Mittler 2002). GABA and β-Alanine are non-proteinogenic amino acids that play a role in stress response and antioxidant pathways in plants. They are also known to accumulate in *Arabidopsis thaliana* in response to heat (Kaplan et al. 2004). Given this Information we hypothesized that exogenous GABA or β-Alanine in growth media could reduce ROS accumulation in *A. thaliana* seedlings subjected to heat stress. Three *A. thaliana* ecotypes were used in this experiment, Columbia, Cape Verde Island (CVI), and Landsberg erecta (LER). In order to measure ROS levels within seedlings we used the dye 2',7'-dichlorodihydrofluorescein diacetate (H2DCFDA) which can cross the cell membrane. Once inside the cell H2DCFDA is cleaved by cellular esterases to form 2',7'-dichlorodihydrofluorescein (H2DCF) which is then oxidized by H2O2 resulting in the fluorescent compound 2',7'-dichlorofluorescein (DCF). DCF was then localized using fluorescent confocal microscopy and quantified using a microplate reader.

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Effects of Injection Size Distribution on the Aerosol Deposition within Human Airways
Jacob Pratt

Aerosolized drug delivery within the human airways using metered-dose inhalers (MDI) is an effective strategy for treating pulmonary diseases. The particle size distribution from MDI is usually polydisperse, which exhibits differences in aerosol deposition compared to a monodisperse distribution. In this study, we examine the effects of injection size distribution on the local and global deposition within a realistic human airway model based on the SimInhale benchmark case, comprising the extrathoracic and intrathoracic airways. We employ the well-established Eulerian-Lagrangian framework to perform large-eddy simulation (LES) under a one-way coupled regime. First, the LES results from the monodisperse injection with the particle size of 4.3 µm at the inlet bulk Reynolds number of 3745 are compared with reference results. Afterward, we compare the monodisperse and polydisperse distributions with the same mean particle size and different values of geometric standard deviation representative of MDI. For the polydisperse injection, we consider Rosin-Rammler, Gaussian, and uniform types of distribution models. Lastly, we perform uncertainty quantification (UQ) of the aerosol deposition under the polydisperse injection scenario by employing a non-intrusive framework relying on the polynomial chaos expansion-based surrogate modeling technique. For the UQ study, the particle size is considered as the uncertain parameter, and the aerosol deposition is regarded as the quantity of interest.

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Effects of Lipocalin Expression on Environmental Stress Response in *Saccharomyces cerevisiae*
Megan Lodge

Many industries rely on the growth and productivity of *Saccharomyces cerevisiae*. Unfortunately, industrial fermentation processes create a myriad of stresses which yeasts must overcome, including conditions like the accumulation of oxidative, osmotic, and saline stressors as well as high temperatures and high ethanol concentrations. This research sought to evaluate whether or not transforming these yeasts with genes that encode lipocalins—a class of small proteins that are capable of binding, transporting, and/or sequestering small, hydrophobic molecules—would increase the stress tolerance of transformants relative to controls that were not transformed. The genes encoding *Arabidopsis thaliana* temperature induced lipocalin (*At*-TIL), human odorant binding protein 2A (OBP2A), and human odorant binding protein 2B (OBP2B) were cloned in *Escherichia coli*, ligated into the yeast shuttle vector, and transformed into wild type (*BY4743*) and knockout ($ALD3^-$ and $ALD4^-$) strains of *S. cerevisiae*. Transformants and their respective controls were then subjected to phenotyping to elucidate any changes in stress tolerance to the five stresses listed above. *BY4743::OBP2A* and *BY4743::OBP2B* performed significantly better than their controls under oxidative stress and heat stress. *At*-TIL did not significantly change the response of the wild type to any of the evaluated stresses. The continuation of this research could ultimately lead to the production of a yeast strain that is highly tolerant to the many stresses faced by yeasts during industrial fermentation processes, improving efficiency and cost-effectiveness for the many industries that are reliant on the success of this microorganism.

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Effects of Multi-component Surrogates on the Dynamics of Non-Reacting Diesel Fuel Spray
Matthew Pruitt

Evaporation of liquid hydrocarbon fuels, such as diesel, coupled with mixing and chemical kinetics plays a crucial role in the combustion processes occurring within various energy- and transport-related applications. Diesel is a multi-component fuel consisting of thousands of components, which leads to a wide boiling range compared to a single-component liquid, thus necessitating an accurate and efficient computational modeling of multi-component evaporation and chemical kinetics. For computational efficiency, surrogates are considered, which are a mixture of selected species having similar thermo-physical properties as the fuel of interest. In this study, we examine the effects of multi-component diesel surrogates on the characteristics of a non-reacting spray configuration. We employ the well-established Eulerian-Lagrangian formulation to perform large-eddy simulations of the engine combustion network spray A configuration. For the multi-component evaporation of liquid droplets, we employ the discrete multi-component approach. We consider multi-component surrogates with an increasing degree of complexity and compare the results against the available experimental data. The numerical results for the liquid and vapor penetration lengths show better agreement with the data with 2 and 4 components surrogates compared to a more complex 5 component surrogate.

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Effects of Operating Conditions on the Decomposition ofMTS/H_2 in Chemical Vapor Infiltration Processes

Jamie Wilson

Silicon carbide (SiC) is a ceramic material of high durability which is used in a variety of applications such as abrasives, LED lights, and many more. While it is an extremely useful material, its natural occurrence on Earth is rare. One way to produce SiC is through a process called chemical vapor infiltration (CVI), in which methyltrichlorosilane (CH3SiCl3 or MTS) and hydrogen gas (H2) are fed through a high temperature reactor, leading to a film of SiC being deposited on the surface of the reactor. The decomposition of MTS in the presence of H2 is affected by the operating conditions, such as inlet temperature and pressure, and the gradient of pressure and temperature, which in turn affect the SiC deposition. The present study examines the effects of these operating conditions on MTS decomposition. The simulations are conducted using a computer programming language called Python, specifically using a software called Cantera, which is designed for simulating thermodynamic models, chemical reactions, and transport properties such as viscosity and thermal conductivity. Simulations are performed in a plug flow reactor (PFR) at various initial temperatures (1000 K - 1600 K) and pressures (5 torr - 100 torr), along with different values of temperature and pressure changes across the length of the reactor. Cantera takes an input file called a chemical mechanism which details the chemical reaction to be studied. Three mechanisms are used in this project, M1 with 42 species and 103 reactions, M2 with 20 species and 30 reactions, and M3 with only 5 species and one reaction. Mechanisms with higher detail can produce more accurate results at the cost of higher computational effort.
Some of the key outcomes of the study are as follows:
While globally reduced chemistry (M3) is computationally the least expensive, it yields significantly inaccurate results, which implies the need for a complex mechanism.
The use of detailed chemistry (M1) is expensive, however, retaining sensitive species and reactions led to the moderately complex mechanism (M2), which yielded similar results to the detailed one.
The decomposition of MTS is more sensitive to temperature than pressure, however the concentration of some of the other chemical species depends upon pressure.
Temperatures greater than 1350 K led to the complete decomposition of MTS and is associated with the production of other compounds, which can be helpful to trigger the surface reactions needed for deposition of SiC.

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Effects of Perceptual Response Training on Injury Incidence among Women's Collegiate Soccer Players

Lauren Brooks, Alejandra Gullion, Katarina McMahan

Context: Prevention and clinical management of musculoskeletal injuries have historically focused on assessment and training of physical factors, such as strength, endurance, and flexibility. Relatively little research has addressed the central role of brain processes in generating fast and effective motor responses to dynamic visual stimuli. Immersive virtual reality (VR) systems can measure the speed, accuracy, and consistency of body movements corresponding to stimulus-response instructions for completion of a forced-choice task.

Methods: A cohort of 26 college women's soccer players (age 19.5 ±1.3 years, height 167.8 ±5.5 cm, mass 63.6 ±6.7 kg) included 10 players who participated in a baseline assessment, 10 perceptual-response training (PRT) sessions, and a post-training assessment over 12 consecutive days that preceded the first soccer practice. The remaining 16 players completed a single assessment prior to the first practice. The assessments and training sessions involved left- or right-directed neck rotation, arm reach, and step-lunge reactions to 40 presentations of different types of horizontally moving visual stimuli. The PRT program included 4 levels of difficulty created by changes in initial stimulus location, addition of distractor stimuli, and increased movement speed. All assessments utilized level 1,with 90% response accuracy used as the criterion for training progression. Perceptual latency (PL) was defined as the time elapsed from stimulus appearance to initiation of arm movement toward a peripheral virtual target. Speed-accuracy tradeoff was represented by rate correct per second of PL (RCS-PL; test-retest ICC=0.887), and across-trial PL variability (PLV; test-retest ICC=0.763). The arm PLV metric has been validated for an association with concussion history (OR=22.5, *P*=0.004). The behavioral efficiency index (BEI) is a derived metric (RCS-PL /PLV) that provides a single value for speed, accuracy, and consistency. Analyses included bivariate correlation between exposure volume and difficulty level achieved, dependent t-testcomparison of pre- and post-training performance, and independent t-test comparison of training and non-training groups (α
Results: Training session number demonstrated a logarithmic association (Spearman's ρ=0.872 *P P*=0.007). The first-time assessments of the training and non-training groups did not demonstrate a significant BEI difference (4.09 ±3.58 vs. 3.40 ±2.87; *P*=0.595), but a large BEI difference was found between the groups for post-training assessment and the non-training first-time assessment (14.25 ±7.34 vs. 3.40 ±2.87; *P*=0.001).
Conclusions: The10-session PRT program produced significant improvements in perceptual-motor performance capabilities that may provide a far-transfer benefit in a competitive sport environment. The BEI may serve as a useful surrogate measure of brain processing efficiency that further research will assess as a potential prospective predictor of sport-related injury.

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Effects of Total Ionizing Dose on Specific Emitter Identification and Authentication of Software-Defined Radios
Alayna Grover

Specific Emitter Identification (SEI) is a method that identifies a wireless emitter, such as Radio Detection And Ranging (RADAR) and WiFi radios based upon unique radio frequency characteristics caused by unintentional distortions on the physical layer features. While there is a preponderance of research into the field of SEI, no SEI experiments have been performed when the to-be-identified device is being irradiated. This limits the ability for SEI to be performed on communications platforms deployed on spacecraft. This experiment irradiates six B200 mini Software Defined Radios (SDRs) with cobalt-60 to investigate the performance of SEI in the presence of increasing radiation dosage. An AI network was trained to identify how increasing radiation dosage affects the physical characteristics of the six SDRs.

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Engaged at Work, Detached at Home: The Role of Leadership Stress Management Competencies
Alaina Cook, Allaysia Watkins, Alexis Ormes

Organizational leaders play an important role in fostering employee engagement and promoting recovery outside of work, particularly in high-stress professions such as law enforcement. This study examines the relationship between perceived leadership stress management competency (i.e., a leader's ability to mitigate and respond to work stressors), employee engagement, and recovery, drawing upon existing research on occupational stress, burnout, and resilience. Prior studies have established that effective leadership behaviors mitigate stress-related burnout and enhance work engagement (Gillet et al., 2013; Zheng et al., 2020). Research also indicates that leaders with strong stress management competencies promote resilience among employees, improving their ability to recover from work-related stress (McCraty & Atkinson, 2012; Houdmont et al., 2020). Furthermore, poor leadership has been tied to elevated psychological distress and decreased work engagement, emphasizing the need for leadership training in stress management (Queirós et al., 2020; Richardsen et al., 2006). Based on this established literature, we hypothesize that perceived leaders' stress management competencies will be significantly correlated with work engagement and recovery experiences outside of work. We tested our hypotheses in a sample of over 200 city police officers who completed a survey assessment about their work stressors, resources, leadership, and health and well-being. Analyses will be complete by the time of the UTC Spring Research and Arts Conference. Our results are expected to add to the literature that suggests that leaders who enforce stress management strategies, such as resilience training and emotional intelligence development, can strengthen both workplace engagement and outside of work recovery (Liu & Boyatzis, 2021; Chitra & Karunanidhi, 2021). These insights can provide recommendations for creating work environments that reinforce employee well-being both during and outside of work hours.

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Enhancing Effective Communication with Autistic Individuals: A Virtual Expert-Guided Mobile Serious Role-Playing Game
Dixit Bharatkumar Patel

Effective communication between **neurotypical individuals** and those on the **autism spectrum** remains a critical challenge in fostering **inclusive interactions**. **ALICE Autism Care** is a **mobile coaching application** designed to enhance the **communication skills** of neurotypical individuals through **guided serious role-playing sessions**. The application features a **virtual expert instructor** and **interactive standardized autistic individual**, providing immersive training in **Direct/Action-based Communication** and **Nonverbal Interfering Behavioral Communication Skills**. Participants engage in **first-person interactive simulations**, assuming the role of a **resident advisor**, and receive **real-time feedback** from a **virtual expert guide**.
This research aims to assess the **effectiveness** of **ALICE Autism Care** in **improving communication skills**, **raising awareness** about **autism spectrum disorder**, and examining the role of **virtual standardized individuals** and **real-time feedback** in an **experiential learning mechanism**. Additionally, the study explores how **interactive digital training modules** can contribute to **long-term behavioral improvements** in **communication strategies**. This **Institutional Review Board (IRB)-approved** study encourages volunteers to participate by **downloading the application** and **completing training sessions**, contributing to a broader understanding of **technology-driven interventions** in **communication training**.

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Enhancing Industrial Reliability, Safety, and Efficiency: Airlock and Slide Gate Valve Design, Manufacturing, and Optimization for Sustainable Operations
Mayank Bharatkumar Patel

The **Airlock and Slide Gate Valve Design and Optimization** project is a **critical advancement** aimed at transforming the **reliability, efficiency, and safety** of industrial material handling systems. By optimizing the design of these key components, the project addresses vital industry challenges in sectors such as **bulk material handling, food processing,** and **pharmaceuticals**. Through the innovative integration of **high-performance materials, advanced sealing technologies,** and **smarter manufacturing processes,** the project ensures **precise material flow control**, enhances **system durability**, and significantly **reduces downtime**.
This **breakthrough** in airlock and slide gate valve optimization offers industries a highly **cost-effective solution** that not only improves **operational reliability** but also drives substantial reductions in **maintenance costs** and **operational risks**. By ensuring **safer,** more **efficient,** and **sustainable industrial operations,** this innovative project represents a **transformative contribution** to the global manufacturing landscape.

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Environmental Impact of Anesthesia: An Educational and Best Practices Tool
Hannah Aycox, Mihailo Nikolic

Healthcare plays a critical role in promoting human well-being, often involving surgeries that require anesthesia for safety and comfort. However, healthcare significantly contributes to greenhouse gas (GHG) emissions, with operating rooms accounting for 40-50% of healthcare's total emissions. Inhaled anesthetic agents are notable contributors to GHG emissions, yet their environmental impacts are often underestimated and poorly understood among healthcare providers. This quality improvement project focuses on educating anesthesia providers on the ecological effects of anesthetic agents to promote environmentally sustainable practices. The project addresses the clinical problem of anesthesia providers' reliance on inhaled agents like desflurane and nitrous oxide, significantly increasing GHG emissions. Research highlights that intravenous (IV) anesthetics, low-flow anesthesia, avoidance of desflurane and nitrous oxide, and regional techniques are eco-friendly alternatives; educational initiatives can drive meaningful reductions in high-emission agent usage. The translational project will utilize pre- and post-educational surveys to assess knowledge improvement among anesthesia providers at North Mississippi Medical Center (NMMC). A review of recent literature was used to gather information regarding the project and educational incentives. The evidence-based initiative aims to reduce anesthesia-related GHG accumulation and promote sustainable practices while maintaining high standards of patient care. Guided by the Model of Nurse-Patient Transactions, this project fosters a collaborative and evidence-driven approach to enhancing provider knowledge. By addressing gaps in understanding and providing practical solutions, the project seeks to reduce anesthesia's carbon footprint and improve environmental stewardship in clinical practice. The poster outlines the project's methodology, findings, and significance, emphasizing the importance of collective efforts in combating climate change through sustainable anesthesia practices.

Keywords: anesthetic agents, environment, global warming, carbon footprint, pollution

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EV Charging Behavior in Tennessee: A Machine Learning Approach to Understanding Station Utilization
Mehdi khaleghian

This study analyzes electric vehicle (EV) charging patterns and station utilization in Tennessee using machine learning (ML) techniques. While previous research has examined time series usage data, few studies have incorporated point of interest (POI) information or explored the relationship between various features and charging station (CS) utilization, particularly in the context of U.S. public charging infrastructure. Moreover, existing studies have often relied on limited feature sets and achieved relatively low coefficients of determination (R-squared). To address these gaps, we utilize a dataset consisting of 49,900 charging session records of Level 2 (L2) and direct current fast charging (DCFC) stations across Tennessee from 2018 to June 2024. To the best of our knowledge, our work is the first study which extensively analyzes utilization under various features, especially POI info. By employing a range of supervised ML models, including Ordinary Least Squares (OLS) regression, Gradient Boosting, XGBoost, Multi-layer perceptron (MLP), and Random Forest (RF), we predict daily charging station utilization with significantly improved accuracy. Our models achieve a 74% improvement in R-squared values for L2 stations and a 72% improvement for DCFC stations compared to the state-of-the-art research baseline. These results demonstrate that our approach outperforms the models used in previous studies.

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Evaluating Gene Expression of ACAT1 in Mice With Critical Limb Ischemia
Carli Todd

Critical Limb Ischemia (CLI) is an advanced stage of peripheral artery disease characterized by plaque buildup within the arteries, leading to reduced blood flow to the limbs. Atherosclerosis, specifically ischemic heart disease, is the leading cause of death globally. The Acetyl-CoA Acetyltransferase 1 (ACAT1) gene plays a role in forming the atherosclerotic plaque. This study investigates the hypothesis that the expression of the ACAT1 gene is overexpressed in response to ischemic conditions mimicked in mice. The goal of the research is to evaluate the ACAT1 expression and its potential role in the metabolic changes associated with ischemia and the possible improvement of the prognosis of the atherosclerotic plate.
To achieve our goal, we induced CLI in four of six mice through surgical femoral artery ligation. Gene expression analysis of ACAT1 in the liver and heart was performed using real-time quantitative PCR and compared in ischemic and non-ischemic limb tissues. We compared expression levels of ACAT1 activity and beta-actin, a housekeeping gene, to determine the impact of ischemia on ACAT1 activity. From our results, mouse 2 was removed due to discrepancies in beta-actin results, most likely resulting from issues during experimentation. Female mice had the highest expression of the ACAT1 gene in both the heart and liver tissues. The comparison between male and female mice leads us to conclude that there may be more efficient lipid metabolism in females than in males. Additionally, the liver tissue tends to overexpress the ACAT1 gene as compared to the heart. In conclusion, more work is needed to confirm if the ACAT1 gene is continuously overexpressed in both tissues, so the

research team will repeat the experiment with an increased number of mice and repeat using a different housekeeping gene. The future significance of the study could lead to cell therapy treatments to create new pathways of blood vessels for the ischemic tissue, improving outcomes for patients with this condition.

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Evidence-Based Practice: The Implementation of an Obstructive Sleep Apnea and STOP-Bang Educational Module in the Postanesthesia Care Unit
Ferrell Lanier, Leah Gunderman, Russ Trollinger

Evidence-Based Practice: The implementation of an Obstructive Sleep Apnea and STOP-Bang Educational Module in the Postanesthesia Care Unit
This evidence-based project addresses the knowledge gap related to obstructive sleep apnea (OSA) and the STOP-Bang (SB) screening tool. The authors will utilize a pre-and post-survey to determine how nursing knowledge is affected by an educational intervention in the postanesthesia care unit (PACU) at North Mississippi Medical Center (NMMC). Following a comprehensive literature review, the authors identified a lack of time spent educating on sleep-disordered breathing, fueling a knowledge gap experienced in clinical practice related to OSA and the SB screening tool. Evidence pointed to an increased vulnerability of patients with OSA in the PACU unit due to increased complications experienced postoperatively compared to patients without obstructive sleep apnea. Christine Covell's Nursing Intellectual Capital (NIC) theory provides a strong theoretical foundation for the quality improvement project, emphasizing that human capital has a role in improving nursing and organizational practice. The project is designed to provide education in the PACU and to utilize a survey to evaluate the effectiveness of the educational component. Decreasing the knowledge gap will improve patient outcomes in the PACU. The project's short-term and long-term goals have been identified. Short-term goals include 75% of nursing staff gaining knowledge related to OSA and its effects, the staff demonstrates confidence using the SB screening tool in patients with undiagnosed OSA, there will be 40% participation in the project by NMMC PACU nurses, and the surveys demonstrate a 40% increase in nursing knowledge related to OSA and the SB screening tool. Long-term goals include a 50% decreased incidence of hypoxia and postoperative airway obstructions in the PACU.

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Examining Certified Registered Nurse Anesthetists' Perception and Knowledge Surrounding Perioperative DNR Orders
Mackenzie Sanders, Elizabeth Swicegood, Claire Keiser, Kaylie Womack

This translational project explores the challenges Certified Registered Nurse Anesthetists (CRNAs) face in managing patients with Do Not Resuscitate (DNR) orders during the perioperative period. The project examines the complexities surrounding DNR orders in surgical settings, considering ethical, legal, and procedural implications. Anesthesia, which involves procedures like mechanical ventilation and hemodynamic support, creates unique challenges for providers as the practice may be interpreted as a resuscitative act, creating ethical dilemmas. Despite evidence supporting the necessity of preoperative discussions, or required reconsideration, nearly 26% of hospitals nationwide still reverse DNR orders automatically.

At Erlanger Hospital, the current policy states that DNR orders remain in effect unless explicitly reconsidered in a documented conversation between the provider and the patient or their decision-maker. The preoperative discussion combines resuscitative actions with patient values, decreasing ethical conflicts and legal issues. This translational project aims to evaluate the processes for managing DNR orders in the perioperative setting at Erlanger Hospital to ensure patient-centered and ethical care. A pre and post-survey will be used to collect data on CRNAs' knowledge, perceptions, and experiences regarding the management of DNR orders in the perioperative setting. The project highlights the promotion of best practices, including concise, patient-centered discussions, complete documentation, and clear communication with the perioperative team.

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Examining Disclosure Barriers To Sexual Assault For The LGBTQ+ Community
Cara Flowers

Sexual assault is a pervasive problem disproportionately impacting theLGBTQ+ community compared to their heterosexual counterparts (Coulter et al., 2017). Prior researchers have found that LGBTQ+ people are two to four times more likely to experience sexual assault revictimization compared to their straight counterparts (Daigle & Hawk, 2022). Among LGBTQ+emerging adults, sexual assault disclosure is often underreported due to fears of retaliation, questioning the validity of their experiences, and minimizing trauma (Weise, 2023). Unique barriers to disclosure, such as fear of stigma and not wanting to perpetuate negative stereotypes about the LGBTQ+community, significantly affect reporting (Kanefsky, 2022; Edwards et al.,2023). Further, sexual and gender minorities (SGM) face unique barriers to disclosing sexual assault, which can hinder their access to support and resources (Edwards et al., 2023). Understanding how these barriers affect disclosure is critical, as LGBTQ+ individuals are at a greater risk for victimization and revictimization (Friedman et al., 2011). The goal of our study is to identify and analyze how barriers to disclosure such as concerns about not fitting the "typical" rape victim stereotype, distrust of formal institutions (like colleges and police), outness, and rejection sensitivity, influence the disclosure of sexual assault among LGBTQ+ survivors.

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Examining Self–Perceptions of Professional Behavior in Prospective, Current, and Recently Graduated OTD/DPT Students
Anna Berry, Brooklyn Caballero, Claire Clemmons, Michaela Clouse, Viktoriya Marushka, Faith Price

Background: The purpose of this study was to examine the development of professional behavior in occupational therapy (OT) and physical therapy (PT) doctorate students. According to the literature, it is common that definitions of professional behavior are ambiguous and context-dependent (Robinson et al., 2012). **Methodology:** A pilot survey was used to identify indicators, form definitions, and assess self- perceptions of professional behavior among pre-OT/PT students, current students, and alumni. Analysis focused on self-perceived professional behavior between the time of considering application to an OTD or DPT program and the time of working as an OTD or DPT post graduation. **Results:** Statistically significant differences in professional behavior were found among the cohorts. Pre-OT/PT cohorts scored themselves lower on trustworthiness, problem-solving, moral

compass, honesty and confidentiality, and valuing diversity, when compared to later cohorts. **Implications:** Results supported the need for professional behavior to be taught throughout OTD and DPT programs. Additionally, results pointed to the need for a more universal definition of professional behavior.

Robinson, A. J., Tanchuk, C. J., & Sullivan, T. M. (2012). Professionalism and occupational therapy: An exploration of faculty and students' perspectives. *The Canadian Journal of Occupational Therapy, 79*(5), 275-284. https://doi.org/10.2182/CJOT.2012.79.5.3

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Examining the Benefits of Epidural Management Education within the Labor and Delivery Nursing Populace: A Translational Project

Whitney Recchia, Tim Lott

Patients in labor have the option to utilize epidural analgesia (EA) to manage contraction-induced pain. While EA provides optimal pain relief during childbirth, unwanted side effects can follow initiation. One particular outcome of EA potentially requiring interventions from anesthesia professionals presents as hypotension. Patients who develop hypotension following EA administration have increased risks of developing birthing complications. This integrative review (IR) aimed to scrutinize literature pertaining to research conducted on both the prevention and management of EA-induced hypotension, along with applying the findings to labor and delivery (L&D) nurses. As key contributors to the care and well-being of parturients, L&D nurses educated in EA-induced hypotension can provide enhanced care within their scope of practice and also appropriately escalate care to anesthesia providers in relevant situations. A literature search utilizing the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane Library, PubMed, National Institutes of Health Library, Google Scholar, Science Direct, and Gale One-file Health and Medicine provided literature concerning nursing education to prevent hypotension after initiation of EA. The final review produced 40 articles including systematic reviews, meta-analyses, randomized control trials, retrospective cohort studies, observational studies, and quantitative surveys. The IR results demonstrate the Iowa model's the efficacy as a guide for the developing an educational tool, outlining the deleterious effects of epidural-mediated hypotension on the parturient or fetus, and providing interventions to prevent or correct hypotension. These results support the developing and implementing an educational tool for bedside L&D nurses.
Keywords: hypotension, neuraxial analgesia, epidural anesthesia, education, management, labor and delivery nursing

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Examining the effects of 29 unique exogenous fatty acids on growth and membrane permeability in *Vibrio cholerae*

Carli Todd

Many Gram-negative bacteria possess the intriguing ability to utilize exogenous fatty acids from their environment for physiological and behavioral purposes. Specifically, *Vibrio cholerae* has been shown to scavenge an array of polyunsaturated fatty acids for incorporation into membrane phospholipids, thereby affecting permeability and antimicrobial resistance. *V. cholerae* encodes

several homologs of proteins involved in the uptake and assimilation of fatty acids into phospholipids. This study conducted an initial survey of saturated fatty acid responses in *V. cholerae* by performing growth curves and permeability assays with a library of commercially available fatty acids. Assessment of growth over 12 hours involved both i) normal minimal media with 300 micromolar fatty acid and ii) carbon-deficient minimal media with 1 millimolar fatty acid. Compared to the control, most fatty acids slowed the growth of *V. cholerae* when monitored in minimal media. Preliminary findings suggest that *V. cholerae* is capable of utilizing over a dozen fatty acids as sole carbon sources. Using the hydrophobic dye crystal violet, we determined the membrane permeability impact of fatty acids, ranging from 10 to 22 carbon lengths and 0-6 unsaturation(s). Of 7 linolenic acids (18:3), only one caused a decrease in permeability. 20-carbon fatty acids followed a pattern of increased permeability with each added unsaturation. Longer carbon lengths generally led to more significant changes in permeability. Regardless of carbon length, polyunsaturation typically resulted in significant changes to permeability. Up to 20-30% fluctuations in permeability were observed compared to the control. Collectively, data suggests a wide repertoire of fatty acids can alter growth and membrane permeability in *V. cholerae*. These effects on growth and membrane changes highlight *V. cholerae*'s ability to scavenge a multitude of fatty acids from its environments, as well as the potential for these fatty acids to alter lipid homeostasis.

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Exploring Emotional States and Gaze Behavior in Digital Learning Platforms: An EEG and Eye-Tracking Approach
Menekse Adar, Zack Ridder

This study explores how students emotionally and cognitively respond to different Canvas page templates using both EEG (EMOTIV) and eye-tracking (Gazepoint) technologies. By capturing brain activity and gaze behavior simultaneously, we aim to understand which design elements foster greater engagement and learning interaction. The integration of these two modalities enables a richer, multimodal analysis, offering insights into how emotional states influence visual attention in digital learning environments.

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Exploring Key Factors in Student Retention: Insights for UTC's RLC Program
Bailey Payne

Residential Learning Communities (RLC) are a model implemented by universities to address declining retention rates. This model incorporates many stakeholders within a university to create a culture of support and guidance for the students. A literature review was completed to spotlight research which studied student retention rates and the impact RLC programs may have on those retention rates, with the intent to inform future research for the RLC program at the University of Tennessee at Chattanooga (UTC). The literature review considered various retention models which describe the relationship between specific variables and how those variables may affect the retention rate of students. Results indicated student integration in the social and academic systems of a university, student commitment to the university, satisfaction with the quality of education received, and overall student supports play a vital role in retention.

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Exploring Limitations and Realism in Proto-Languages
Rylea Swafford

This paper explores the intricate dynamics of Historical Linguistics, particularly focusing on the comparative method's reliability in reconstructing proto-languages. The primary hypothesis postulated is that the existing methodological framework inadequately addresses the complexities inherent in language evolution and relationships, especially regarding distantly related languages such as proto-languages. Predominantly relying on the comparative method, this study investigates its limitations, particularly the absence of quantitative data, as highlighted by critics like Baxter and Ramer. A multifaceted approach combining qualitative and quantitative analyses is employed, emphasizing the need for empirical data to reinforce linguistic discoveries.
Utilizing examples from the Proto-Indo-European languages and groundbreaking studies like Grimm's Law, this research synthesizes historical changes in phonology and their impact on language reconstruction. Results indicate significant obstacles in reliably reconstructing proto-languages due to the lack of evidence and reliance on flawed methodologies. The findings illuminate challenges such as the treatment of irregularities and cognitive biases toward false cognates, suggesting that traditional models may obscure vast linguistic connections that extend beyond a straightforward comparative analysis.
Concluding that the reliance on the comparative method alone is insufficient, the paper advocates for the integration of probabilistic models to enhance the accuracy of language reconstruction efforts. In doing so, it calls for a transformative shift in historical linguistics methodologies, suggesting potential implications of artificial intelligence in overcoming the statistical and probabilistic limitations currently faced. This research contributes critical insights into the ongoing dialogue regarding the methodologies of historical linguistics and the future of language reconstruction in the context of evolving linguistic frameworks.

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Exploring the Impact of Marital Status and Number of Children on Mental Health Among Spanish-Speaking Adults living in the U.S. During and After the COVID-19 Pandemic
Apryl Johnson, Luis Mendez

The COVID-19 pandemic had lasting impacts on people worldwide and caused significant changes in family responsibilities. When examining mental health, it is important to consider familial factors. The aim of this study was to explore the impact of marital status and number of children on depressive symptoms experienced among Spanish-Speaking adults in the United States through the administration of a Spanish-language survey. Analysis revealed statistically significant correlations between marital status and depressive symptoms, marital status and number of children, self-esteem and depressive symptoms, as well as depressive symptoms and number of children. Our findings suggest that separated individuals experience the highest levels of depressive symptoms, followed by widowed, married, divorced, and single. The results of a one-way between subjects ANOVA revealed that number of children does have an effect on the amount of depressive symptoms experienced; individuals without children reported the lowest number of depressive symptoms, while parents with two children reported the highest. Our findings suggest that number of children has no impact on self-esteem. Furthermore, participants with higher self-esteem

reported less depressive symptoms. While such trends may have existed prior to the pandemic, examining how the pandemic influenced these dynamics based on marital status and number of children is essential for understanding its effects on self-esteem and mental health. This study highlights the importance of addressing family dynamics and their role in mental health.

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Fabrication of Bioactive Ceramic Coatings on Magnesium Alloys.
Diya Patel

Magnesium's biodegradable properties and excellent biocompatibility make it a promising candidate for temporary biomedical implants. For example, the need to remove implants after orthopedic surgeries due to failure or complications can lead to significant pain and financial strain on the patients. Therefore, developing effective biodegradable implants as alternatives to permanent ones is crucial. One effective approach to making magnesium suitable for biomedical use is applying protective coatings to reduce its corrosion rate. Over recent years, hybrid coatings such as Plasma Electrolytic Oxidation (PEO) and Sol-gel coatings have been studied to improve the corrosion resistance of magnesium alloys. This study focuses on examining how modifications in key parameters of the layer-by-layer Sol-gel coating process affect corrosion resistance in hybrid PEO/Sol-gel-coated magnesium samples. The coated specimens are analyzed for morphological and corrosion characteristics through electrochemical corrosion testing, scanning electron microscopy (SEM), contact angle measurement, microhardness testing, and X-ray diffraction (XRD) analysis. The study aims to assess the impact of different Sol-gel coating parameters with the goal of improving the corrosion resistance of PEO and Sol-gel-coated magnesium samples.

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Fighting Antimicrobial Resistance using Organometallic Cobalt Complexes that contain a Chiral Bidentate Ligand
Allie Boldizsar, Emilia Potter

The synthesis and characterization of four water soluble organometallic cobalt(III) complexes containing a chiral bidentate amine to see the effect of antimicrobial growth has been completed. The inner coordination sphere of these Co complexes contains a carbocyclic ligand (cyclopentadienyl Cp/pentamethylcyclopentadienyl Cp*), which is present in related compounds, and a chiral bidentate amine ligand that we hope to explore. It also contains acetate both in the inner and outer coordination sphere that provides water solubility. The complexes [CpRCo(X,X-DPEN)(OAc)](OAc) (R = Me, Cp* or H, Cp and X,X-DPEN = 1R,2R- or 1S,2S-diphenylethylenediamine, and OAc = acetate) were prepared in a two-step reaction involving ligand substitution from [CpRCo(CO)(I)2] with DPEN followed by anion metathesis with AgOAc. All complexes have been characterized by 1H- and 13C-NMR, elemental analysis, and in the case of [Cp*Co(R,R-DPEN)(OAc)](OAc) by single-crystal X-ray crystallography. The complexes were tested by exposing a series of gram-positive and gram-negative bacteria to varying concentrations of the antibiotic compounds. The synthesis, characterization, and results on the complexes as antimicrobial resistance agents will be presented.

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Fine-Tuning a Domain-Specific Language Model for Truss Structural Analysis
Rajon Dey

This research investigates the feasibility of fine-tuning a domain-specific language model (LLM) to enhance the accuracy and accessibility of truss structural analysis. General-purpose AI models, such as ChatGPT, often struggle with engineering-specific problems due to insufficient domain knowledge. To address this, we propose fine-tuning a small LLM tailored for structural engineering tasks, with truss analysis using the stiffness method as a case study. The project leverages a curated dataset of textual and diagrammatic inputs from engineering textbooks, manuals, and solved examples. Image-to-text tools will translate structural diagrams into machine-readable formats, reducing data preparation costs while maintaining numerical precision. Fine-tuning involves preprocessing domain-specific datasets, adapting pre-trained models using supervised learning, and incorporating physics-based constraints. A transformer-based model, such as Flan-T5, will be fine-tuned to process text-based truss problems and produce detailed analysis results, including intermediate calculations and force distributions. The model's accuracy and computational efficiency will be evaluated against benchmarks, conventional analysis tools, and case studies. Although the primary focus is on text-based inputs, this work lays the foundation for integrating visual inputs, providing engineers and students with a practical tool for rapid and accurate analysis. By addressing challenges in dataset preparation, fine-tuning, and evaluation, this study advances the application of AI in structural engineering.

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FireWatch
Wyatt Gaines, Stephen Mcreynolds, Megan Burns, Ethan Godbehere, Kailee Davidson, Brooke Synder

We aim to find a more seamless way for users to find out wildfire information and its impact to the area they live in. This would involve allowing users to see a generalized area the fire is in and would eventually have more information. It would include the direction and how big an area is affected by the wildfire.

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Flash Frequency of Split Fin Flashlight Fish *(Anomalops Katoptron)* in relation to the Lunar Cycle
Zainab Tanveer

The flashlight fish (*Anomalops katoptron*) employs symbiotic bacteria to produce bioluminescent flashes, which are believed to play key roles in communication, schooling, predator avoidance, and prey detection. In the wild, flashlight fish flash in relation to the lunar cycle, but the cues mediating this lunar-cycle-based flashing are unknown. In particular, it is unclear if lunar-cycle-based flashing is innate or mediated by environmental cues. This study aims to examine whether the flash frequency of *A. katoptron* fluctuates in response to different lunar phases. A captive population of *A. katoptron* at the Tennessee Aquarium, Chattanooga, was observed across two distinct recording phases: Fall 2024 (October 15 - November 15) and Spring 2025 (beginning January 28 and ongoing).

Observations were conducted nearly daily, with occasional disruptions due to aquarium events. Each session involved a 25-minute video recording of the fish's flashing behavior, with the camera positioned to capture activity from a sample of the tank. The number of flashes per session was counted, and statistical analyses will be performed using one-way ANOVA in SPSS to assess potential correlations between flash frequency and lunar phases. Data collection is still in progress, with preliminary data suggesting a possible relationship between lunar illumination and flash frequency. Final results will determine if the patterns are statistically significant. This research will provide valuable insights into bioluminescent signaling in *A. katoptron* and the potential environmental factors influencing their flashing behavior, shedding light on the adaptive significance of this phenomenon.

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Forgeon
William Reinhardt , Hayden Verstrat

Game designers and Dungeon Masters often struggle to create detailed dungeon maps due to time constraints and the complexity of immersive environments. Traditional methods, such as hand-drawn maps or pre-made templates, frequently lack flexibility and hinder creative storytelling. Forgeon is an open-source mapping generator designed to streamline the dungeon creation process while preserving user control and customization. It produces detailed and dynamic dungeon layouts with room descriptions, encounters, and environmental features. Unlike conventional approaches that demand extensive manual effort, Forgeon enhances the creative process, allowing users to focus on storytelling rather than structural design. By eliminating the most time-consuming aspects of dungeon design while maintaining flexibility and creative freedom, Forgeon empowers game masters and designers to craft richer, more immersive worlds with ease.

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Free Polyamine Quantification of 3 Ecotypes of *Arabidopsis thaliana* Exposed to Beta-Alanine
Sam Bright

Polyamines like putrescine, spermidine, and spermine have been shown to play an important role in cell differentiation, growth, and stress response in plants. In *Arabidopsis thaliana*, a flowering plant often used as a model organism for research, it has been shown that polyamine production increases to aid in osmoregulation when the plant is under salt stress. This research aims to quantify *A. thaliana*'s polyamine production and accumulation in response to different stressors. To carry out this research, a 1X Murashige and Skoog salt medium was created to grow *A. thaliana* seeds. Beta-Alanine, a nonproteinogenic amino acid linked to polyamine production, was introduced to the 1X MS medium to make a second treatment. After letting the seeds grow for fourteen days, the plants were harvested, and the free polyamines were quantified using high performance liquid chromatography. At the conclusion of this research, polyamine levels are expected to be higher in the seedlings grown with Beta-Alanine, since this amino acid is thought to aid in polyamine production. This research will help give a greater understanding of how polyamine biosynthesis is affected by Beta-Alanine and salt stress in *A. thaliana*. In the future, this research has the potential to have broader implications for stress tolerance responses in other plants and the effects of polyamines in other organisms.

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From Coexistence to Collaboration: Integrating English Language Learners into Campus Internationalization
Yvonne Dunham Slobodenko

This narrative literature review explores internationalization in higher education, focusing on how English language programs can actively participate. Over the last several decades, many higher education institutions have added global engagement goals strategic plans to produce interculturally competent students. However, international and domestic students typically do not regularly interact, and English language students have minimal engagement with other students. The literature examines ways to successfully integrate English language students into campus learning, benefiting both groups. Using an iterative and exploratory approach, I conducted searches using Google Scholar and the Primo discovery platform to identify relevant literature on internationalization in higher education, internationalization at home, and active engagement of English language learners and domestic students. The presence of international students does not automatically lead to successful interactions or intercultural competence. Instead, interactions must be strategically planned by faculty and staff. Additionally, learning outcome targets should be identified, and multiple forms of assessment should be used. Improved intercultural competence and communication is essential as the world becomes more connected, and students will need these skills in the workplace and beyond. While previous research has highlighted the importance of internationalization, this review emphasizes the often-overlooked opportunity for English language learners to be part of fostering meaningful engagement.

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Future Research of Masking in Young Adults with Autism Spectrum Disorder
Luke Hicks

Approximately 40% of autistic adults have a lifetime prevalence of depression. 44% - 67% of autistic young adults report experiencing stigma in their daily interactions.
Social camouflaging is the technique of hiding or "masking" certain aspects about oneself in order to 'get by' in social interactions. Past research has shown that many ASD adults utilize social masking to avoid feelings of social discomfort or avoid intense discrimination across many different contexts with their neurotypical peers. However, further research demonstrates that this masking may have counterproductive results by inducing higher levels of stress, creating feelings of inauthenticity, and a displaced identity.
There has been a limited understanding regarding the impact of positive oriented self-related outcomes such as self-acceptance, as most of these studies examine maladaptive behaviors in autistic adults. Finally, most ASD studies consist of participants from homogenous, higher socio-economic backgrounds. Therefore, the present study will seek to utilize a strengths-based perspective of neurodiversity in studying self-acceptance as it relates to the mechanisms and reasons behind social masking behavior in socioeconomically marginalized autistic young adults. We expect higher social camouflaging scores to relate negatively to self-acceptance scores. We also expect higher acceptance scores to predict lower frequencies of social masking themes.

We will recruit 10-15 individuals from the Chattanooga Autism Center for 1 hour semi-structured interviews and a survey with acceptance and social camouflaging measures (i.e., SCS, CAT-Q). These interviews will contain open-ended questions asking about social interactions and masking such as "Can you share an experience where you felt you needed to change how you acted or communicated when around others?" We hope this study can contribute to a growing body of strengths-based research promoting greater self-acceptance in neurodivergent populations. Additionally, we encourage future research to examine reasons behind social camouflaging in ASD adults so therapeutic interventions can adjust and foster authentic behavior no matter the context.

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Getaway Outpost

Ella Van Dyke, Sadie Ayers, Emily Pelletier, Ben Fowler, Lillian Fite

Clay County, located in northern Middle Tennessee, is a small county with many tourists. An option for tourists is a proposed campground with cabins and a staff building on a parcel of land in Clay County. The campgrounds will be the property of Getaway House LLC, who have hired Regan-Smith to develop this property.
Our team shall assist Regan-Smith by providing geotechnical analysis, access roadway design, and septic system design.
The team shall adhere to Tennessee code 0400-48-01: Regulations to Govern Subsurface Sewage Disposal Systems, and Section 903.05 of the Tennessee Department of Transportation specifications, considering sections 307 and 411, and utilize Civil 3D.
Road design: A cross-section was developed to balance requirements with safety and comfort. A design speed of 25 mph was selected. Lane widths are 12 feet with a 2-foot shoulder. A maximum superelevation rate of 4% was chosen to reduce horizontal radii and align with terrain.
Septic system: a conventional drain field was chosen for simplicity of design and installation, economy, and aesthetics. Drain field locations were based on location and depth of suitable soil, proximity to cabin sites.
Results of road design: Preliminary design, roadway alignment, horizontal and vertical curve analysis, stormwater calculations, cross-section design, earthwork estimates.
Results of septic system design: Water usage calculations, linear footage and area requirements, location planning and drain field layout, and detailed field dimensions. Construction cost estimates and prints produced for road and septic design.

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Global Alliances and Their Impact on U.S. Economy

Jacqueline Alvarado, Ally Hefner, Sara Ruiz, Olivia Mills, Abril Chavez Bustos, Aidan Zak

The United States' shifting stance on global alliances has had subsequent effects on the economy. President Jimmy Carter's pull from the Mutual Defense Treaty with Taiwan helped grant formal diplomatic recognition for the People's Republic of China, establishing a beneficial trade relationship that is the country's most significant to this day (Goldwater, 1977). In 2001, President George W. Bush made the decision to back out of the Anti-Ballistic Missile Treaty, claiming the treaty had outlived its purpose with the collapse of the Soviet Union (Acton, 2021). The withdrawal has led to tens of billions of dollars being poured into homeland missile defense, effectively canceling out any

economic benefit gained from dropping out of the treaty. Presently, President Donald Trump and his "American First" campaign have led to the United States pulling out of alliances like the World Health Organization in 2025 and the Paris Climate Agreement in both 2017 and 2025. By analyzing the impact the withdrawal from the Mutual Defense Treaty with Taiwan, the Anti-Ballistic Missile Treaty, the Paris Climate Agreement in 2015, and the World Health Organization had on the U.S. economy, we anticipate Trump's withdrawals from foreign alliances will impact the economy.

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Harnessing Quantum Light for Enhanced Sensing of Biokinetic Processes
Evan Humberd

Biokinetic processes are attributes used to characterize how systems interact on a molecular level which can be used for biomedical applications such as drug synthesis. One method to measure these processes is using a plasmonic sensor; the precision of which depends on the number of photons used in the study. Plasmonic sensors use photon-phonon interactions to extract information, and as such the shot noise limit (SNL) of the number of photons imposes a limit on the minimum amount of information that can be extracted1. Using two quantum correlated beams of light, the SNL can be overcome thus improving the precision of the measurement. In this study, we report a quantum-enhanced sub-SNL measurement of the biokinetic process of bovine serum albumin (BSA) using surface plasmonic resonance2 (SPR) and demonstrate the quantum advantage of using entangled beams of light for biomedical applications.

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High-Performance Industrial Pump System Design, Manufacture, and Optimization for Enhanced Flood Disaster Preparedness and Emergency Life Rescue Applications
Mayank Bharatkumar Patel

Flood disasters cause significant loss of life, environmental damage, and economic hardship, highlighting the urgent need for effective disaster management solutions. This project presents the design, development, and optimization of a high-performance industrial pump system to enhance flood preparedness and emergency response, aligning with national interest in crisis management and public safety. The project focuses on overcoming critical challenges, including achieving high flow rates, ensuring operational reliability under extreme conditions, and optimizing energy efficiency for extended use in emergency situations.
A robust prototype was designed and rigorously tested to validate its performance, prioritizing hydraulic efficiency, durability, and adaptability. Advanced engineering techniques—structural analysis, computational modeling, and material optimization—were employed to maximize effectiveness and resilience. Precision casting techniques were used to manufacture an initial batch for field testing, with ongoing improvements focused on portability, rapid deployment, and system robustness in disaster zones.
This work bridges theoretical design and real-world application, providing a scalable solution for flood mitigation. By enhancing emergency pump technology, the project serves national interest by strengthening public safety, disaster resilience, and recovery efforts. The optimized system offers dependable, high-performance equipment for rapid deployment in extreme environments, setting a new benchmark in mechanical engineering for national flood preparedness.

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Higher Ed in Half the Time: A Literature Review on the Shortened Course Format
April Kidd

The shortened course, which reduces the course length from the full semester (Johnson & Rose, 2015), offers a popular higher education format for nontraditional students, especially those at community colleges. The impacts of accelerated learning on both students and faculty have been studied, yet the variety of shortened course lengths makes comparison across studies more challenging. The purpose of this study is to focus on the half semester length for research published from 2010-2024 on undergraduate higher education. The methods used to locate dissertations and articles included searches on Google Scholar and the University of Tennessee at Chattanooga library database using key words such as: *accelerated courses*, *community college*, and *two-year college* and backward citation chaining. Findings revealed an emphasis on student success, faculty and student stakeholder perceptions, strategies for andragogy, application for underprepared students, and considerations for decision-makers. The narrowed focus of this study can help continue conversations of institutional efficiency and effectiveness utilizing undergraduate shortened courses.

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History of Nurse Anesthesia Education as Evidence for Healthcare Policy Change
Katherine Freeman, Elena Carden, Zach Carden, Zach Vaden

Certified Registered Nurse Anesthetists (CRNAs) have been providing care in the United States since the development of medical ether in the 1860s, and today, they make up more than half of the anesthesia workforce. Nurses continue to be as instrumental in the development of the profession as they were to its founding, despite a general lack of recognition among the public and policymakers. In the city of Chattanooga, nurses have been trained in anesthesia since 1972, beginning at the Baroness Erlanger School of Anesthesia for Nurses (BEHSAN) and continuing today through the University of Tennessee-Chattanooga (UTC). Despite the more than 25 years of CRNA education before merging with the university, there is no documentation of BEHSAN outside of student records. Indeed, state legislators from the local area have recently mistitled CRNAs and misrepresented their contributions in discussion of anesthesia legislation for Tennessee. In order to decrease the knowledge gap for healthcare policymakers, this project will conduct oral histories of graduates of BEHSAN, archive them with the Special Collections Library at UTC, and develop resources to distribute to policymakers from those oral histories. Education developed from the oral histories will highlight the human side of the already overwhelming statistical evidence that utilizing CRNAs increases patient access to safe, effective, and cost-efficient care.

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How Does Attendance at Private Versus Public High School Affect the College Experience?
Hayle Murphy, Adynn cluver, Sarah Mathis, Sulmy Perez, Lane Wick

This research study aims to understand how attending a private or public high school influences one's college experience. This study will focus on how high school education plays a role in mental health, academic success, campus involvement, and personal school funding in college; these factors will be the study's definition of the college experience. This study will define those four factors as the college experience that will be measured. These four aspects are important to our research because, within our literature review, they have been the focus of many studies. Some of our findings have shown that people who attended public school tend to be more involved in campus activities during college. While people who attended private school tend to have higher GPAs in the first couple of years, studies have shown that their GPAs tend to drop after a couple of years (Dupeé, Ryan Curtis, 2021). The standards of high school education may have an immediate effect on college academic success. It is also evident that whether a student attended public or private school may affect their enrollment, as students who have attended private school typically come from more financially stable backgrounds, which gives an easier barrier to entry regarding tuition and textbook fees. Garofalo's (2014) study explains the effect of mental health on high school education leading to college education. Mental health is one of the main aspects we will be looking at because it can affect all the other aspects in question. (Garofalo, L. 2014). Currently, there is a lack of substantial research comparing the effects private schooling and public schooling have on alumni's future. One of the knowledge gaps that we are seeing in our research is the lack of studies comparing public and private schools in America. This has been a little difficult during our research because schooling is different in each country. We must look at the influences of the American school system. Through this, we will be able to determine how different types of high school education can influence these factors to help explain students' transition to college and theiroverall success. This study will pay attention to the different dynamics that play a role in college success, like campus involvement, mental health, and personal school funding. We can use the findings from this study to understand how those different life experiences can influence behavior in college students.Conducting a study that explores the dynamics of public schools versus private schools is significant as it can correlate to determining the needs of the population. This study will be beneficial forstudents and future parents to decide what kind of education may be the best for their students. These findings may show the areas in which students are succeeding the most and where they need more support in college depending on their high school background.

Garofalo, L. (2014). The Effects of Prior Schooling on the Transition to College. Texas Christian University. https://repository.tcu.edu/handle/116099117/7288

Dupeé, R. C. (2021). Evaluation of the alignment of student perceptions of parental expectations regarding academic success in private college-prep high schools (Order No. 28717202).Available from ProQuest One Academic. (2572603697). Retrieved from https://proxy.lib.utc.edu/login?url=https://www.proquest.com/dissertations-theses/evaluation-alignment-student-perceptions-parental/docview/2572603697/se-2

https://symposium.foragerone.com/utc-spring-research-and-arts-conference-2025/presentations/72635

Howard Pressure Chair
Luke Wilhelm, Eric Contreras, Carson Hendricks, Alex Lighthall, Nathan Boaz, Jacob Haynes

Our team is tasked with creating a chair that can apply pressure to kids with autism to help relive stress and anxiety that they may experience.

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Identification of key biomarker genes in liver hepatocellular carcinoma and kidney renal clear cell carcinoma progression: A shared high-throughput screening and molecular docking method with potentials for targeted therapeutic interventions.
Jannatul Ferdoush

ABSTRACT
Background and objectives: Liver Hepatocellular Carcinoma (LIHC) and Kidney Renal Clear Cell Carcinoma (KIRC) are leading causes of cancer death worldwide, but their early detections remain hindered by a lack of genetic markers. Our study aims to find prospective biomarkers that could serve as prognostic indicators for efficient drug candidates for KIRC and LIHC treatment.
Methods: To detect differentially expressed genes (DEGs), four datasets were used: GSE66271 and GSE213324 for KIRC, and GSE135631 and GSE202853 for LIHC. Visualization of DEGs was done using heatmaps, volcano plots, and Venn diagrams. Hub genes were identified via PPI analysis and the cytoHubba plugin in Cytoscape. Their expression was evaluated using box plots, stage plots, and survival plots for prognostic assessment via GEPIA2. Molecular docking with PyRx's AutoDock Vina identified optimal binding interactions between compounds and proteins. Pharmacokinetic and toxicity analyses reinforced the drug-likeness and safety of these compounds.
Results: In this study, 47 DEGs were identified, with the top 10 hub genes being *TOP2A*, *BUB1*, *PTTG1*, *CCNB2*, *NUSAP1*, *KIF20A*, *BIRC5*, *RRM2, NDC80* and *CDC45*, chosen for their high MCC scores. Data mining revealed a correlation between TOP2A expression and clinical survival outcomes in KIRC and LIHC patients. Docking studies of the TOP2A structure identified a promising compound from *Andrographis paniculata* with high binding energy and interactions with TOP2A. Pharmacokinetic and toxicity assessments support its potential as a drug candidate.
Conclusion: Our study emphasizes *TOP2A*'s prognostic significance in KIRC and LIHC and recognizes *Andrographis paniculata* compound as potential therapeutics, offering prospective for enhanced treatment and patient outcomes in these cancers.

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Idiopathic Scoliosis Brace for Children
Hailey Henderson, Arwen Moss, Lynsey Lawson

Adolescent scoliosis patients need faster turnaround times for brace adjustments. Current bracing methods require frequent adjustments that take weeks to complete. Once the brace is returned to the patient, they are often close to or have already grown out of the brace. There needs to be a faster and inexpensive way to produce the brace and provide reliable treatment. Using low heat thermoplastic, we have found a way to craft scoliosis braces in short amounts of time. With heated water, or a heated gun, we can safely mold the thermoplastic to the patient's body. We can then adjust the brace to match the needs of the patient and attach the cords and straps used to

hold the brace tight to the body. Overall, it took us one day to complete the construction of the brace and an extra day to custom design the brace. Our brace can provide reliable treatment for idiopathic scoliosis, while also lowering the cost for the patient and the manufacturer. Lowering the cost for the brace allows more availability for treatment, especially for low income families, or families without health insurance. With our fast design process, we can provide more braces in less time, giving patients more time with their individual brace before they need an adjustment.

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Impact of Flexible AC Transmission Systems (FACTS) Devices on Power Transmission Lines
Blake Pickett

Flexible Alternating Current Transmission System (FACTS) devices optimize power distribution networks by enhancing voltage control, reducing power losses, and improving system stability and efficiency. Research focused on the integration of Thyristor-Controlled Series Capacitor (TCSC), Static Var Compensator (SVC), and Static Synchronous Compensator (STATCOM) devices within 50-kilometer (km), 200-km, and 500-km Power Transmission Lines. MATLAB Simulink was used to develop baseline and optimized models with a FACTS device at either the Sending or Receiving End of the Power Transmission Lines. Comparative analyses of current, voltage, and power indicated TCSC devices at the Sending End of the Power Transmission Lines significantly improved power transfer capacity by reducing line reactance and enhancing voltage stability. STATCOM devices at the Sending End provided improved reactive power compensation and minimized voltage fluctuations, providing enhanced system stability. Research on the SVC devices indicated that the placement of these devices did not impact their performance. Findings indicate that the TCSC devices increase power flow, while SVC and STATCOM devices minimize voltage fluctuations and improve overall system stability. The optimum distance for the Power Transmission Line with the TCSC device is 200-km, while the optimum distance for the Power Transmission Line with an SVC or STATCOM device is 50-km.

Optimal placement reduces transmission congestion, minimizes energy losses, and enhances economic performance of power networks, resulting in significant cost savings. Research indicates economic benefits of integrating FACTS devices within power networks can be substantial. These benefits may come at a cost to the environment. Additional research is needed to identify strategic placement of FACTS devices to balance efficiency and environmental concerns.

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Impact of Transferring on Undergraduate Student Stress
Emma Stidham, Grace Crossett, Alexis Kennedy, Samantha Trojan, Julianna Seder

This presentation explores the relationship between transferring colleges and undergraduate student stress levels. Utilizing a quantitative survey approach and chi-square analysis, the study compared stress levels of transfer and non-transfer students at UTC. Results showed no statistically significant difference in stress levels between the two groups, suggesting that transferring itself may not inherently elevate stress. However, gender differences were noted, with female students reporting higher stress. The findings highlight the importance of individualized support in social work

practice and suggest that various personal and situational factors influence student stress more than transfer status alone.

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Implementation of an Evidence-Based Abusive Head Trauma Prevention (PURPLE) Practice Guideline to Pediatric Providers
Alexa Allen, Logan Zumbrun

Abusive head trauma in the pediatric population is the foremost cause of child abuse deaths in the United States (National Center on Shaken Baby Syndrome, n.d.). The majority of cases of abusive head trauma occur in infants under six months (National Center on Shaken Baby Syndrome, n.d.). The Period of PURPLE Crying, an evidence-based education program was developed by the National Center on Shaken Baby Syndrome to prevent abusive head trauma (National Center on Shaken Baby Syndrome, n.d.-b). This project implemented the Period of PURPLE during the peak of early infant crying at one and two-month infant wellness in a rural pediatric clinic. Objectives were to increase pediatric provider and staff knowledge of abusive head trauma and implementation of the Period of PURPLE Crying. Statistical analysis is currently in progress to determine if outcomes were achieved.

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Implementing a Second Victim Peer Support Program in the Medical Intensive Care Unit
Suzanne Ridge , Susan Thul

Background: The second victim phenomenon occurs when a healthcare provider experiences trauma as a result of an unanticipated adverse event, leading to severe mental health consequences such as burnout and secondary traumatic stress.

Purpose: The purpose of the pilot project is to mitigate mental health consequences of the second victim phenomenon through implementation of a second victim peer support program in a Medical Intensive Care Unit.

Methods: An evidence-based practice guideline has been developed to guide the peer support program. Unit staff received education about the second victim phenomenon. Volunteer peer supporters received education utilizing a combination of basic mental health first aid and critical incident stress management techniques.

Anticipated Outcomes: Improvement in secondary traumatic stress and burnout is expected and will be measured at 3 and 6 months post implementation.

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Implementing an Evidence-Based COPD Care Bundle to Reduce Hospital Readmissions in Patients with Moderate to Severe COPD Who Reside in a Long-Term Care Facility.
Tonya Morgan

This quality improvement DNP project aimed to decrease hospital readmission rates in patients with moderate to severe COPD residing in a local nursing home. The project's purpose was to implement an evidence-based COPD care bundle shown to decrease hospital readmissions, decrease COPD exacerbations, and decrease healthcare costs. Data collection and analysis is currently taking place. Results and conclusions will be available at the time of presentation.

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Implementing Requirement for Curriculum Maps as Part of Academic Program Assessment
Cindy Williamson, April Matthews, Grace Peters

Working to establish a culture of assessment and improve outcomes assessment processes, the Office of Accreditation and Assessment (OAA) has strategically increased communication and resources related to assessment. Initially, the outcomes assessment process focused more on accountability to the exclusion of improvement in process, services, and programs. The focus is now toward quality of outcomes and assessment, with requirements that have continually improved to help support the process and use of assessment results to make data-informed decisions.

Those responsible for assessment, as well as administrators, were notified beginning in Fall 2024 of the upcoming curriculum map requirement to be implemented beginning Fall 2025. To help support faculty, OAA created a website with resources related to curriculum maps and plans to hold workshops in Spring and Summer 2025 to assist with curriculum map development. Curriculum maps act as a critical tool for program assessment by providing a comprehensive overview of how a program is designed to achieve its learning objectives.

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Improving Safety - Risk Reduction
Grant Fuller, Nicholas Walton, Bradley Sutton

The focus of this project at Schnellecke Logistics' Chattanooga plant is improving warehouse safety and creating a reduction in actionable safety events by identifying key factors and implementing practical solutions to reduce the likelihood of incidents occurring. The primary areas of improvement involve improvement of safety walkways, installation of highly visible hazard communication devices (signs/lights) and development of additional training metrics to increase awareness of incidents to lead to a better trained and more aware staff. Additionally adding frequent safety audits to the new methods to ensure a control plan was in place to prevent incidents from reaching pre-project levels as well as aiding to create a continuous improvement mindset to aid in creating a strong safety culture, in turn improving employee morale and efficiency.

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Improving the Accuracy and Reliability of Attitude Control Systems in Cube Satellites
Tate Harrison

A Cube Satellite, or CubeSat, is a cube with a side length of 10cm sent into Low Earth Orbit (LEO) to run tests in space. CubeSats often use attitude control systems to orient themselves in space to face a certain direction. The most common type of attitude control system uses reaction wheels, which are wheels that spin in one direction on certain axes to rotate the entire CubeSat in the opposite direction using the conservation of angular momentum. The CubeSat attitude control system worked with in this project uses reaction wheels in a low-friction test environment to allow accurate tests simulated in space to further CubeSat research. Using a previously implemented air-bearing as well as wireless serial communication from an on-board IMU, real time CubeSat X, Y and Z angle difference was read by an external computer running Megunolink software. The efficiency and effectiveness of reaction wheels fabricated from materials with differing densities was then compared to find the optimal material. Tests were carried out along the X axis with PLA, stainless steel, and brass reaction wheels at differing start angles to find the fastest converging system. The findings proved that denser reaction wheels performed better at larger start angles, while less dense reaction wheels performed better at smaller start angles. This data can now be used to optimize future reaction wheels that will benefit CubeSats in space. Research is now being furthered by creating an expanding reaction wheel that can automatically change its moment of inertia based on its needs for maximum efficiency.

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Increasing Palliative Care in the Rural Community
Kristen Carroll

Background: Palliative care referrals among rural populations lag behind those of their urban counterparts. This gap in practice exists due to the absence of or delayed palliative care referrals among rural primary care providers related to lack of training and education in palliative care in rural areas and misperceptions of palliative care among providers.

Purpose: The purpose of this Quality Improvement project is to increase provider competency and patient referrals to palliative care within the targeted rural community. This will be accomplished by providing an evidence-based referral presented in an organized educational format.

Method: A convenience sample of primary care providers within the target area will receive the evidence-based practice guideline, accompanied by a comprehensive education session which addresses the purpose, benefit, and need for palliative care services within their patient population.

Anticipated Outcomes: Improvement in competency and referrals is expected and will be measured by pre- and post-presentation surveys over a four-month period and by referral data gathered after six months.

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Increasing the number of debriefs postcode in the emergency department
Maddie Piva, Jada Harris

Abstract
Introduction
A debrief is a structured, collective conversation held after an event that provides learning, engagement, sharing, and reflection opportunities. This process has been shown to reduce burnout, improve patient safety by reducing medical errors, and promote resilience in staff members. Debriefs facilitate open communication, helping teams identify strengths and areas for improvement. Despite their positive impact and well-documented benefits, emergency departments frequently overlook and underutilize debriefs. This gap represents a challenge and emphasizes the need for a more consistent approach to debriefing.
Purpose
This project aimed to increase the number of debriefs postcodes while simultaneously increasing documentation compliance by implementing a debrief button within the electronic charting system.
Methods
To accomplish this, a Chi-Square analysis was run on the number of debriefs performed after medical codes before and after implementing a debrief button, and a z-score was conducted on the number of times a debrief was documented. A debrief button is an additional line in the charting system that asks if a debrief has been completed, with a "yes" or "no" response. Pre-implementation data was collected by reviewing charts for all medical codes and conducting follow-ups with the primary nurse. Post-implementation data was collected through chart review, utilizing the button's response data captured via the appropriate selection within the chart. The primary nurse was contacted for follow-up if the button was not used.
Results
The number of debriefs increased after the debrief button was implemented, rising from 12.1% pre-implementation to 45.9%, with a p-value of 0.0048. This shows statistical significance and supports using the debrief button within the electronic charting system. Documentation capture increased from 0% pre-implementation to 40.5% post-implementation, with a z-score of -4.13 and a corresponding p-value of 0.000037.
Conclusion
Debriefing is a valuable practice for emergency department staff. It should be conducted following all medical codes. Implementing an electronic reminder within the charting system ensures that debriefing occurs consistently.

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Influences on Social Dynamics in Southern Vietnam vs. the American South: A Comparative Analysis
Victoria Lac

Southern Vietnam, unlike its counterparts in the North and Central regions, is an area of Vietnam that has found focus on urbanization along with agriculture. The American South has notably held a similar focus in agriculture, resulting in a rise in urbanization that has lead to widespread development.

With such a similar development, similar factors yet different influences work to curate the unique social dynamics presented by both southern regions.

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Innovating Green Building Construction Practices
Garrett Rucker, Connor Nystrom

This project aims to reduce the high costs typically associated with eco-friendly, modular homes, while enabling MDG Properties to promote affordable smart home technology. Affordability is a critical issue for MDG Properties to address, due to inflated housing markets, high interest rates, and uncertainty in what the future holds. In this project, the DMAIC process was incorporated to ensure a systematic approach to identifying cost reduction opportunities, optimizing processes, and ensuring sustainable improvements. The team gathered alternative solutions, weighing the potential risks associated. One of the key findings from the project was that relocating the prefabrication facility to Texas could result in a 20% cost savings, due to lower labor costs, reduced transportation expenses, and favorable state tax incentives. MDG Properties will carefully review all findings from the project before making an executive decision on the proposed strategies and recommendations.

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Intelligent Reconfigurable Battery Systems Enabled by Deep Reinforcement Learning
Mehedi Hasan, Philip Segraves, Yu Liang

Existing large-scale batteries, such as batteries for electric vehicles, electric planes, and electric boats/ferries, are designed so that battery cells are assembled by a combination of fixed parallel and series connections, making them unsuitable for efficient battery power management to improve the overall battery operating time. This paper proposes dynamic multi-cell battery reconfiguration based on deep reinforcement learning to prolong battery operating life. Specifically, unlike existing research mainly focused on cell-level battery reconfiguration, our approach directly optimizes the battery topology at the switch level while considering different battery and load constraints, explicitly generating the optimal topology for the entire battery pack. We use PyBaMM, an open-source battery simulation toolkit, to model multi-cell battery discharge behaviors in the reconfiguration optimization. Simulation results show that the proposed approach can significantly improve battery operating time while meeting various operational constraints.

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Interceptive Contributions to Spatial Orientation Perception
Sandra Pullam

Perceiving the position of the body relative to gravity is essential for daily functioning and the prevention of physical bodily injury. Vestibular disorders and other health conditions can impair this ability, demonstrating the importance of reliable assessments. A commonly used measure, the Subjective Visual Vertical (SVV) test, evaluates this capability by having participants rotate a stimulus to be aligned with what they perceive to be the gravitational vertical. Traditionally, SVV performance is thought to rely on the integration of visual, vestibular and somatosensory information. However,

recent research suggests that interoceptive signals, specifically from the cardiovascular system, may also play a role (Teaford et al., 2022). Interoception is defined as the sensation and integration of internal bodily systems, such as the heart, lungs, and gastrointestinal organs. This study investigates the relationship between pulse rate variability and SVV task performance under stationary conditions, aiming to isolate cardiovascular signals. A sample of college student participants was recruited through a combination of Sona Systems. These participants completed the SVV task adapted to a Virtual Reality (VR) environment. Pulse rate was measured using pulse oximetry before and during the SVV task to calculate pulse rate variability. It was hypothesized that higher pulse rate variability would be associated with more variability and less accuracy in SVV performance (i.e., larger differences between the perceived and true gravitational vertical). Correlational analyses will be conducted on the data to assess these hypotheses. These findings will expand our understanding of multisensory integration in the context of spatial orientation and potentially have implications for aviation. Specifically, if pulse rate variability is found to be associated with SVV accuracy, changes in pulse rate variability could potentially be used to trigger spatial disorientation related counter measures in aircrafts.

https://symposium.foragerone.com/utc-spring-research-and-arts-conference-2025/presentations/71998

Investigating the Effects of Additives on the Performance of Biodegradable Polymer Composites
Natalie Williams, Jessica Song, Asaf Varol

As industries shift toward sustainable materials, biodegradable polymers like PLA 3052D and PBAT offer a viable alternative to traditional plastics. However, enhancing their mechanical properties remains a key challenge in manufacturing. This study examines the effects of glycerin, bamboo fiber, and activated carbon as additives to improve flexibility, strength, and durability. Using a controlled melting and mixing process, we assessed the structural and functional modifications induced by each additive. Results show that glycerin enhances flexibility and mixability but slightly increases brittleness, bamboo fiber reinforces strength and thickness while introducing processing challenges, and activated carbon improves hardness and opacity but makes the material more brittle. These findings are critical for optimizing biodegradable polymer formulations in manufacturing, enabling the production of more durable and application-specific bioplastics. Future research could explore long-term degradation and mechanical performance under real-world conditions to further refine sustainable polymer manufacturing processes.

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Investigating the Role of *ILV1* on Stress Response in Saccharomyces cerevisiae
Luke Beachboard

Saccharomyces cerevisiae, a model organism within molecular genetics, is also known for its broad role within baking, brewing, biofuel, and pharmaceutical industries. An unpublished study at The University of Tennessee at Chattanooga observed decreased cell viability in an *ILV1* Knockout strain of *S. cerevisiae* when exposed to environmental stressors. A subsequent study at The University of Tennessee at Chattanooga found expression levels of the candidate genes to be significantly altered within the *ILV1* Knockout strain relative to the BY4743 Wildtype strain, demonstrating the reality of *ILV1*'s pleiotropic role.

Now, this study aims to further investigate this peculiar characteristic of *ILV1* and role on stress response in *S. cerevisiae* by analyzing eight candidate genes involved in various metabolic processes. Two strains of *S. cerevisiae*, a BY4743 Wildtype and *ILV1* Knockout, were subjected to identical stress conditions (salinity, osmotic, oxidative, and heat) and RNA was individually extracted from each trial of yeast cells, converted into cDNA, and analyzed through quantitative Real Time Polymerase Chain Reaction (qRT-PCR). The results of this study demonstrate minimal significant variation in candidate gene expression levels between the *ILV1* Knockout and the BY4743 Wildtype strains. These results do not entirely support the pleiotropic nature of *ILV1* and instead challenge the pleiotropic hypothesis of *ILV1*, warranting further investigation into the nature of *ILV1*.

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Is Fair Lovely?: A Cross-Cultural Comparison of the Impact of Colorism on Mental Health in South Asian Women
Shyla Khan

Colorism, the preference for lighter skin tones within and between racial or ethnic groups, is a prevalent issue in many non-White communities, particularly those with a history of colonization (Rhondilla & Spickard, 2007). The practice of skin bleaching to achieve lighter skin tones with products such as *Glow & Lovely* is widespread due to associating it with higher status, despite severe health risks, including skin cancer, renal failure, and stillbirths (Dhillion-Jamerson, 2019; Magsi, 2011; Street et al., 2014; Hall, 2022). Psychologically, colorism can lead to diminished self-esteem, depression, and social isolation due to internalized messages of unattractiveness (Sharif & Siddique, 2020; Hall, 2017). Previous researchers have analyzed attitudes endorsing colorist experiences (Harvey et al., 2017); however, in the current study, we extend past research by examining the intensity and frequency of colorist messages from social circles. In the present study, we investigated the nuanced relationships between the sources of colorism messages (e.g., family, friends, media) and their impact on mental well-being among South Asian women in Asia. We hypothesized, based on Objectification Theory, that the relationship between colorism messages and well-being would be mediated by self-objectification processes, which are influenced by experiences with colorist discrimination. Using structural equation modeling (SEM), we aimed to understand how cultural, familial, and societal influences contribute to body-related perceptions and psychological well-being.

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Joint Specific Finger Rehabilitation Brace
Brenden Lippard, Austin McDade

The Joint Specific Rehabilitation Brace project focuses on developing a specialized device aimed at enhancing finger joint rehabilitation. The brace is designed to offer precise control over individual finger movements while also promoting flexibility through a splay exercise feature. Initially, existing wrist braces were modified as a foundation, and a custom design was created for optimal fit and comfort. The project progressed with the development of finger attachments, where a print-in-place design emerged as the most effective solution due to its simplicity and adaptability. A two-piece main body design was incorporated for ease of use.

Testing demonstrated a 30% increase in finger joint flexibility, validating the brace's effectiveness in improving range of motion and joint control. The design's hinges enhanced stability, while the customizable print-in-place design allowed for easy adaptation to different hand sizes. Further refinements focused on durability and usability, with Velcro straps replaced by hinges for greater functionality.
This innovative rehabilitation device offers targeted joint movement control, improved flexibility, and user comfort, showing strong potential for enhancing finger rehabilitation therapy. Future developments will aim to expand its features, such as incorporating splay exercises and progress tracking to further optimize therapeutic outcomes.

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Kayden's Activity Wall
Timothy McDaniel, Rylan Parker, Jaelyne Uy, Terrion Turner, Tatem Flener, Eric Frizzell

Kayden is a 13 year old boy with Autism/Down syndrome. Kayden is also fully blind in one eye and partially capable of vision in the other, being able to perceive light(most sensitive to red light). Kayden has also been described as being very strong and having destructive tendencies.
Having a specialized activity wall located in the home will help Kayden by integrating sensory integration as part of his daily routine - regular sensory stimulation in people on the autism spectrum has resulted in consistent benefit. Research indicates that sensory processing plays a key role in brain development.
Due to Kayden's strength and visual needs, Kayden requires a specialized activity wall for sensory stimulation purposes. The wall must stimulate multiple senses - visual, tactile, auditory - while being securely mounted to the wall to withstand Kayden. The wall must fit in the allotted 6 ft x 8 ft space identified by Kayden's Mother. The wall should provide diverse sensory stimulation, such as (but not limited to) lights, sounds, fidgeting elements, velcro, handles, and other elements that will strengthen and develop Kayden's fine motor skills. Kayden's mother wants Kayden to stand to use the wall instead of sitting. Kayden is presently 4 feet 3 inches tall and has a reach of 1 foot, 7 inches.

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Kayden's Premier Activities - Design for Independence
Braden Tomlinson, Daniel Malone, Caroline Schrader, Marshall Harris

The Kayden’s Activity Wall project aims to enhance sensory engagement and developmental growth for Kayden, a child with autism and Down syndrome who has visual impairments. This project focuses on the design and creation of two interactive components: the **Light-Up Programmable Soundboard** and the **Thumper Box**. The Soundboard features customizable sound buttons that promote auditory stimulation and fine motor skills, while the Thumper Box incorporates bouncy balls that provide dynamic visual and auditory feedback. Both components are designed with safety, accessibility, and adaptability in mind, ensuring they meet Kayden’s unique needs. By fostering independence, encouraging social interaction, and promoting cognitive and physical development, these tools aim to create a stimulating environment that supports Kayden’s growth and enhances his quality of life.

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LAB-CREATED SILICA GELS: ENVIRONMENTAL INSIGHTS INTO SILICIFICATION PROCESSES OF THE PROTEROZOIC
Samantha Doss-Watson

Early diagenetic chert deposits are common in Meso- and Neoproterozoic peritidal carbonates and can preserve microbial morphologies. These deposits formed as silica gel precipitated from seawater enriched in dissolved silica. The process of silicification is still not understood. Building on previous experiments by Newbille and Manning-Berg (2023), we performed laboratory experiments using artificial Proterozoic seawater spiked with 35 ppm, 70 ppm, 100 ppm, and 120 ppm of sodium silicate ($Na_2Si_3O_7$) and explored the effects of varying temperatures and humidities on silica gel precipitation. The composition of the gels and associated evaporite phases was determined using environmental scanning electron microscopy (ESEM) and X-ray diffraction spectrometry (XRD). ESEM-energy dispersive spectroscopy (EDS) was used to map the spatial relationship of these phases. Preliminary data confirmed the presence of a hydrated or amorphous magnesium-rich silica phase and halite. Ongoing experiments may provide insights into the silicification process during the Proterozoic.

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Lake Cleaning Robot for Tennessee River Shores
Jorge Marcano, Owen Sharp, Angle Lopez

The Tennessee river is one of the most microplastic polluted rivers in the world. Whether through wind, stormwater acting on roadside litter, or leeching from landfills, millions of tons of plastics find their way into rivers, lakes, and streams each year. These plastics degrade into microplastics, currently the Tennessee river has nearly 10,000 particles of plastic per cubic meter of water. We aim to help organizations like the Tennessee Valley Authority (TVA) and the Chattanooga Aquarium to combat the rampant pollution of the Tennessee River. We have researched and developed an autonomous River Cleaning Robot that travels along an area of the river and collects varying sizes of trash and pollutants in the river, ranging from large plastics like bottles to small particles like microplastics.

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Land Development
Jordyn Panzer, Rylee Anderson, Darrion Whaley, Sarah (Meggie) Woody, Jonah Bolden

The goal for this project is to design and deliver a pre-existing singular real estate development project, provided by Kimley-Horn. To do so, zoning codes, land layouts, schematic plans, hydrology, and utility design will all be used as major factors in this design. The zoning codes will need to be interpreted and outlined during the entire project to ensure we are meeting the required constraints. Land layouts must meet zoning codes and be as aesthetically pleasing as possible. Schematic plans will display all design elements and be used to present our project. These plans will

be done using AutoCAD. Hydrology will include the review of drainage systems and the effect that the new design will have on post-development flows to a facility. Utility design will be to ensure water and sewer is available to the project site and that the location of the wastewater and stormwater pipes are in an acceptable location. The design will be presented to Kimley-Horn and University staff, along with lessons learned.

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Leadership in any language: Constructing a multilingual professional identity
Ashleigh Pipes

While there is ample scholarly work (e.g., Hanges et al., 2016; Pagda et al., 2021; Tolstikov-Mast et al., 2021) and popular literature (e.g., Black & Morrison, 2020; Livermore, 2024) regarding cross-cultural leadership, investigations specifically into the role of foreign and second language use as it relates to leadership in practice is more limited. This presentation will explore how business professionals who regularly interact in a non-native language in their work environments develop their language skills, construct their multilingual leadership identities, and adapt their communicative efforts to myriad contexts. Using a phenomenological approach, themes emerging from in-depth interviews will be explored alongside insights from research into relevant individual differences in second language acquisition, i.e. willingness to communicate (Munezane, 2023) and motivation (Henry, 2017). The results from this study will provide insight into language instruction that may inform language teaching as well as leadership training in cross-cultural contexts.

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Leveraging Bayesian Optimization for Effective Prompt Engineering in Large Language Models
Joseph Ballew

Bayesian optimization(BO) has been widely used to optimize expensive black-box functions efficiently with few evaluations. This paper explores the application of BO in prompt engineering to improve the accuracy of binary classification tasks using OpenAI's ChatGPT. We employ a Gaussian process as the surrogate model to aid in estimating the performance of different prompt candidates. These prompts are generated by an LLM using an expansion function, which uses a seed prompt to generate new candidates. These candidate prompts are then evaluated, and the upper confidence bound(UCB) acquisition function is used in conjunction with the uncertainty given by the Gaussian process to score the prompts. This optimization process refines prompts based on prompt accuracy on a small set of data and uncertainty given by the Gaussian process, aiming to improve classification accuracy while minimizing API calls.

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LiDAR as a Conservation Tool: Enhancing Suitability Models for the Timber Rattlesnake (Crotalus horridus)
Thomas Wilson, Team Salamander

The Timber Rattlesnake (*Crotalus horridus,* Fig.1a) is a species with a unique niche habitat within the Eastern United States (Fig. 1b) that faces significant threats from habitat alteration and climate change. It is characterized by a distinctive coloration and pattern which can range from yellow to brown to black (Fig. 1). , this species relies on deciduous forests, rugged terrain, and rocky outcrops for survival, making it particularly vulnerable to the impacts of changing environments. As climate change alters their niche habitat, the need for precise conservation efforts becomes critical. In response, this research employs advanced Remote Sensing and Light Detection and Ranging (LiDAR) technologies to identify potential habitats and refine conservation strategies. By combining LiDAR data with Geographic Information System (GIS) techniques, along with climatic, soil, land use, geology, elevation, and biological data, we aim to create a multidimensional habitat suitability model. This model is designed to detect the microtopographic features essential for the timber rattlesnake's survival and to evaluate the species' distribution and ecological preferences within Tennessee and surrounding regions. The use of LiDAR in this context, capable of penetrating forest canopies to reveal detailed terrain features and identify vertical surface features, represents a novel approach in reptile conservation, offering a way to map out vital habitats with increased precision. Our project not only addresses the need for targeted conservation plans in the face of climate change but also demonstrates the potential of pairing LiDAR with other well-established remote sensing tools and processes in the identification and preservation of niche habitat species like the timber rattlesnake.

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Lipid Bilayer Experiment Apparatus Symposium Poster
Olivia Humphrey, Titus Lim, Elliot Gidcumb, Matthew Riggs, Hannah Brown

Team Lipid designed a device that will allow Dr. Tantawi to yield consistent, high-quality results via the Montal Mueller Method of lipid bilayer analysis. This will aid him in his research of electrophysiology in muscular disorders.

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Loneliness in Older Adults
Kiana Patterson, Kennie Almonor, Jillian Colson, Lauren Zoladz, Jenny Holcombe

The purpose of this research is to gain a better understanding of loneliness in the aging adult population and identify potential strategies to combat said loneliness. Participants were recruited using a snowball sampling method and asked to complete a survey about the activities they regularly participate in and feelings of loneliness. Results indicate a relationship between these variables such that participation in more activities is related to lower loneliness scores. Additional exploration is needed to determine the impact of various demographic factors on loneliness scores.

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Longitudinal Changes in Countermovement Jump Performance in a Division I Women's Soccer Team
Amanda Lambert, Jade Giordano , Cooper Fowler

The countermovement jump (CMJ) is widely used to assess lower body neuromuscular function in athletes, providing insights into performance adaptations and injury risk. This study examined longitudinal changes in single- and double-limb CMJ waveforms among Division I women's soccer athletes over a single competitive season. Twenty-two athletes performed CMJs pre- and post-season on a force plate, capturing key performance variables including peak force, concentric rate of force development, and reactive strength index (RSI). Waveform analysis was conducted using statistical parametric mapping (SPM) and discrete analysis using 2x2 repeated measures ANOVAs to detect changes across the season, between tasks, and between limbs. Compared with pre-testing, results revealed greater force during post-testing associated with concentric rate of force development during a single-leg CMJ. Notably, alterations in concentric force development suggest strength and functional improvements throughout the season. These findings emphasize longitudinal CMJ monitoring to assess physical readiness and guide training interventions. Understanding how jump performance evolves across a season can aid in optimizing performance in collegiate soccer athletes. Future research should explore individual variability in adaptations and the impact of specific training loads on CMJ performance.

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Looking Past Binary Lenses: Accessibility and Disability Rhetoric
Katherine Kahne

Writing Center tutors and administrators are trained to work with different kinds of writers, including writers with disabilities. I aim to focus on the current rhetoric behind disabilities and writing center staff, and how transforming it can reframe deficits as strengths. As a disabled and neurodivergent peer tutor, I intend to illuminate the intersectionality of staff in writing centers by discussing common binary mentalities and ideas around neurodivergence or disabilities. Including how the current rhetoric affects writers and staff, and how changing the rhetoric can improve accessibility for all writers.

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Machine Learning for Reparameterization of Molecular Dynamics Water Model to accurately Capture Electrical and Thermal Behavior.
Khowshik Dey

Water is an important component in many scientific and engineering applications, but precisely modeling its thermal, electrical, and physical properties remains difficult in molecular dynamics (MD) simulations. The widely used TIP4P water model, while useful in many circumstances, requires parameterization to better agreement with experimental results under various conditions. In this study, we have used interpretable machine learning (IML) techniques to systematically tune the TIP4P model parameters, resulting in a more accurate depiction of water behavior. We have created a data-driven approach to refining critical model parameters while maintaining physical interpretability by combining molecular dynamics simulations, optimized neural network model for predictions and deep symbolic optimization techniques for interpreting the mathematical relationship between the features and targets.

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Machine Learning supported Mesoscale Modeling of Gas Conduction in Nanoporous Systems
Amirehsan Ghasemi

Heat transfer through nanoporous systems is a complex phenomenon involving contributions from solid and gas phases. Existing theories for estimating the gas thermal conductivity in nanoporous materials, such as aerogels, often rely on one-dimensional heat transfer assumptions and neglect the influence of side walls in confined geometries. Moreover, the impact of molecular surface forces dominating nanoscale confinements is often overlooked in the literature. This study aims to comprehensively understand gas conduction at the nanoscale confinement by addressing the missing information in the literature and developing a new computational scheme for nanoporous systems analysis. The research will develop a new mesoscale boundary condition for nanoscale molecular surface forces and microscale kinetic theory gas/solid energy exchange. These boundary conditions will be implemented as an open-source package in the Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS) repository. Additionally, machine learning (ML) algorithms will be employed to develop structure-property correlations with thermal conductivity, complemented by SHAP analysis for model explainability. This study develops a novel mesoscale classical boundary condition that better represents nanoscale heat transfer phenomena and

develops reliable ML models that can predict thermal conductivity for various pore size configurations without running millions of simulations.

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Machine Learning-Based Temperature Predictions for Climate Impact on Pavement Infrastructure
Maneesha Vanga

Accurate temperature forecasting is crucial for assessing the long-term impact of climate change on pavement infrastructure. This study evaluates machine learning models—LSTM, XGBoost, and NeuralProphet—to predict temperature variations over extended periods. While LSTM excels in capturing short-term dependencies, it struggles with long-term predictions and demands extensive computational resources. XGBoost, though efficient for short-term forecasting, requires significant feature engineering, limiting its applicability for long-term analysis. NeuralProphet, integrating neural networks with traditional time series methods, demonstrated strong potential for long-term forecasting, providing accurate predictions with 500 epochs despite its computational intensity.

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Macroinvertebrates and Land Use, to the Buffalo and Back: Results Emerge from a Collaborative Field Expedition
Annie Humphrey, Kara Kimes

This project began as a collaborative field expedition on Arkansas's Buffalo River, the country's first National River and a designated Wild and Scenic River. Students and faculty from UTC, Virginia Commonwealth University, and Northeastern State University as well as professionals from the River Management Society came together on a multi-day river trip to experience the beauty of the Ozarks, discuss the role of community in meeting management challenges, and engage in scientific research. This project explores the relationship between watershed land development and water quality, using the Buffalo River and our respective home rivers as sample sites. We performed a simplified version of an EPT index, a common method for estimating stream water quality that gives the relative abundance of three orders of aquatic macroinvertebrates (Ephemeroptera, Plecoptera, Trichoptera) that are intolerant of water pollution. Sampling was done at sites along the Buffalo, Nantahala, James, and Illinois Rivers and the results were compared with watershed land use data gathered from Model My Watershed. We found that generally, higher development in the watershed corresponded to lower modified EPT index, with the Nantahala River as an outlier. Ultimately, the expedition on the Buffalo served as a unique opportunity for us to build community, grow our knowledge of river management and conservation strategies, and gain experience in field-based research.

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Magnolia, The AI Grocery Store Companion
John Earl, Sean Tiner, Trent Hobbs, Dellven Thomas

Magnolia is an AI-powered shopping assistant designed to streamline the grocery shopping experience. It integrates real-time inventory tracking to check in-store stock availability and leverages AI-driven list generation to optimize grocery planning. By combining predictive analytics with user preferences, Magnolia ensures efficient, hassle-free shopping, minimizing wasted trips and improving overall convenience.

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Mathematical Modeling of Zoonotic Disease Transmission Under the Impact of Land Use Change
Collin Kilmer

Land conversion is occurring worldwide due to a growing population and expanding economy. This process increases the likelihood of pathogen spillover, posing significant economic and public health risks. The objective of this presentation is to model pathogen spillover under the impact of land use change. We develop a zoonotic disease transmission model that describes spillover of Puumala virus from bank voles to humans during land conversion. Our model introduces a land conversion index to capture the dependence of the carrying capacity and the death rate of bank voles on the proportion of converted land. This index is then used to examine how different levels of land conversion influence pathogen spillover. Through simulations, we demonstrate that the risk of pathogen spillover from bank voles to humans is highest at lower levels of land conversion.

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Measuring F1 Competition Using Python
Kevin Harris

Formula 1 has always strived to be the pinnacle of racing and innovation in motorsport, with an added benefit and goal that R&D costs will funnel down to other racing disciplines and even consumer cars. After an extended period where the top teams have dominated repeatedly, new efforts to promote competition such as drag effects and team cost caps have been implemented but the question remains- has it worked?

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Mechanochemical Response to Indicate Mechanochemical Response to Indicate Force on Polyurethane Foam
Lillian Poarch

In polymer mechanochemistry, there is significant interest in using mechanical force for constructive responses by cross-linking a force-reactive molecule called a mechanophore into a polymer network. Spiropyran is a mechanophore that undergoes a ring-opening reaction to form the colored molecule merocyanine. This color change has been widely used to quantify a material's response to stress in a

range of materials, but to our knowledge, has not yet been used in polyurethane foams. We report spiropyran-based mechanochromism in polyurethane foams, which are common materials in everyday life due to their excellent mechanical properties. After successfully cross-linking the material, we have conducted tensile testing on polyurethane foams and correlated strain with the color-changing response using RGB image analysis. We will also report optimization of the cross-linking reaction and foam composition, as well as ongoing work to tune color change by altering the foam's mechanical properties.

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Mechatronics Systems Senior Project.
Patrick Kent, Xander Bastnagel, Kenny Allgood, Jackson Killebrew

This is our poster for the project we all worked on for Mechatronics Systems.

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Modeling the Dynamics of User Adoption and Abandonment for a Single Product
Uyen Nguyen

We introduce a compartmental differential equation model to analyze user adoption and abandonment dynamics for a single product. Our model distinguishes between two types of abandonment: infectious, influenced by interactions among current and former users, and non-infectious, driven by mass media, advertisements, or new product launches. Unlike prior studies, we allow the infectious abandonment coefficient to vary linearly with the number of past users, adding complexity and enhancing dynamic behavior. We investigate model equilibria, deriving the threshold quantity $\mathcal{R}0$, where a user-free equilibrium is always present, and its stability is maintained when $\mathcal{R}0$

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MOTOR LEARNING STRATEGIES INCREASE INTRINSIC MOTIVATION AND QUADRICEPS TORQUE OUTPUT IN HEALTHY INDIVIDUALS
Erin Ezell, Haleigh Pressley, Lauren Parker

Context: A key part of return to play following ACL reconstruction is restoring and maintaining quadriceps strength. Strategies to adequately restore quadriceps function are lacking, leading to high rates of reinjury and early-onset osteoarthritis. Incorporation of higher order motivational processes improve strength outcomes, but few mechanistic studies exist. Elucidating the mechanism will provide a clinical target to acutely improve quadriceps function.

Methods: A crossover study design was used. Thirty-three previously uninjured participants within the last 2 years (23.45±3.62 years, 172.12±8.31 cm, 77.80±12.71 kg, 24 females) participated in a single session. Participants completed two counterbalanced conditions, each consisting of isometric quadriceps assessment on a Biodex isokinetic dynamometer (45° knee flexion, 3x5 seconds). The Optimized condition included delivery of motivational (autonomy support and enhanced

expectancies) strategies during assessment. Specifically, when performing the Optimized condition, the participants chose between line / bar graphs for biofeedback (autonomy support) and were told that “Watching the screen during your reps has been shown to increase your quadricep force production” (enhanced expectancies). The Non-Optimized condition was a standard of care assessment with no biofeedback displayed. All participants were instructed to “Kick your leg forward as hard as you can.” Participants completed the 7-item Interest / Enjoyment subscale of the Intrinsic Motivation Inventory immediately following each condition; cumulative totals were generated for each condition and the Optimized – Non-Optimized difference was calculated. For torque, the absolute peak across all repetitions was extracted from the Biodex software and the Optimized – Non-Optimized difference was calculated. Paired t-tests evaluated efficacy of the manipulation on interest / enjoyment and peak torque and a Pearson correlation evaluated the relationship between interest / enjoyment and peak torque difference scores. A hierarchical forward multiple regression evaluated the extent to which the addition of Optimized interest / enjoyment explained variance in Optimized peak torque, controlling for Non-Optimized interest / enjoyment and Non-Optimized peak torque.

Results: Intrinsic motivation increased between the Non-Optimized and Optimized conditions (Cohen’s *d*=.53, *p*=.01), as did peak quadriceps torque (mean difference=.13±.23 Nm/kg,Cohen’s *d*=.57, *pr*=-.16, *p*=.38). Non-Optimized peak torque predicted 87% of Optimized peak torque (p *p*=.32) and Optimized interest / enjoyment an additional 2.4% (R2change *p*=.07).

Conclusion: Our manipulation improved interest/enjoyment and peak quadriceps torque. After controlling for baseline peak torque and interest / enjoyment, Optimized experimental interest / enjoyment explained marginally more variance in Optimized peak torque, suggesting a mediating effect of motivation on performance. However, acute strength improvements did not correlate with greater interest / enjoyment. Future work should assess the impact of other motivational constructs (e.g., external regulation) on acute and chronic motor behavior.

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Navigating New Beginnings: The Role of Academic Advising in Supporting Transfer Students' Academic and Social Success
Rachel Ellis

Transfer students often encounter distinct challenges and barriers to success in higher education compared to their traditional, native peers. This review delves into the concepts of “transition theory” and “transfer shock.” Additionally, the social challenges transfer students encounter, including feelings of isolation and level of connectedness, are examined. The findings of studies included in the review consistently suggest how academic advising can support social integration by encouraging student participation and fostering connections through institutional support, such as campus collaboration and referrals, mentoring programs, and peer networks. This literature review explores the multifaceted role of academic advising for transfer students in higher education, focusing on their academic transition and progression, social integration, and institutional support.

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New Winglet Design for the Boeing 757
Jerry Ma

In the last 40 years, wingtip devices have captured the attention of many aeronautical engineers in their effort to improve the efficiency of aircraft performance. As aircraft get larger and fly farther, wingtip device technology's effects on efficiency will be more dramatic. For example, a Boeing 747, enhanced with a proposed winglet (Blended winglet), would save an estimated 23,000 pounds of fuel on flights from the U.S. West Coast to Hong Kong. The efficiency doesn't just translate to fuel saving but also to longer range and carrying a larger payload. This project aims to develop a new vortex-reducing winglet device for fixed-wing aircraft and gain a greater understanding of how wingtip devices modify vortex structure. Using the Boeing 757 as the test case, different winglet designs will be analysed using a low-speed wind tunnel to compare the differences in Induced drag (CDi), Drag (CD), and Lift coefficient (CL). This will produce an optimal winglet design for the 757 and provide empirical data to support the final product. Currently, the airfoil for the testbed has been designed in CAD and fabricated with a 3D printer. Basic performance data from the wind tunnel was also collected. In the future, I hope to use the testbed to research and analyse different winglet designs. This research will assist in the efficiency of aircraft and save costs in air travel in the future.

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Nickel Plating on Polymers for Advanced Structural Applications
George Thompson, Mohammad Mahtabi

Traditional metal manufacturing methods require time consuming processes and vast amounts of waste to produce complex geometries. The electrodeposition of metal onto 3D printed polymers offers an innovative approach for fabricating metal components with complex geometries. This project explores the use of 3D printed polymers as a novel mandrel for nickel plating, hypothesizing

that this process will be able to produce fully dense metal structures after the polymer is removed. To achieve this, FDM-printed polymer samples were plated with nickel through an electrodeposition process. Once the metal was deposited, the polymer support material was selectively removed. The mechanical properties of the nickel-plated structures were evaluated through hardness and tensile testing. The results show that the electrodeposited nickel successfully formed robust, dense metal structures after the removal of the polymer. Tensile strength and hardness values indicate that the metal deposits are mechanically sound and suitable for a range of engineering applications. In conclusion, this work demonstrates the viability of using 3D printed polymers as a mandrel for the electrodeposition of metal, opening new possibilities for the fabrication of complex, customized metal parts without the need for traditional metal-forming processes. This technique has significant potential for applications in industries such as aerospace, automotive, and mold manufacturing.

https://symposium.foragerone.com/utc-spring-research-and-arts-conference-2025/presentations/72304

Nifty 50 Stock Market Data Analysis
Margaret Coulter

Data Analytics 3260

Analysis of the Nifty-50 Stock Market Dataset (2000 – 2021) and Stock Price Data of the Fifty Stocks in NIFTY-50 Index from National Stock Exchange (NSE) India

The dataset analyzed contained the price history and trading volumes of the fifty stocks in the NIFTY-50 index from the time period January 1, 2000, to April 30, 2021.

The analysis focused on determining whether the volume-weighted average, or the simple moving average better predicted the stock's price. The effect of the stock's trading volume on predictions based on the two methods was also evaluated.

From 2000 to 2024, there was not much correlation between the volume of the stocks traded and the volume weighted moving average. However, from 2020 to 2024, there appeared to be some potential positive correlation between the average volume and the volume weighted average price. However, the simple moving average price correlated better with the actual stock prices over the entire data range.

Obviously, since this was a limited time frame data set on only 50 stocks, much more research is needed.

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Observing Detritivore Communities in Urban Bioretention Gardens
Angelica Lance

Decomposition is one of the most important ecological processes due to its role in nutrient cycling and is highly dependent on the presence of organisms that help break down organic material (i.e. detritivores). Decomposition in urban environments may be altered due to an increase in modified land cover and the consequential absence of detritivores. Bioretention basins are primarily engineered for stormwater management in urban areas yet may also serve as a refuge for urban detritivore communities when designed to support plant biodiversity. However, the detritivore communities that are supported in bioretention basins are relatively unknown. This study aims to investigate and analyze the detritivore communities of two bioretention gardens in Chattanooga,

Tennessee for the purpose of providing a baseline for understanding urban detritivore community structure. Leaf litter bags were placed in the gardens for 2-3 months and organisms were isolated using a Berlese funnel. Organisms within the samples were identified to the family level and a Shannon-Wiener index was calculated as a measure of community diversity. We compared community diversity between gardens using a Student t-test, alpha diversity and beta diversity. Our findings will potentially inform decisions in bioretention planning and promote future research of the state of urban biodiversity and other ecological processes in urban green infrastructures.

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On the Development of a Two Qubit Nuclear Magnetic Resonance Quantum Computer
Rigdon Anderson

Quantum computing is a burgeoning field in science and technology. As with any adolescent, quantum computing requires enormous expense to further its development. Thus, learning tools for quantum computing remain beyond the reach of many smaller institutions. Our goal is to build a low cost, two qubit Nuclear Magnetic Resonance (NMR) quantum computer for a tenable price. We will thoroughly document the process of building the computer from start to finish, providing comprehensive documentation on the construction and operation of a small NMR quantum computer. Thus far we have characterized two magnets which we will use to build the computer. We have also begun modeling the computer's frame, which will be 3D printed. A 3D printed housing will be the most effective because we must avoid metal when designing this computer to avoid interfering with our magnetic field. We aim to implement the following single qubit gates: the Hadamard gate, the CNOT gate and the X, Y and Z rotation gates. In addition, we hope to implement at least one two qubit gate. We hope that this project will enable other schools to build their own quantum devices, improving upon our methodology along the way. Eventually, this collective work can form a "quantum open-source community." Such a community would provide resources for anyone to learn how to build a quantum computer, increasing public awareness of quantum computing.

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On the Development of Electromagnetic Suspension System for Cars.
Henry Wang

Cars have become one of the most common modes of transportation in modern society. While driving, comfort is a major aspect of competition between car companies. In most cars, coils and metal fluids are used as shock absorbers to increase comfort, stability, and overall safety. In regular shock absorbers, the variable mechanical dampening changes the firmness fairly quickly during car rides, but is limited by the speed of the mechanical action inside the shock itself. The goal of this research is to find a way to instantly change the dampening without relying on mechanical parts. A benefit of this design is that the pressure can be instantly changed by a program built into the car. With adjustable pressure, the car's comfort can be applied for many different types of roads, especially for different types of cars going through rough places. In this newer design of a suspension system, the upper body of the car is suspended through the magnetic pressure of the Suspension System. Single magnetic coils cause a small delay when the ECU turn off the current caused by a temporary electric current called an Eddy Current. To cancel out this current, two electromagnetic

coils will be attached on the two ends and apply pressure to the opposite directions. This design creates a quicker responding suspension system. A test bed that provide vibration can simulate actual road conditions while driving. A motor will be part of the test bed. Programming of motor will present the amount of rotations and better exemplify the vibrations. Through the programs, the magnet force can be calculated to determine the stability of the overall system. These improvements can make the cars better whether on comforts, safety, or stability.

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Open-World Hazard Detection and Captioning for Autonomous Driving with a Unified Multimodal Pipeline
Parisa Hatami

Autonomous driving systems must operate reliably in dynamic environments where uncommon or unanticipated hazards frequently arise. Traditional perception models often rely on closed-set recognition, restricting them to predefined object categories and limiting their ability to address novel or rare obstacles. To tackle these open-world challenges, we propose an integrated pipeline that merges image enhancement, optical flow, depth estimation, semantic segmentation, and vision-language models. We evaluate our method on the COOOL dataset of 200 annotated dashcam videos, containing both standard and previously unseen hazards. By applying depth filtering and road segmentation, our system focuses on objects along the drivable surface. In parallel, optical flow analysis captures driver reactions, adding a temporal dimension that supports hazard assessment. A vision-language module then generates concise, semantically relevant captions for novel objects, enhancing interpretability. Experimental results show that our unified pipeline consistently improves hazard detection and captioning performance in open-world scenarios, underscoring the need for flexible perception strategies that advance autonomous driving safety.

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Opioid-Sparing Anesthesia with Dexmedetomidine, Ketamine, Lidocaine, and Magnesium
Garrett Peek, Jonathan Felts, Zachary Rush

“Opioid-Sparing Anesthesia with Dexmedetomidine, Ketamine, Lidocaine, and Magnesium” addresses literature gaps associated with multimodal anesthesia techniques, specifically within certified registered nurse anesthetist (CRNA) practice. The national opioid epidemic warrants immediate attention from responsible healthcare providers. While this national opioid epidemic is primarily related to improper post-surgical prescribing practices, anesthesia providers may largely influence postoperative pain and opioid use through their specific intraoperative techniques. The project aims to provide education to CRNAs regarding the use of dexmedetomidine, ketamine, lidocaine, and magnesium, all non-opioid analgesics, during the intraoperative period. Proper dosing, timing, and opioid-sparing effects of each medication are addressed within a developed educational website. The educational website will be disseminated to the ACE Anesthesia Group, a partner of Erlanger Health, and pre- and post-testing will be conducted on participant CRNAs. The results and conclusions are to be determined, but the project aims to improve CRNA knowledge and readiness to employ the DKLM method, specifically for inpatient spine procedures. The project’s potential secondary impacts include improved postoperative pain control, reduced opioid

consumption, and reduced risk for postoperative opioid misuse among those inpatient spine surgeries.

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Optimizing Wireless Communication Pipelines With Neural Networks
Jack Rawls

The number of mobile users continues to rise with an expected number of connected users to reach nine billion by 2030. This demand is exacerbated by the increased number of smart devices that rely on wireless communications for connectivity as part of the Internet of Things (IoT) ecosystem. Couple this information with the fact that new wireless standards and devices must coexist with existing communication systems and standards. Thus, modern communication systems must be able to regularly handle higher frequencies, while achieving higher data rates and contending with adverse operating conditions. For wireless communication networks, the block error rate (BLER) is a crucial performance metric that indicates a data transfer success or failure. The lower the BLER is, the more successful the transfer of data is between the transmitter and receiver.

Neural networks are being investigated as a possible solution to these highlighted challenges because they thrive under increasing amounts of data, reduce the amount of time needed for redesign from weeks and months to hours and days, and can learn the wireless channel distribution directly. The latter removes any dependency on knowing or assuming tractable wireless channel models that current communications rely on to reach their full design potential. This project assesses the performance benefits of replacing one or more of the Wireless-Fidelity (Wi-Fi) transmitter pipeline's blocks with a neural network. The goal is to keep latency on par with the conventional transmitter pipeline, or as low as possible while improving BLER. For Phase 1, an ablative study is conducted to determine the minimum number of blocks that must be replaced within the transmitter's pipeline to meet or exceed the desired goal. Initially, the Wi-Fi receiver pipeline is unaltered. The experiment is tested at signal-to-noise ratios (SNRs) of 2 dB to 23 dB in 3 dB steps between consecutive values and 1,000 epochs per SNR to ensure the BLER is consistent in both conditions.

Future research will investigate a similar study implementing Phase 2 and Phase 3. For Phase 2, the receiver pipeline will be altered but the transmitter pipeline will remain unaltered. Phase 3 will investigate where both pipelines undergo the ablative replacement of their conventional blocks with a neural network. As 6G technology is researched and fielded in coming years, this research provides a potential means to implement 6G communications standards using neural networks.

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Oral Pain Medication Utilization in PACU Phase I Post-PACU RN Education
Sarah Ingell, Kaylene Fodra

Purpose: This quality improvement (QI) project was created after a noted divergence in practice from current guidelines. The aim of this project was to educate post-anesthesia care unit (PACU) nurses on the benefits of providing early oral analgesia in post-surgical recovery in attempt to

increase the use of oral pain medications in Phase I while also evaluating how utilization of early oral analgesics affected patient pain scores.
Methods: Nursing education via daily huddles was implemented in September 2024. Data collection consisted of retrospectively reviewing a total of 2,186 postoperative charts one month before and following the education period (August and October 2024, respectively). Data collected included Phase I oral analgesia administration, NPO status, and initial and final pain scores in Phase I with associated pain scale utilization.
Results: Data analysis revealed no statistically significant (p = 0.19) difference in the administration of oral analgesics in the post-implementation period (21.1%) compared to pre-implementation (23.5%). There was a statistically significant (p
Conclusion: While there was no significant difference in the administration of oral analgesics, institutional processes, such as requiring permission from anesthesia providers and added nursing tasks, could have impacted and skewed utilization. The project leaders still support the standard of care of using oral analgesics in the immediate postoperative period and suggest including this practice change in post-anesthesia care policies to promote better post-surgical recovery.

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Path-finding methods in EcologicalConservation
Matthew Gentry

Path-finding methods fill a crucial role in ecological conservation because they address several important challenges related to wildlife management, habitat preservation, and connectivity of the ecosystem. Path-finding methods help in multiple areas such as: identifying corridors, designing optimal routes for resources, predicting pathways to aid in adapting to changes in climate, minimizing the disruption of species movement, preventing the spread of invasive species, and analyzing migration patterns. Since ecological landscapes vary in shape and size, finding an efficient and optimal method for identifying paths is important to produce optimal solutions within a reasonable amount of time.

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Perceptions of Disabled Instructors
Daniel Carpenter, Bailee Smith

To promote the inclusion of individuals with disability in the professional realm, it is important to understand how they may be perceived in such a role. The current study was designed to evaluate how perceptions of an instructor with an apparent disability compare to perceptions of an instructor without an apparent disability. Participants (n = 210) were randomly assigned to one of two video lectures embedded in an online Qualtrics survey. The instructor posed as an individual with an apparent visual impairment in one video, while the instructor did not have a visible disability in the other video. The videos were followed by measures of perceptions of the lecture, perceptions of warmth, perceptions of competence, and the Social Desirability Scale. We found that students perceived the instructor with a visible disability as significantly more competent than the instructor without a visible disability when controlling for socially desirable responding, $F(1, 207) = 8{,}59$, $p = .004$,partial eta squared = .04. Additionally, students who were assigned to the disabled instructor

condition also had more positive attitudes towards the content of the lecture, $F(1, 207) = 4.76$, $p = .03$, partial eta squared = .02.

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Performance testing of 3D printed carbon fiber gears
Grady Robbins

Grady Robbins

Material testing using Carbon Fiber

3D printing has been around since 1980, and it has come a long way. You can now print massive houses using a cement printer or you can print detailed objects. In this study I am testing the strength to weight ratio of a gear by using the carbon printer to see how the carbon filament holds up in biking gears. I am making two gears and putting them in a test bed. The test bed has two mounts to hold two motors. One of the motors will be spinning and acts like someone pedaling and the other one will not be powered. My hypothesis is that the gear's teeth will wear down fast, and the gears' integrity will be fine. The reason for studying this is to minimize weight on a bike. In the competitive side of the sport extra weight will make you slower so by making the small objects lighter it will make your times go down. By making the gears made of carbon fiber it will make them lighter but will bring the strength down. In my future work I will make other objects that need to be lighter.

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Polyunsaturated fatty acids (PUFAs) can alter the killing effects of antimicrobial peptides in Vibrio cholerae
Meredith Grant

One of the top global threats to public health is antimicrobial resistance. There is an urgent need for development of novel therapeutic regimens that can bypass existing microbial mechanisms of antibiotic resistance. Previous research has established that exogenous polyunsaturated fatty acids (PUFAs) are assimilated into the membrane phospholipids of Gram-negative bacteria, altering membrane permeability and susceptibility to antimicrobials. Introducing membrane vulnerability may create opportunities for antimicrobials to diffuse through the outer and inner membranes of Gram-negative bacteria. In this study, combinatorial treatment of the human pathogen Vibrio cholerae with three physiologically relevant PUFAs (linoleic acid [18:2], arachidonic acid [20:4], and docosahexaenoic acid [22:6]) and 12 antimicrobial peptides (cecropin A, cecropin B, LL-37, melittin, SMAP29, TET20, temporin L, CRAMP, NRC-16, PMAP-23, apidaecin 1B, and protegrin 1) was evaluated using broth dilution minimum inhibitory concentration (MIC) assays. Significant changes in MIC (> 8-fold) were observed, particularly when 20:4 was paired with SMAP29, protegrin 1 and melittin. Minimal changes to MIC were observed for LL-37 and temporin L, while the MIC of some peptides (CRAMP, PMAP-23) could not be determined due to limiting concentrations. Collectively, this data highlights not only PUFA-mediated biomembrane effects, but also the potential for PUFAs and membrane-attacking antimicrobials to synergistically target Gram-negative infections. Conversely, availability of these physiologically relevant PUFAs may allow bacterial membrane

adaptation that facilitates innate immune evasion, thereby contributing to pathogenesis in Vibrio species.

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Pose Recognition Using Pose Estimation and Machine Learning
Rowan Langston

With a quickly growing population, safety becomes more and more important. The population would benefit from a system that uses machine learning to detect dangerous situations by determining positions in which people are in danger. My project aims to make steps in this direction. Even if a program like this is not foolproof, any steps towards making the world a safer place is a good step to take. In crowded settings, someone could experience health issues that require medical attention but not get the help they need in time if the people surrounding them don't take immediate action. If there were overhead cameras that could detect this kind of thing and notify authorities, a life could potentially be saved.

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Post-rapid Assessment
Katrina Mazza, Adolfo (AJ) Davis

Patients who require activation of a rapid response team have higher mortality compared to patients who do not require this activation (Chalwin et al., 2019). Mortality further increases when patients continue to require subsequent or recurrent rapid response activations, making this a higher-risk patient population (Chalwin et al., 2019). The post-rapid assessment process (PRA) is a new and critical evaluation tool that follows the completion of a rapid response. The primary goal of the PRA was to reduce the need for recurrent rapid response activations by ensuring the effectiveness of the initial findings, interventions, and recommendations executed during a rapid response. Secondary goals included increased surveillance of a higher-risk patient population and opportunities to provide real-time education to team members. This process involved a dedicated rapid response team of experienced nurses who thoroughly reviewed and assessed clinical data, the patient's physical condition, and the efficacy of performed interventions. One of the key aspects of the PRA was the engagement of stakeholders, whose involvement was instrumental in the success and continuation of the post-rapid assessment process. This paper outlines the key components of the post-rapid assessment, including implementation, stakeholder engagement,data analysis, and methodology. The findings accentuate the necessity of a systematic post-assessment phase to complement the strengths of the existing rapid response process and provide a continuum of care for a high-risk patient population.

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Preliminary design and cost estimate for a hydrochloric acid off-gas treatment system.
Caleb Allen, Kevin Ebert, Daron Lyons, Zakaius Isom

The goal of this project is to develop a preliminary design for a hydrochloric acid vapor filtration system; as well as investigate the projected cost of said system. This process consisted of first determining the optimal type of filtration system based on the amount of vapor, its flowrate, and HCl concentration. Next, we outlined the components needed for the filtration system while considering various specifications and environmental conditions, such as space restrictions, ambient temperature, and efficiency of filtration. Finally, we approached multiple vendors to acquire current and reliable cost information to relay current industry estimations to install the unit and the accompanying components. This process represents an essential component to keeping the environment safe as the unregulated release of HCl into the atmosphere can be harmful to the environment, primarily through the formation of acid rain. It also represents a major aspect of an engineer's job to develop a system that is not only efficient, but cost effective.

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Preliminary design and cost estimate for a microbrewery
Cora Miller, Thomas Lane, Macayla Flynn, Shelby Adams

We present a 7 barrel design for a microbrewery focused on the production of three distinct types of beers. This design examines the key stages of the brewing process, including ingredient selection, mashing, boiling, fermentation, conditioning, and packaging. Particular emphasis is placed on the various fermentation methods employed to achieve different beer profiles. Additionally, the report explores the role of temperature regulation in the brewing process, highlighting the use of heat exchangers to maintain optimal conditions for product consistency. The goal of this design is to ensure efficiency, quality, and scalability while maintaining the distinct characteristics of each beer variety.

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Pretty Dangerous: The Romanticization of Grooming Behaviors in Pretty Little Liars
Katherine Johnson, Emma Gilland

Poster
Pretty Problematic: Shifting Portrayals of Grooming in *Pretty Little Liars*
Data collection is complete

Katherine Johnson, Emma Gilland, Heather Almand, Alexandra G. Shappley, and Ruth V. Walker

Sexual grooming is the deliberate manipulation of a minor by an adult to reduce their sensitivity to sexual contact, with the specific aim of perpetrating child or adolescent sexual abuse (Winters, 2022). Prevalence rates for sexual grooming vary; however, a recent study by Winters and Jeglic (2022) found that approximately 24% of their sample of undergraduate student sample reported experiencing sexual grooming as a minor. These predatory behaviors were prominently featured between lead adolescent and adult characters throughout the popular television show, *Pretty Little Liars*. This raises concerns about how such behaviors might be perceived when portrayed in popular

media targeted at teens and young adults. When *Pretty Little Liars* first aired, it was ranked number one in TV programming in Female Teens in 2010 (ABC Family, 2010). This strong viewership highlights how the show was effectively marketed towards a young audience despite its portrayal of problematic – and illegal - romantic relationships between adults and teens. The goal of our study was to examine how sexual grooming behaviors were portrayed in both the original series and its reboot, exploring changes in how sexual grooming behaviors were framed over time.

We conducted a content analysis study to examine grooming behavior in *Pretty Little Liars,* the original series, as well as *Pretty Little Liars: Original Sin*, the reboot. For our study, we developed a codebook to track the manifest and latent content of each episode, with two raters independently scoring each episode for the following content: victim and perpetrator demographics, grooming behaviors, how grooming behaviors were portrayed in the episode, and stage of grooming. There are five basic stages of the Sexual Grooming Model (SGM) that were coded: 1) victim selection, 2) gaining access and isolating a child, 3) trust development, 4) desensitization to sexual content and physical contact, and 5) maintenance following the abuse (Winters et al., 2022). This was done for the first and second seasons of the original series and the first season of the reboot. For season one of the original series, we found that 90.9% of grooming behavior was portrayed as romantic, as for season two it decreased to 84%. Grooming behaviors were normalized and often seen as positive or romantic throughout the original series. The reboot had a dramatic change; there was only 10% that believed grooming behavior was being portrayed as romantic. The writers for the reboot reframed the portrayal of grooming in a negative light, often having the adolescents confront their perpetrators for their behaviors. Additional manifest and latent content will be presented and described.

Understanding how grooming behaviors are depicted in media is essential for public awareness; this study contributes to a deeper understanding of grooming behaviors portrayed in the media. Teachers and educators can use these findings to help students recognize and critique problematic behaviors in television shows and movies, fostering critical discussions about the differences between reality and media portrayals of grooming and other sensitive topics. Ultimately, our findings could spark essential conversations about how the media portrays sensitive topics and encourage future creators to handle these topics more thoughtfully.

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Prevalence of Long Covid and Associated Risk Factors Among Adults 18 years and Older, United States: 2023 Behavioral Risk Factor Surveillance System
Gregory Heath, Emily Holden, Gloria Oppong , David Levine

Purpose: During the COVID-19 pandemic physical activity and being vaccinated were shown to provide protection from serious/critical cases of COVID-19. In the wake of the pandemic, there emerged between 12%-20% of US adults who had COVID-19 and manifested symptoms for COVID-19 three months or more following their illness but lacked an active infection. Hence these adults were diagnosed with Long COVID (LC). The purpose of this study was to examine the associations of physical activity, vaccination status, and selected chronic conditions among US adults identified as having LC using CDC's 2023 Behavioral Risk Factor Surveillance System (BRFSS). Our hypotheses were that adults meeting the aerobic physical activity guidelines (PAG) and those having at least one COVID-19 vaccination (VAX) would have lesser odds of reporting LC. Methods: We examined the association of LC among the 46.4% of adults 18 years and older who had tested positive for COVID-19 (n = 201,248) and a subset of adults who reported having LC (n = 27,074, 13.6%). Both univariate and logistic regression analyses were conducted using SPSS (v29) for complex samples. A series of logistic regression analyses controlling for age, sex, overweight/obesity, type 2 diabetes, race/ethnicity, and educational attainment comparing the outcome variable of LC with the exposure variables of 1) not meeting the PAG and 2) having

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Preventing Post Operative Ileus: An Educational Program on Sham Feeding
Sarah Crump, Samantha Bougher

Background

A postoperative ileus is a complication that affects hospital costs and can alter the course of a patient's hospital stay. Although sham feeding via chewing gum has been known to prevent this complication, it is not currently implemented as a standardized option in many hospitals. This project aims to determine whether providing an educational program for providers and nurses caring for patients post abdominal and cardiac surgeries would aid in using sham feeding via sugar-free gum and the long-term goal of creating a standardized order set.

Methodology

An educational program was provided to general surgeons, cardiothoracic surgeons, their respective PAs and NPs, and staff nursing within a medical ICU and cardiothoracic ICU. A pre-education survey was obtained from providers and nursing, with one specific to providers and another specific to nursing. The educational program was provided, and a post-education survey was followed up for providers and nurses. One and three-month post-education surveys were additionally obtained to determine how likely they were to implement or recommend after surgery. Outcomes were measured based on the study and measured whether doctors would be more likely to include this recommendation in their postoperative order sets, whether providers as a whole would be more likely to recommend the proposed intervention to other providers, and whether nurses would be more likely to select this method over others for ileus prevention, with a goal of reaching 25% of participants for each objective. The collected data was combined and analyzed via a sample t-paired test to examine the results of the objectives.

Results

A total of 37 participants, including 27 nurses and 10 providers, consented to participate in the study. Initial pre-education surveys revealed varying levels of familiarity with chewing gum as a method for preventing postoperative ileus. After an educational intervention, both nurses and providers demonstrated high likelihood to incorporate gum chewing as a preferred method for ileus prevention. At the one-month and three-month follow-up, most participants reported remembering the information, with nurses consistently expressing a high likelihood of selecting gum over other methods. Providers indicated strong support for including the intervention in post-operative order sets. Statistical analysis showed significant improvements in knowledge retention (p**Conclusion**
In conclusion, this project addresses postoperative ileus's significant impact on hospital costs and patient outcomes. Introducing an educational program allowed the promotion of sham feeding with sugar free gum as a preventative measure for postoperative ileus. The methodology involved pre- and post-education surveys and follow-ups at one and three months to assess the program's effectiveness. The three outlined objectives were met, and knowledge was measured with statistical significance at one- and three-month, establishing overall clinical significance. Creating an educational program is the first step in informing providers and nurses of the benefits of this intervention. The ultimate goal is to enhance patient care by reducing the incidence of postoperative ileus. This project could improve patient outcomes and streamline postoperative care practices significantly.

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Privacy Concerns in Machine Learning-DrivenElectronic Health Data Analytics
Swati Kar

As machine learning becomes increasingly integrated into healthcare analytics, concerns around patient privacy and data security have grown significantly. This study explores potential privacy risks arising from unintentional data leakage in de-identified electronic health datasets, specifically focusing on breast cancer patients in Tennessee. By narrowing down information from state-level to county-level using statistical analysis and publicly available data, we demonstrate how de-identified records can still be vulnerable to re-identification, especially through location-based filtering. Our findings highlight the limitations of current de-identification techniques and underscore the need for more robust privacy-preserving methods in health data analytics. Approved by the IRB (IRB #24-078), this research uses real-world datasets provided by the Center for Biomedical Informatics at UTHSC. The study advocates for developing secure electronic health record systems that ensure zero data leakage, thereby protecting patient confidentiality and fostering trust in health technologies.

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Project Management in Military Projects
Bryce Moore, Tyler Nuernberger, Mason Smith, Wolday Abrha

Power BI and predictive scheduling are key tools for fixing scheduling and staffing issues in the military. Predictive scheduling uses AI to reduce errors and unexpected delays in project timelines. Power BI helps visualize staffing needs, making it easier to assign the right people to the right roles. Improving recruitment gives managers more options and manpower. Cross-training allows staff to

handle multiple roles, increasing flexibility and efficiency. Together, these tools and techniques strengthen military project planning and execution.

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Provider Confidence in the Usage of Beers Criteria
Victoria Cadavero, Sarah Montgomery

urpose: This project seeks to investigate provider knowledge on appropriate medications for adults aged 65 and older by assessing their confidence in prescribing practices in accordance with Beer's Criteria. This project also seeks to increase provider confidence using education materials developed by The American Geriatrics Society. Method: Providers in an outpatient healthcare clinic will be asked to complete a pre-educational intervention test and two post-educational intervention tests regarding their confidence in the usage of Beer's Criteria. The material will consist of evidence-based tools for 2023 AGS Beers Criteria for PIM sourced directly from The American Geriatrics Society. Confidence in prescribing medications to patients aged 65 years and older will be objectively measured using a 4-point Likert scale. Goal: An increase in provider confidence in the usage of Beers Criteria after the conclusion of an educational intervention. Conclusion: Conclusions of this study prove that provider confidence level is positively impacted by an educational intervention.

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Quantum Mechanical Insights into Heterogeneous Surface Reactions in Chemical Vapor Infiltration
Atal Bhowmik

This study investigates the decomposition mechanism of Methyl trichlorosilane during Silicon Carbide (SiC) deposition during Chemical Vapor Infiltration (CVI). High-performance applications require SiC-based ceramic matrix composites (CMCs). However, producing them presents difficulties due to limited deposition rates, high energy consumption, and uneven coatings. To overcome these challenges, the mechanism of SiC formation needs to be understood completely. Modeling surface reactions of MTS decomposition on the SiC substrate using density functional theory (DFT) calculations with the Vienna Ab initio Simulation Package (VASP) is the key point of current research. By focusing on the adsorption, reaction, and desorption mechanisms that control SiC development, our method incorporates quantum mechanical models such as Kohn- Sham equations, the Many-Body System, Born-Oppenheimer (BO) approximation, and Generalized-Gradient Approximation (GGA). Using Transition State Theory (TST) and Potential Energy Surface (PES) mapping, the study investigates reaction routes and discovers important intermediates, such as methyl (CH_3) and other hydrocarbon species. The findings expand our knowledge of the rate-limiting steps in MTS breakdown and offer guidance for refining CVI/CVD procedures, which could increase material quality and deposition efficiency for cutting-edge engineering applications.

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Real-Time Production Controls for Enhanced Operational Efficiencies in Manufacturing
Wolday Abrha

This paper discusses the functionality of real-time production control to enhance operational effectiveness in manufacturing plants. Recent pressures on productivity and quality in contemporary manufacturing have turned the implementation of real-time monitoring technologies imperative. Drawing on extensive literature review and preliminary analysis of data, this research underlines considerable advantages of the mentioned technologies: the reduction of downtime, errors, and increasing general productivity and efficiency. This research underlines investments in advanced analytics and training necessary to take full advantage of real-time production control. Looking ahead to the future of manufacturing, further AI integration and the inclusion of sustainability metrics into the monitoring system create new frontiers of innovation and resilience.

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Red Bank Community Softball Fields: Stormwater Drainage Remediation
Elizabeth Macdonald, Olivia Smith, Rafael Urena, Reed Oscar, John Roulier

The Red Bank softball fields, located at 2226 James Ave Chattanooga, TN 37415, suffer from improper drainage and erosion issues, allowing large quantities of sandy-clay infield soil to enter the nearby stormwater drain. This stormwater conveyance flows directly to Stringers Branch (TN06020001426_0200), an impaired stream on Tennessee's 303d list. The goal of this project was to propose a combination of design options, as well as analyze the cost, environmental, and economic impacts of the proposed solutions. The team began this project by conducting research on the site's history and applicable city codes and guidelines. This led to the preliminary project scope where desktop and field surveys were performed. These studies allowed the team to outline the contributing drainage area and respective factors, as well as constraints including existing infrastructure and restrictions under law. The team then collected soil samples from each field, and water samples from each outfall, to execute a detailed analysis of the current environment. After all constraints were outlined, the team proposed five design options, including permanent silt fence, french drains, re-grading of infields, permeable pavers, and a rain harvesting system. The total cost of the capital project is around $280,000. These designs would allow better infiltration throughout the site, as well as decrease the amount of stormwater runoff leaving the site. This would enhance the surrounding environment and downstream water quality. Additionally, these solutions would revitalize the site and attract more community members to use the sports complex for their leisure activities.

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Reducing Catheter-Associated Urinary Tract Infections in Patients Who Underwent Uncomplicated Coronary Artery Bypass Surgery in the Cardiovascular Intensive Care Unit
Ling Qin, Luis Ramirez

Abstract
Background: Catheter-associated urinary tract infections (CAUTIs) increase patient morbidity, prolong hospital stays, contribute to unnecessary antibiotic use, and impose financial burdens on both patients and healthcare institutions. This quality improvement project aimed to reduce CAUTI

rates in a cardiovascular intensive care unit (CVICU) by implementing the ACT CAUTI prevention bundle (ACT Care). The intervention focused on improving nursing adherence to evidence-based CAUTI prevention strategies, including proper catheter anchoring, routine cleaning, and timely removal within 48 hours after uncomplicated coronary artery bypass (CAB) surgery.
Methods: This project utilized the SQUIRE 2.0 framework and descriptive statistical analysis of unpaired samples. Baseline data were collected through nurse knowledge surveys and chart reviews before the implementation of ACT Care. Seven training sessions were conducted to educate nurses on CAUTI prevention strategies. Post-intervention assessments included post-training knowledge surveys, chart reviews for catheter removal rates, and a final evaluation of CAUTI incidence in February 2025.
Results: The implementation of ACT Care resulted in improved compliance with catheter management protocols. Preliminary findings demonstrated increased adherence to proper anchoring, routine catheter care, and timely removal. The intervention's overall effectiveness was evaluated based on post-implementation CAUTI rates obtained from CVICU management.
Conclusion: The ACT Care intervention successfully enhanced nursing adherence to CAUTI prevention practices. By addressing key modifiable risk factors, this project contributed to improved patient safety, reduced infection risks, and strengthened adherence to evidence-based practices. These findings support the sustainability of ACT Care as a standardized CAUTI prevention strategy in CVICUs.

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Relationships Among Healthcare Experiences, Trust in Providers, and Student Health
Saba Mustafa

The present study examines the effects of institutional betrayal in the healthcare system and its impacts on students' perceptions trust in healthcare providers and their own health. Institutional betrayal is defined as the trauma endured by the individual by an institution after an individual's trust in the institution's ability to keep the individual safe is broken. Since current research regarding college students' healthcare institutional betrayal is limited, I am conducting a survey among UTC college students to assess what healthcare experiences they have had and how this has impacted their trust in providers and institutions. I hypothesize that more experiences with institutional betrayal in the healthcare setting will be correlated with decreased trust in providers and lower perceptions of health. I also hypothesize that there will be mean differences based on socioeconomic background, where individuals in a lower socioeconomic status will blame providers more often for their negative experiences. The study, which is currently in progress, aims to recruit at least 100 participants. Survey responses will be analyzed by using either scale correlations or by using mean differences analysis among certain measures. Preliminary results will be ready at the time of the conference. We hope to find results in support of our hypotheses, and we hope to prompt further research on college students' experiences with institutional betrayal in the healthcare setting.

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Reliability and Validity of Trazer for Analyzing Global Linear Kinematics
Samantha Nichol

Vicon (3D) Motion Capture (VMC) is the gold standard for examining functional movement. It can predict injury performance by examining global kinematics. Limitations include training to operate, sufficient space in the motion capture area, and expensive equipment. Two-dimensional (2D) motion capture, like TRAZER (TZ), may be more feasible. Test-retest reliability and concurrent validity lacks for updated TZ software. The study aimed to assess the reliability and establish the concurrent validity of TZ with VMC. For reliability and validity, 18 healthy individuals (23.72 ± 2.35 years, 166 ± 6.68 cm, 77 ± 24.59 kg) participated. Reliability was a two-session, within-subject design, separated by >48 hours. Validity was a one-session, within-subject design measured simultaneously by both systems. Participants responded to visual stimuli on the screen in which they hit buoys in 8 potential directions. Outcome measures were total distance, average velocity, average acceleration, and average deceleration. Reliability also included average reaction time. Excellent agreement existed between trials for average velocity (ICC = 0.92), average acceleration (ICC = 0.93), average deceleration (ICC = 0.94), and good agreement for total distance (ICC = 0.78), and reaction time (ICC = 0.82). ICCs had excellent agreement between TZ and VMC for all measures (total distance = 0.90, average speed = 0.91, average acceleration = 0.93, and average deceleration = 0.91). TZ is reliable and valid in measuring linear kinematics compared to VMC, indicating TZ would be an acceptable alternative to VMC.

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Retrospective and Prospective Associations of Introspective Dysfunction Ratings with Injury Occurrences among College Athletes
Abbey Palk, Erin Lunt , Hailey Smith

Context: Previous research has established common mechanisms of injuries among college athletes, but few studies have assessed the association of introspective dysfunction ratings with the occurrence of a core or lower extremity injury (CLEI) or concussion. This study focused on the potential value of using introspective dysfunction ratings and self-reported injury history to quantify sport injury risk among college athletes. Seemingly healthy athletes often report some degree of dysfunction that may elevate injury risk.

Methods: Prior to participation in the first pre-season practice session, 143 Division I athletes completed the Global Well-Being Index (GWBI) survey via the Research Electronic Data Capture (REDCap) system, which included items relating to general pain or discomfort, sleep-related problems, mood-related problems, musculoskeletal problems, and performance limitations. The responses to each question provided a 0-10 numeric rating of the frequency, temporal proximity, and severity of a problem, which were added to create a 0-50 Introspective Dysfunction Rating (IDR). Additional items included questions pertaining to negative life events and symptoms related to repetitive head impacts.

Results: The results of receiver operating characteristic and cross-tabulation analyses revealed that a sleep problem(s) rating of 4 or higher was associated with 2.4 times greater odds for the subsequent occurrence of a CLEI. A rating of 6 or higher was associated with 4.54 times greater odds for the subsequent occurrence of a sport-related concussion (SRC).

Conclusions: The design of the GWBI survey was based on the biopsychosocial model of health status, and the introspective self-ratings derived from it appear to have strong clinical value for identification of athletes who possess elevated injury risk.

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Revolutionizing Workplace Health and Safety: Advanced Dust Collection System Design, Manufacturing, and Optimization
Mayank Bharatkumar Patel

Research Problem Statement: Occupational health hazards caused by **dust exposure** in industrial environments—such as **manufacturing, construction,** and **mining**—pose serious **risks to worker safety, health, and productivity**. Addressing this issue is a **national priority**, as it directly affects **workforce well-being, public health, economic sustainability, and environmental quality**. Advanced dust management strategies are crucial for **improving air quality, mitigating health risks, reducing environmental pollution, and ensuring compliance** with evolving regulatory standards.
Proposed Solution: This research presents an advanced Dust Collection System designed to tackle these challenges by integrating **High-Efficiency Particulate Air (HEPA) filtration, Pulse Cleaning Mechanism, Safety Monitoring Mechanism, Digital Interactive User Interface, and Computational Fluid Dynamics (CFD)-optimized airflow regulation**. The system features **adaptive automation, adjusting in real-time** to enhance dust capture efficiency and minimize energy consumption, ensuring optimal performance across **diverse industrial settings**. This system **improves air quality, boosts worker health and safety, supports regulatory compliance, promotes operational sustainability, and minimizes environmental impact**—setting a new benchmark in industrial air quality management.

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Rheological changes in antibiotic resistant*Escherichia coli*
Katie Catlett, Ritu Sharma

Antibiotic resistance has become a rising issue worldwide. The increasing development in antibiotic resistance proves troublesome for disease treatment, leading to thousands of deaths a year in the U.S. alone (NFID). In this research, we aim to study if there are physical differences in antibiotic resistant E. coli that may be related to their increased resistance. A calcium chloride DNA transformation with a pGLO plasmid was performed in order to select colonies that carried an ampicillin resistance gene (ampR) in the presence of arabinose. The transformed colonies were used for rheometry studies to evaluate any differences from the non-transformed colonies in terms of viscosity.

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Rheology of Complex Fluids
Emily Dickey

Shear thickening is an intricate rheological process observed in suspensions that involves a significant viscosity increase under applied shear stress. This study analyzes the shear thickening behavior of silica particle suspensions in polyethylene glycol (PEG), focusing on the effects of different concentrations and the addition of sodium chloride (NaCl). The data was obtained using rheological instruments. The results of this study show a direct relationship between the shear thickening effect and silica concentration. We propose that this intriguing phenomenon is due to the electrostatic interactions between the silica particles and PEG, resulting in the formation of elaborate networks that resist movement under high shear stress. These findings present a clearer understanding of rheological properties and can be used to advance ideas in material design.

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Risk-Averse Decision-Making in Multi-objective Combinatorial Optimization
Chathuri Aththanayake

Uncertainty in input data significantly affects the quality of solutions in mathematical optimization, making it crucial to explore alternative decisions when the selected decision becomes unavailable or suboptimal. This study introduces a novel risk-averse decision-making approach for cases where objective function coefficients are uncertain in multi-objective combinatorial optimization problems. We construct a region in the objective space based on reference solutions obtained from the deterministic formulation. Alternative decisions, identified using a neighboring structure that falls within this region, are used to determine risk-preference solutions. We propose two sets of indices to quantify the quality of outcomes and neighboring decisions in terms of performance and risk level. The approach is demonstrated in diverse test cases, highlighting its effectiveness in improving risk-averse decision-making under uncertainty.

Keywords: Multi-objective Combinatorial Optimization, Neighboring Decisions, Risk-averse Decision-Making, Sensitivity Region, Uncertainty.

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San Salvador Bahamas Student Field Projects,UHON:3630: Tropical Island Ecology
Dawn Ford

This poster presents the field projects completed by students in UHON 3630 at the Gerace Research Centre on San Salvador, The Bahamas in March 2025. These projects involve students to work in small groups to collaborately pose a question, collect and analyze data, and draw conclusions about a tropical ecology topic.

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Scream Room for Howard Connect Academy
Nicholas Kincaid, Holland Hunneke, Logan Pendergrass, Nicholas Mao, Jacob Dunleavy, Damion Daniels

Mrs. Jennifer Dunleavy is a teach at Howard Connect Academy. She is responsible for all students with special needs. She has ask us to create a scream room, to help her with class. A scream room is a small box that is intended to dampen noise. (from yelling). Its benefits include the following: lower stress, avoid embarassment, and allow self expression. Mrs. Dunleavy believes that this scream room could become an essential part of her classroom. My group, the scream team, has brainstormed multiple solutions. We have recognize what is needed, what is wanted, and what our constraints are. After a recent bout of prototyping, we are ready to construct our final design.

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Seeking to understand the Rheology of increasingly antibiotic-resistant *Escherichia coli.*
Tabitha Wilson

We seek to understand the hydrodynamic properties of *E coli.* in response to increasing concentrations of ampicillin, our goal is to shed light on the rheological changes associated with antibiotic resistance. Significant challenges are posed by antibiotic-resistant vectors, i.e. difficult treatment of infections caused by multi-drug-resistant bacteria. Therefore, antibiotic resistance is a major concern in regard to human health. We aim to quantify how enhanced ampicillin resistance alters the viscous response of E. coli, with the hope to provide insight into bacterial behavior under stress. Utilizing a controlled experimental design, we will culture E. coli across four generations, with each generation exposed to escalating levels of ampicillin, starting at a minimum inhibitory concentration of 4.0 µg/ml. Optical density will be measured on each sample to verify culture growth. Then rheological assessments will be conducted on each generation using a viscometer to measure shear stress and viscosity. The resulting data will allow us to elucidate the relationship between antibiotic exposure and bacterial activity. We hypothesize that increasing antibiotic resistance will correspond to measurable change in viscous response, which can be indicative of bacterial viability and motility. This research not only enhances our understanding of E. coli's adaptive mechanisms in antibiotic-rich environments but also has broader implications for developing novel therapeutic strategies and drug delivery systems in medical and biotechnological applications. Our findings could ultimately contribute to combating the escalating threat of antibiotic-resistant infections, underscoring the need for innovative approaches to bacterial management and treatment.

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Senior Software Engineering Capstone Project - Clinic360
Zephirin Schmidt, Canon Roberts, Kaden Smith, Andrew Hicks, Sami Abu-orf, Jordan Roach

For healthcare providers, clinics, and patients who desire an easy, efficient, and secure way to communicate between patients and doctors, as well as facilitate communication between patients who desire to build a support network, the Clinic360 project is a comprehensive healthcare management suite that has privacy compliance while still offering many useful and convenient features. Unlike other healthcare platforms like MyChart, which focuses exclusively on

communications between patients and doctors, our product would also include features for patients to connect with each other and build a support network. Hospitals and healthcare clinics are the target customers for the Clinic360 Suite, and it would provide them a way to communicate with patients, giving a unique sense of community not offered on the market currently.

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Sexism in Syntax: Language and Its Relationship with Female Leadership
Kyle Rains

This paper evaluates the association between various language structures and female leadership, emphasizing the disconnect between how economists and linguists define gender. Using data on females in middle to senior-level management positions from the Labour Market-related SDG Indicators database (2024), gendered language structures from Gay et al. (2017), and pronoun drop from the World Atlas of Language Structures, I evaluate how language structures involving gender and pronoun drop may be associated with the presence of female managers. In a cross-section of 84 countries, I find that gendered language structures do not appear to have high levels of significance, and an index of these structures produces misleading results. Meanwhile, pronoun drop has a highly significant and inverse association with female leadership in business, building upon the existing literature on collectivism and female empowerment. These results remain robust despite differences in how economists and linguists define gender.

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ShotCaller
Caroline Bell, Joshua Love, Will Latimer

Basketball Shooting Robot

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Single Droplet Combustion of Algae Oils
Joseph Sanders

N/A

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Smart Factory EV Production Line
Jonathan Leffew, Michael Kinsey, Griffin Lichtenwalter, Alvin Binoy

Manufacturing roles in Tennessee are growing at a rate faster than the national average. The goal for this project is to design and build an assembly line that will be used to train industry

professionals and test new manufacturing technologies. Interviews have been conducted with businesses in smart manufacturing to determine the production line's design elements. From there, the team decided to create a scaled down, modular electric vehicle production line. Accordingly, the team researched automotive assembly lines in industry and miniature scaled down assembly lines. This year's project will consist of one module, with plans to add modules in future classes of Mechatronic students. The first module will consist of a six-axis robot used to assemble a 3D printed electric vehicle model. There will also be a vision camera used to visually check the assembled vehicle as well as a weight check. This project aims to provide a resource for manufacturing businesses interested in advancing their technology and for students interested in manufacturing roles.

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Smart Game Board
Danae Wnuk, Chris Kmetz, Casey Goins, Jon Womble

Project Mission
Over the last few decades, technology has transformed many aspects of life like transportation, housework, and entertainment. Board games, however, have remained immune from this transformation. Many attempts at modernization are just an app that runs on a tablet where all the classical aspects of the board game are diminished. There are no physical game pieces, and playing with a computer does not allow for socializing. Historically, board games have been a great way to connect with friends and family while engaging in some friendly competition. The smart game board brings classical tabletops to the technological era, while allowing for socialization and multiple games to be played and holding onto the aspects that make classical board games so cherished.

Goals
The technical goals for the project are to make sure the circuitry and code function correctly. The smart game board has an accompanying application programming interface that allows other developers to code games for the board. The overall goal is to upgrade classical board games by making them easier to learn utilizing modern technology, without losing the social aspect that makes the originals great.

Design Objectives
There are multiple design objectives to ensure the project functions correctly. These objectives include quick and competent communication between the microcontroller and its peripherals, an aesthetically pleasing and unambiguous user interface, open-source software, and efficient power consumption while maintaining portability.

Benefits
The smart game board does not adopt the pattern of isolation seen in modern gameplay. There is no internet protocol required for human or machine communication. Rather, players are required to physically interact with their opponents. This aspect of the smart game board promotes socialization and deters a culture of seclusion. The idea that humans need to socialize offline is routinely supported through various studies and the smart game board aims to encourage such interactions, thus greatly benefiting the health of its users.

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Solar Thermochemical Conversion of CO2 into Fuels Using Ni-Ferrite Driven Redox Reactions: Thermodynamic Efficiency Analysis
Andrea Stevens

The growing levels of carbon dioxide (CO_2) in our atmosphere are a significant driver of climate change, highlighting the need for innovative strategies to utilize this greenhouse gas. One promising solution is solar-driven thermochemical CO_2 splitting (CDS), which can convert CO_2 into carbon monoxide (CO)—a vital component for producing syngas and fuels. This study examines the thermodynamic performance of nickel ferrite ($NiFe_2O_4$) as a redox material in solar thermochemical CO_2 splitting processes. To evaluate how different factors influence the efficiency of this process, a detailed thermodynamic model was created. This model looks at how variations in inert gas flow rates and gas-to-gas heat recuperation affect key parameters and the overall solar-to-fuel energy conversion efficiency. The findings reveal that while increasing the inert gas flow rate lowers the required thermal reduction temperature, it also raises the total energy demand. On the other hand, enhancing gas-to-gas heat recuperation significantly decreases the energy demand associated with the process, thereby boosting overall efficiency. Overall, this research underscores the potential of $NiFe_2O_4$ as a highly effective catalyst for solar thermochemical fuel production. It also offers valuable insights into optimizing process parameters to improve energy efficiency. This work advances the development of sustainable CO_2 utilization technologies and paves the way for scalable systems focused on solar-driven fuel production.

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Spatial and Ecological Patterns of Meiofauna Biodiversity in Southern Florida's Atlantic Coastal Ecosystems
Sebastian Jimenez, Ben DeWitt, Francesca Leasi

Meiofauna are a diverse group of microscopic invertebrates (less than 1mm in size) present in nearly all animal phyla and play crucial roles in aquatic ecosystems. These organisms contribute to nutrient cycling, sediment stabilization, and the functioning of food webs. Due to their diversity, abundance, and short generation times, meiofauna serve as highly effective bioindicators, making them invaluable for monitoring ecosystem health and environmental changes. This study seeks to assess the diversity and distribution of meiofauna across both spatial and ecological scales in the Atlantic coastal ecosystems of southern Florida, which are particularly vulnerable to the ongoing impacts of climate change. Sampling was carried out along the coast in areas around Fort Pierce, Miami, and the Florida Keys. Measured environmental conditions include habitat type (water vs. sediment) and salinity levels. Meiofauna biodiversity was quantified by evaluating species richness, phylogenetic diversity, and community composition using environmental DNA (eDNA) techniques. After DNA extraction and amplification of the eukaryotic 18S rRNA gene, raw DNA sequences were processed with the bioinformatics software QIIME2 to generate amplicon sequence variants (ASVs), and taxonomic identities were assigned using BLAST. The resulting data were analyzed statistically in R to identify biodiversity patterns across regions, habitat types, and sampling depths. The study aims to detect potential barriers to meiofauna distribution and correlate biodiversity changes with environmental variables.

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Streamlining Manufacturing Workflow
Wolday Abrha

The project aims to improve the manufacturing process for hot oil expansion tanks by eliminating unnecessary movement between the jig and welding rollers, which currently adds non-value-added time and increases the risk of defects. The proposed solution involves redesigning the workspace to allow both tacking and final welding to occur in the same location, streamlining the process. Upon implementation of the proposed solution, the expected benefits include reduced production time, lower labor costs, improved manufacturing efficiency, improved safety, and enhanced product quality.

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Study of spatio-temporal dynamics in the VOLVO combustor using the spectral proper orthogonal decomposition technique
Ian Tidwell

A comprehensive understanding of reacting flow dynamics is essential when considering combustor performance and stability. This study focuses on two key analyses: the instantaneous reacting flow field and spectral proper orthogonal decomposition (SPOD). Instantaneous flow field analysis provides a snapshot of properties critical to understanding the mechanisms responsible for sustaining the flame—including temperature, velocity, vorticity, density, and species mass fractions. SPOD is then applied to extract dominant coherent structures governing flame motion, called modes, providing insight into the physical mechanisms driving translational movement. By identifying the highest energy modes in the system, SPOD helps characterize periodic flow behavior and its influence on flame stabilization. The combination of these approaches provides a more complete analysis of the reacting flow field, improving the accuracy of combustion dynamics models and control strategies, leading to enhanced combustor efficiency and reliability in practical applications.

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Sustainability of Emotional Intelligence Strategies
Bernadette DePrez

UTC IRB #21-097 Exempt
Sustainability of Emotional Intelligence (EI) Strategies: Participants were surveyed regarding usefulness and frequency of EI strategies post study participation to assess the impact of EI strategies over time.

Introduction: Self-care means learning to recognize your own temperament and trying to prepare for your personal limits (Psychology Today, 2018). Emotional intelligence skills can be improved through practiced strategies. Emotional Intelligence skills positively contribute to job performance and relationship management. (Emotional Intelligence 2.0, 2009). The ability to manage and understand emotions to self-regulate can decrease negative self-talk, and stress to contribute to the improvement of well-being and self-care. EI requires effective communication between emotions and rational thinking.

A post study survey was conducted in 2024 to determine if participants were impacted by and/or utilizing EI strategies post study. The initial study was conducted using TalentSmart® Emotional Intelligence Appraisal® pre- and post-survey to assess improvements in scores after education, reflection, and discussion. A Qualtrics follow-up survey was administered in 2024 (one-year or more post study) to assess sustainability and usefulness of EI strategies.
Aim - Study Sustainability Survey: Are Emotional Intelligence strategies useful and sustainable over time? Faculty and staff at a public university participated in the EI study, (SON Participants AY 21-22 and HHP Participants AY 22-23) to determine if overall Emotional Intelligence scores improved after the introduction of Emotional Intelligence strategies through education, reflection, and discussion. Participants were surveyed in 2024 to determine if the improvement noted in appraisal scores and EI specifically, Self-Awareness, Self-Management, Social Awareness, and Self-Management were sustainable over time.
Methods: Quantitative data collection, survey pre- post-design study Results - Sustainability Survey: SON and HHP Participants were surveyed in August 2024 post study participation regarding the impact and use of Emotional Intelligence strategies over time. Results- Respondents indicated the EI strategies related to Self-Awareness (n-8) were Extremely 100% useful (25% extremely useful, 50% very useful, and 25% slightly useful); Self-Management (n-8)100% useful (25% extremely useful, 50% very useful, and 25% slightly useful); Social Awareness (n=6) 100% useful (33% extremely useful, 66% very useful); Relationship Management (n-6) 100% useful (33% extremely useful, 66% very useful). Improvement in EI awareness (n-7) 100% affirmative (57% definitely yes, and 43% probably yes).
Impact - Overall, all survey participants indicated a sustained improvement over time of their EI awareness and usefulness.

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Sustainable Solutions for Plastic Industry: Manufacturing Practices and Waste Management
Vishakha Mokashi

The plastic industry plays a major role in environmental pollution, primarily due to inefficient manufacturing processes and poor waste management practices. In Tennessee, the increasing demand for plastic products worsens this problem, emphasizing the urgent need for sustainable solutions that can help lower carbon emissions and mitigate environmental harm. This research aims to identify and evaluate sustainable manufacturing methods and waste management strategies that can lessen environmental impact while also preserving the plastic industry's economic feasibility in Tennessee.

The study proposes that adopting advanced sustainable practices, such as energy-efficient production methods, closed-loop recycling systems, and waste-to-energy technologies, has the potential to greatly reduce carbon emissions and environmental pollution. To evaluate this hypothesis, a thorough literature review of current sustainable practices was performed, along with case studies and a comparative analysis of industries that utilize innovative waste management strategies. Data was gathered from research reports, industry statistics, and interviews with stakeholders to measure the effectiveness of various approaches. This study's hypothesis supports that the integration of sustainable manufacturing techniques and modern waste management systems can lead to a significant reduction in the carbon footprint and waste generation within Tennessee's plastic industry.

This research highlights the significant influence of sustainable solutions on reducing the plastic industry's environmental impact. It offers practical recommendations for policymakers and industry leaders in Tennessee, pointing them to establish efficient waste management systems and adopt sustainable manufacturing practices. By tackling the environmental issues linked to plastic production, this study plays a vital role in encouraging the development of sustainable industrial practices, ultimately supporting a greener and more sustainable future.

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Synthesis and Optical Characterization of Boron Nitride Quantum Dots
Katelyn Hamilton, Erin Fitzgerald

Quantum dots (QDs) are nanoscale semiconductor crystals with unique optical and electronic properties, widely utilized in cell biology, bioimaging, and fluorescence applications. Among them, boron nitride quantum dots (BNQDs) stand out due to their biocompatibility, high thermal conductivity, and chemical stability, making them promising for applications in biosensing, gas storage, and biomedical technologies.
This study synthesizes BNQDs using hydrothermal and solvothermal methods via a top-down approach. The process involves particle size reduction and purification techniques, including ultrasonic sonication, centrifugation, and filtration. While the exact mechanism behind BNQD photoluminescence—particularly in the ultraviolet region—remains under investigation, research suggests that particle size, structural defects, or quantum confinement effects contribute to this behavior. UV-vis spectroscopy confirms the presence of BNQDs. A strong absorption peak at 230 nm appears in samples synthesized via the hydrothermal method, suggesting successful BNQD formation. Further optical characterization utilizes fluorescence spectrophotometer. Each stage of the synthesis process undergoes analysis to determine optimal conditions for BNQD production. Future work focuses on scaling up synthesis for potential commercial applications and expanding their functional properties for advanced material development.

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Synthesis of 1,2,3-Triarylnapthalenes Utilizing the Photo-Dehydro-Diels-Alder Reaction
Ethan Dailey

The photo-dehydro-Diels-Alder (PDDA) reaction is a variation of the widely known Diels-Alder reaction. It is a unique route to produce sterically hindered naphthalenes, which are a platform for many important compounds in the pharmaceutical industry–an example being Rifampin, an antibiotic used in the treatment of Tuberculosis-as well as general chemical synthesis. There are many examples of intramolecular PDDA reactions; however, there are only a small handful of known intermolecular PDDA reactions. The intermolecular PDDA reaction necessitates the presence of an electron-withdrawing group on one side of a triple-bond moiety. Our research group has previously identified our desired compound, and we are currently working to better isolate our product and to characterize the reaction by utilizing NMR spectroscopy. This research aims to provide insight into a novel example of an intermolecular PDDA reaction, and the results of which will be presented.

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Synthesis of tpm ligands using C-F activation, subsequent functionalization, and coordination to a Mn(I) metal center
Alyssa Matthews

Trispyrazolylmethane (tpm) ligands and their associated metal complexes are commonly utilized in medicinal chemistry and catalytic applications. Of note, $[TpmMn(CO)_3]PF_6$ and its derivatives have been investigated for their controlled release of carbon monoxide, which can be utilized within the medical field. A unique way to prepare Tpm ligands involves the C-F activation strategy that exploits a quinoidal intermediate of aniline or anisole derivatives. Here, we present a strategy to generate substituted tpm ligands of the form $H_2NPh(^{R}pz)_3$ utilizing 4-(trifluoromethyl)aniline, KOH, and ^{R}pz (where ^{R}pz is a 4-substituted pyrazole). We also investigated the functionalization of the $–NH_2$ on $H_2NPh(^{R}pz)_3$ derivatives. For example, we found that $H_2NPh(pz)_3$ can be acylated with acryloyl chloride. We also investigated the coordination of $H_2NPh(^{R}pz)_3$ derivatives with a $[Mn(CO)_3]^+$ metal fragment. We found that $H_2NPh(pz)_3$ reacts with $Mn(CO)_5Br$, and following a NH_4PF_6 counter-ion exchange forms $[H_2NPh(pz)_3Mn(CO)_3]PF_6$. The identity of this newly formed transition metal compound was verified by ^{1}H-NMR spectroscopy and crystals of $[H_2NPh(pz)_3Mn(CO)_3]PF_6$ were grown by layering an acetone solution of our complex with hexanes. Under these conditions, $[H_2NPh(pz)_3Mn(CO)_3]PF_6$ crystalizes as an acetone solvate in space group *P*21/*c* with sheets of the complexes assembled via N-H--F and C-H--F intermolecular interactions.

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Technology and Transportation's Role in Social Isolation in Rural Older Adults
Sara Miller

This study examines the perceptions and experiences of rural older adults. More specifically, the experiences of their community, connections, technology, and transportation. Past literature, when examining these topics, took a quantitative approach utilizing scales. This study takes a qualitative approach, utilizing semi-structured interviews to examine the feelings behind the experiences of the participants. Four themes were found in this process. It was found that the participants were content with the connections that they had, alluding to the quality of connections outweighing the quantity of connections. The theme of community awareness was evident in how the participants were diligent in connecting to their communities. The fear and education of technology were found as themes in the interviews. It was found that older adults were scared of messing up technology while simultaneously not wanting education on technology. The last theme was concerns of public transportation, meaning that there were needs for public transportation and improvements that needed to be made to existing infrastructure.

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That's a Mouthful: Periodical Cicadas, Fish Body Size, and Feeding Ecology
Tyler Davis

Acquiring food resources is fundamental for the survival of individuals and persistence of populations. Body size and gape limitation are known to play an important role in determining an organism's ability to find and ingest those resources. The availability, timing, duration, frequency, and magnitude of prey resources vary widely over space and time, where some resources are

continuously available to consumers while others are delivered in large pulses. Periodical cicadas represent an especially large, allochthonous resource pulse that occurs every 13- or 17-years, translocating the accumulated belowground biomass and nutrients to the surrounding forests and streams. These periodical cicadas are typically 2.4–3.3 cm long with a 7-cm wingspan, depending on the species, providing a potential challenge for some fishes to consume. Taking advantage of the synchronous emergence of Broods XIII and XIX in 2024, we initiated a project to evaluate the feeding ecology and fish body size differences in relation to the availability of periodical cicadas in stream. Our objectives were to: 1) quantify the frequency of periodical cicadas in the stomachs of multiple stream fishes and 2) determine if fish body size correlates with the occurrence of periodical cicadas. Using fish stomach content analysis, we will examine the feeding habits of several stream fishes (e.g., Green Sunfish (*Lepomis cyanellus*), Longear Sunfish (*Lepomis megalotis*), Creek Chub (*Semotilus atromaculatus*), Bullheads (*Ameiurus spp.*)) from 23 streams across four states during the 2024 dual-brood periodical cicada emergence. Preliminary results indicate that about 90% of the 213 processed stomach samples contain cicadas. Further analyses will focus on addressing the body-size feeding-ecology relationships. This research will help us better understand the importance and cascading effects of these large, infrequent resource pulses to recipient consumers and ecosystems.

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The Assistive Guitar Pick Holder: The Pick-Grip
Areej Alghoul, Michael Martin, Amy Guinac

The Pick-Grip is an assistive guitar pick holder designed for John, a 79-year old guitarist and beginner bass player with peripheral neuropathy, which affects his hand coordination and causes tremors. His current pick holders at the time were too large and fragile, limiting his ability to play independently.

Our goal was to create a durable, comfortable, and easy to use pick holder that secures the pick at a 90-degree angle, reduces pain, and enhances user independence. The Pick-Grip consists of two 3D-printed TPU rings worn on the thumb and pointer finger, connected by magnets to securely hold the pick. This design mimics the natural feel of holding a pick while ensuring stability. A memory foam insert in the pointer finger ring adds comfort and security.

Lightweight and resilient, the Pick-Grip allows for a smooth playing experience while keeping the other fingers free for strumming. This device meets the key criteria of ease of use, durability, and comfort. The project was set for completion by December 2, 2024.

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The Chromatographic Separation of Modified Lysozymes by Quinones
Kendall Heath

Polycyclic Aromatic Hydrocarbons' (PAH) metabolism leads to modifications of proteins, lipids, and nucleic acids, and through further reactions, quinones can oxidize to continue reacting. Quinones lead to the formation of oligomers and two types of aggregates in these reactions. Our research focuses on the modification of Lysozymes (LYZ), a protein, with three different PAH quinones: ONQ, HNQ, and PNQ, which allow further understanding of the reactions of the oligomers and aggregates as they appear. The 2-hydroxy-napthoquinone (HNQ) is believed to be the least reactive of the three

quinones we are studying because of the continuous use of its inert form in tattoo ink and hair dyes. To analyze our data, our lab developed a procedure for monitoring the time-dependent incubated samples, using size-exclusion chromatography and UV-Vis. From those techniques, we determined the reactivity and absorbance of the modified lysozymes and quinones. Our data shows 2-hydroxy-napthoquinone (HNQ) as the least reactive PAH. The data shows 1,2-napthoquinone (ONQ) as the most reactive.

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The Cost of Learning: Analyzing Course Material Cost in General Education Courses at UTC
Hannah Daugherty

The rising cost of course materials remains a significant barrier to higher education, disproportionately affecting students with limited financial resources. This project examines the cost of course materials across general education courses at the University of Tennessee at Chattanooga (UTC) to identify disparities and high-cost areas. By providing actionable insights, this research supports efforts to reduce financial barriers and promote educational equity. Aligned with UTC's Affordable Course Materials Initiative (ACMI), the project also advocates for the adoption of Open Educational Resources (OER) and other cost-saving strategies.

This project employs a systematic data collection and analysis approach, focusing on general education courses offered in the 2024-2025 academic year. Data are sourced from institutional records and university bookstore pricing, covering textbooks and other required materials. Cost variations will be analyzed at both the disciplinary level (e.g., humanities, social sciences, natural sciences) and course designation level (e.g., GE23 general education requirements vs. pre-2023 requirements). This comparative analysis aims to identify courses and subject areas with the highest financial burdens while highlighting opportunities for more affordable alternatives.

Preliminary findings indicate substantial cost variations across general education courses at UTC. GE23 courses have an average material cost ranging from $65 to $89 per course, with cost per credit hour varying by discipline. In contrast, pre-2023 courses show a similar range but with notable differences in affordability trends. The adoption of zero-cost/OER materials is higher in certain disciplines, with Humanities and Fine Arts leading at over 50% zero-cost adoption. However, disciplines like Quantitative Reasoning and Behavioral and Social Sciences continue to rely on high-cost materials. While analysis is ongoing, these findings highlight key areas where cost-saving interventions, such as OER implementations, could improve affordability and equity in higher education.

While currently in the data collection phase, this project holds the potential to inform institutional policies and practices. It supports broader efforts to expand the adoption of OER and other affordable alternatives, ultimately reducing education expenses for UTC students. By addressing financial barriers, this initiative contributes to a more inclusive and equitable learning environment, ensuring that all students can succeed without being hindered by the rising cost of education.

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The Development of a 6 Finger Robotic Hand
Alex Bailey

Because of the lack of innovation in the field of prosthetics, the formula has been the same. To determine the innovation that could be found in this field, we bought a robotic hand, able to mimic an artificial hand. This hand allowed me to study and test the workings of general mechanisms in the field of robotic attachments. The hand featured four servos facing the same direction, these four controlled the fingers, and a servo at roughly a 100º angle, which controlled the thumb. There are custom metal pieces which ensure any one phalanx can move and fold inwards or outwards respectively, or as gauged from its command. This is an important aspect of the hand, as it provide examples of ways to manipulate the whole finger in one action. I decided that a sixth finger would improve this aspect of robotic attachments. My goal with this research is to understand how robotic end effectors work, so that I may develop one for a body part in the future. After my research used from gaining information from the model hand, I was able to design a mechanism that utilizes six servos to control six individual fingers. These servos are coded, and in a base to hold them all. Rather that have just a replacement body part, an improvement could be better, and there are more uses found when not limited to just five fingers. In my future research, I want to have all 6 servos developed and working, as well as continue to work on further material for the arm.

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The Development of Thermal Camouflaging Technologies
Calen Hawk

Camouflage was first used and developed in France in 1914 [1]. Throughout the history of camouflage, many various patterns and designs have been used to conceal and distort the shape of the human body.
While most camouflage patterns work, especially when used in environments for their intended purpose, they all fall short of true camouflage. Traditional camouflage, when used correctly, successfully conceals the person from the human eye by blending in with its surroundings. The reason that most camouflage is not considered true camouflage is because while it is possible to hide from the human eye, you cannot hide from different methods of detection like night vision or thermal imaging. However, advanced technology is allowing the production of materials that can mask a human's heat signature, along with changing the body's heat signature and surface to blend in with the surrounding temperature of the environment. So far, not many examples of this technology have been publicly introduced, but there are many different ways to make a thermal camouflage possible. This poster will go over all of my current research on thermal camouflage, along with my plans for future research and development.

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The Dilament Forge
Corey Clark

The 3D Filament Fabrication Machine project aims to create an innovative and cost-effective solution for producing 3D printer filament by recycling PET plastic bottles. This machine is designed to allow institutions, businesses, and independent owners to generate their own filament without

the need for expensive, full-scale equipment. By converting 20oz or larger PET plastic bottles into usable 3D printing filament, the project promotes sustainability, reduces plastic waste, and lowers the cost of filament, which can be as high as $30 per kilogram for standard materials.
The machine works by shredding plastic bottles using a granulator followed by heating the plastic through a rotating auger that melts the shreds for extrusion into filament. A cooling fan solidifies the filament before it is spooled automatically. The project team aims to complete the physical construction of the prototype and the necessary control systems by April 2025.
The key benefits of this project include increased accessibility to affordable 3D printing materials, improved sustainability by recycling plastic waste, and a reduced environmental footprint. Research from previous studies on filament extruders and extrusion systems guided the development of the machine, leading to a design that balances simplicity, cost-effectiveness, and efficiency.
The project is structured around key milestones, including physical construction, electrical system development, and system testing. The team follows strict engineering and safety standards, such as IEEE codes for motor protection, circuit breakers, and electrical safety, as well as ASTM standards for material safety.

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The Effect of Experimenter Behaviors on Projective Interpretations
Jackson Everett

As a part of a broader Honors thesis examining the effects of manipulated experimenter behaviors on participants' responses to psychological assessments, this presentation focuses on the participants' projective interpretations of ambiguous stimuli while working through the Thematic Apperception Test (TAT) with a confederate experimenter. I hypothesized that participants exposed to anxious experimenters would render more negative interpretations while warm experimenters would lead participants to produce more positive interpretations. Participants (N = 98) were randomly assigned to either an anxious, flat, or warm experimenter condition and responded to ten TAT (Murray, 1943) cards in a free-response format. The Linguistic Inquiry & Word Count (LIWC-22) software coded participants' TAT responses. Their responses were highly negative in tone but did not differ by experimenter condition. While my primary hypotheses were not supported, the laboratory environment appeared generally unsettling, suggesting that further research on test anxiety and evaluative settings is necessary.

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The Effect of External Cracks on Solar Panel Power Production
Lake Montgomery

Solar energy, 5.2% of the US net electricity generation in 2024, is expected to grow substantially, reaching 8% of the US net electricity generation in 2026 [1]. The solar energy industry also forecasts 500 GW of solar energy capacity installed per year by 2030 [2]. With the growing installation of solar power, it is important to keep solar arrays functioning at full power, one operations challenge is external surface cracks on panels from rocks or hail. The goal of this study is to analyze the effects of surface cracks on solar panel power production. In order to fully understand the effects of surface cracks on solar power production, this study used the 200 kW Baylor Solar Array. This study measured open circuit voltage, short circuit current, and irradiance of both cracked and intact

panels. On average, the I_{sc} of cracked panels was 27 lower than intact panels. The V_{oc} was 1% lower for cracked panels. While this is less power production, further cost analysis showed that even when replacing the cracked panels with brand new 410-watt panels it would take over five years to payback the investment. This study emphasizes to solar panel owners and buyers that cracked panels may still be producing significant power and it may not always make sense to replace them.

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The Effect of Recreational Music Use on Undergraduate College Students Perceived Stress
Kassy Leach, Angel Kreger, Kiara Watkins, Jessica Popp

The purpose of this study is to explore the effects of music on college students experience as it pertains to stress and its effectiveness as a stress self-management tool.
This research study will help to fill this knowledge gap by exploring the mechanism through which music affects the students' perceived stress. It may also serve to help students identify a stress management tool, which is useful as college students often experience high levels of stress.

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The Effectiveness of Sleep Education in Pediatric Occupational Therapy Clinical Practice
Emma Deeds, Alexandra Shows, Ann Wehinger, Alexie Inman, Kourtney Cummins

Purpose: The purpose of this study was to determine if a sleep education program improves pediatric occupational therapist (OT) clinical knowledge, confidence, & frequency of formal sleep evaluations and intervention recommendations for children with sleep disturbances.
Method: A convenience sample of 80 OTs who attended a sleep education training session or worked in private clinics were identified to provide insight into the perceived and actual evaluation & intervention practices with pediatric sleep disturbance. Fifteen OTs completed the pre-survey and five completed both surveys and data tracking components. Comparative data was analyzed with descriptive statistics.
Results: Three of five OTs reported increased evaluation frequency with one report of increased frequency in intervention recommendations. Four OTs reported an increase in sleep evaluation selection. Increased knowledge of sleep physiology was reported by three OTs. The most common recommended sleep interventions were physical activity, environmental modifications, & structured bedtime routines in both surveys.
Conclusions: The largest threat to the validity of the results is from participant attrition. There was little difference in intervention selection in pre- and post-education sessions. There was a trend toward increased knowledge and use of evaluations. Post-education, knowledge levels increased, however, most commonly recommended interventions did not change. For most OTs, the sleep education sessions positively impacted confidence levels in evaluating disturbances and recommending interventions.

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The Effects of Cover Crops on Soil Carbon Sequestration in an Organic Farming Environment
Philippa Hill

The soil on Earth has incredible potential to store large amounts of atmospheric carbon. Therefore, research into the mechanics of soil carbon sequestration and its relationship to agricultural practices could contribute to a future solution for climate change. Soil carbon storage both alleviates the effects of climate change and positively influences the growth and development of plant life. This study investigates the effects of cover crops on soil carbon levels in the context of an organic garden. In this case, we study the contrasting effects of cover crop coverage versus a bare plot approach during the winter season after the harvest of a sunflower crop in southeastern Tennessee. To simulate a real agricultural cycle, we planted sunflowers (our "cash crop") in two different plots during the spring and harvested them in the fall. We then planted crimson clover (our cover crop) in one of the plots and left the other plot bare with a mulch cover, which we left throughout the winter season. During the different phases of this experiment, we conducted various lab tests in order to measure variations in soil carbon levels, soil nutrient levels, and soil respiration. The results gathered up to this point show that carbon levels between all three plots (cover crop, bare, control) consistently increased from the spring into the winter, with a markedly more significant increase demonstrated in the cover crop plot, and then decreased to original levels in late February. Nutrient levels generally decreased, in line with our expectations. Soil respiration levels rapidly decreased with the onset of colder temperatures and then increased again in March. These findings, taken specifically within the context of organic farming conditions that eschew any synthetic chemicals, reflect the variability of soil carbon levels and support earlier conclusions in the field of soil science, promoting the advantages of sustainable agriculture for carbon sequestration.

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The Impact of Auditory Cues on Roll Vection in Virtual Reality
Chase Artopoeus, Max Teaford

Vection, illusionary self-motion in the absence of actual motion, has traditionally been through to result from visuo-vestibular interactions. However, recent work on roll vection (i.e., illusionary rotaitons around the vertical axis) suggests that auditory cues may contribute to vection as well. Specifically, if the sounds are similar to those heard in the real world and remain stationary (i.e., always plays from the same spatial location). However, there had yet to be a study aimed at determining roll vection (i.e., rotation around the longitudinal axis) was also enhanced by these auditory cues. To test this possibility participants experienced three different combinations of cues (audiovisual, visual-only and auditory-only), via virtual reality, three times each. We found that participants experienced vection faster and more convincingly in the first two repetitions of the audiovisual condition relative to the visual-only and auditory-only conditions. However, there was no difference between the audiovisual and visual-only condition on the third repetition. Regardless of the number of condition repetitions the audiovisual and visual-only conditions were always characterized by higher convincingness ratings and lower onset latencies than the auditory-only condition. In tandem these results suggest that audiovisual stimuli can indeed elicit roll vection that occurs faster and more convincingly than unisensory variants of the stimuli (i.e., visual-only and auditory-only). However, the benefit of including auditory cues diminishes over the course of repetitions suggesting that the brain may down weight auditory cues. Future studies are needed to better characterize the mechanism underlying this finding and other factors which may impact this effect (e.g. sound type and field of view size).

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The Impact of Human Activities on Meiofauna Biodiversity in Lentic Ecosystems
Keyle Bryant

Lentic ecosystems—such as ponds, lakes, and wetlands—differ from flowing systems like rivers due to their stagnant waters, which accumulate sediment and organic matter, creating nutrient-rich habitats. These ecosystems are crucial for biodiversity, providing homes for diverse species, regulating water quality, storing water, and supporting human activities like fishing and agriculture. However, they face growing challenges from pollution, invasive species, habitat destruction, and climate change. Meiofauna—microscopic animals that inhabit these ecosystems—are key players in nutrient cycling, sediment stabilization, and food web dynamics. Due to their diversity, abundance, and short generation times, meiofauna serve as effective bioindicators of environmental change and provide valuable insights into ecosystem health. Despite their ecological importance, meiofaunal communities remain understudied, particularly in freshwater ecosystems. This study focuses on meiofaunal biodiversity across 10 lentic water bodies in the Chattanooga area, with an emphasis on understanding the impact of human activities on their communities. Using environmental DNA (eDNA) techniques, we assess biodiversity, including richness, community composition, and phylogenetic diversity. Additionally, GIS models are employed and integrated to quantify human influences such as population density, traffic, and land use in these ecosystems. The goal is to evaluate how human activities shape meiofaunal communities and contribute to the overall health of lentic ecosystems. The anticipated results will inform strategies for mitigating the negative effects of human impacts, supporting the development of sustainable practices to preserve the health and functionality of these vital ecosystems for future generations.

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The Impact of Mild Hypoxia on Visual Tilt Illusions
Shyla Khan

Previous research has demonstrated that hypoxia (i.e., insufficient oxygen) can adversely affect the function of the vestibular system, at simulated altitudes as low as 8,000 feet (i.e., the altitude commercial airlines are pressurized to). This work suggests, when hypoxic, movements need to be larger for individuals to be able to reliably sense them (Teaford et al., 2023). This is noteworthy as the vestibular system plays a pivotal role in spatial orientation (i.e., knowing where our body is relative to the environment), as it is one of the leading causes of death and disability for military aviators. However, the aforementioned research was conducted in a dark room, devoid of visual cues that would provide orientation cues, meaning it remains unclear if this finding generalizes to situations where there are visual stimuli. In the present study, we compared participants' experience of visual pitch tilt illusions (i.e., experiencing one's body as being in a different position than it actually is despite them not physically moving) while being exposed to gas mixtures with different oxygen contents. Based on past work it was expected that being hypoxic would increase one's susceptibility to visual tilt illusions. Fifteen participants (nine female) underwent a two-part protocol where they were presented stimuli via virtual reality while breathing a gas mixture with 20.9% O2 or 15.4% O2. Before and after each trial of viewing the stimuli, the participants were asked to make a judgment about their body orientation using a digital angle measure. The resulting data was analyzed using a 2 x 7 (oxygen content x test) repeated measures factorial ANOVA. It was found that

there was not a main effect of oxygen content, trial, or an interaction between them (all p values > .05). The results of the present study suggest that hypoxia does not have an impact on the occurrence of visual pitch tilt illusions. This suggests that the findings, reported in previous research, were likely due to changes in vestibular receptor function, which can be compensated for when there are useful visual cues.

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The Impact of Remedial Math Courses on Praxis Core Performance
Tyler Griffin, Jennifer Lynberg

In Tennessee, teacher candidates with ACT scores t-test (SPSS, α = .05) against the national test-taker mean (*M* = 168, *SD* = 14; ETS, 2023). While post-course scores showed no statistical difference from the population (*t*(16) = -0.598, *p* = .558), 94% of participants passed the Praxis Core post-intervention—a dramatic increase from the 92% failure rate pre-intervention. MATH 1999r successfully remediated fundamental math skills, though supplemental supports (e.g., peer tutoring) could further boost student outcomes. These findings support Tennessee's policy shift and propose support strategies to strengthen teacher preparedness.https://symposium.foragerone.com/utc-spring-research-and-arts-conference-2025/presentations/71869

The Magnetic Tremor Suppressing Design
Jorge Marcano

Essential tremor is a nervous system condition, also known as a neurological condition. It causes a 6 – 12 Hz rhythmic shaking that the individual can't control which can affect almost any part of the body, but the trembling happens most often in the hands. The Magnetic Tremor Suppression Device uses magnetic forces to connect the forearm to the hand, stabilizing the rhythmic movement of essential tremors.

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The New Vol Experience: A Year-Long, Comprehensive Approach Toward Supporting the Transition of New Students
Adam White

Professionals across higher education are consistently attempting to uncover strategies to ensure the necessary student learning and development takes place throughout a student's first year on campus (Goodman & Pascarella, 2006; Sidle & McReynolds, 1999). At the University of Tennessee, Knoxville (UTK), the first-year experience has been identified as a tool to promote student success and retention. A complete overhaul of the orientation and transition programming at UTK occurred for the Fall 2024 incoming class, known as the New Vol Experience (NVE), and has the primary goal of ensuring new students are being properly acclimated to campus to promote long-term success (University of Tennessee, 2024). A traditional approach to orientation and first-year programming is no long as effective as it once was, specifically as we look at the needs of this new generation of students ("The new generation of students ", 2018).

The goal of this project is to assess each component of the NVE while understanding to what degree, if any, of these opportunities had an impact on our students' first year. A myriad of assessment methods were utilized in an attempt to capture a comprehensive outlook on the NVE, including a variety of surveys which were disseminated to students as they completed each phase. In addition, data was collected regarding first-year students' academic success and spring semester course registration. At the end of the fall semester, a final First-Year Experience Survey was distributed, focusing on students' understanding of UTK and their overall academic preparedness heading into their second semester on campus.

After the results were compiled, we found 94% of students were satisfied with the NVE, and 92% ultimately felt prepared for their first semester at UTK. Additional data surrounding each component of the NVE will be provided, including the average cumulative grade point average (GPA) for students who completed specific first-year student initiatives. It was critical to properly assess this unique approach toward orientation and supporting the transition of new students. While we hoped to learn about the impact of the NVE, we were also able to discover additional information directly related to students' needs throughout the first year. The research collected around the New Vol Experience at UTK is an important place to start as higher education professionals look to uncover innovative strategies to yield student learning and success.

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The Power of Gender Roles: Aging Perceptions, Health, and Well-being
Isabella Hooper

This study explored how aging-expectations and gender role adherence predict well-being and perceived health outcomes in women. A sample of 288 female-identifying adults were recruited from a college student population and from the outside community. The participants completed a series of measures related to well-being, aging expectations, gender role traits, and health-related quality of life. Correlational analysis revealed that femininity was negatively associated with both perceived health and well-being outcomes. Two linear regressions found femininity and psychosocial loss to be negative predictors of perceived health and well-being outcomes. Additionally, psychological growth and perceptions of positive control were positive predictors of well-being. These findings suggest adherence to traditional feminine traits may make women more susceptible to benevolent sexism and benevolent ageism. Both of these open up the potential for poorer health and well-being outcomes with decreased autonomy and decreased resilience. Promoting growth-oriented views of aging and the importance of individual agency may improve women's health and well-being outcomes.

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The Relationship Between Sense of Agency and Perceived Stigma in Those with Cognitive Disabilities
Scarlet Pardue

The focus population of this study is those with cognitive disabilities, which limit in some way a person's ability to complete mental tasks, such as communication, planning, or remembering. The primary purpose is to focus on the participants' sense of agency and perceived stigma. The Sense of Agency Scale (SoA) measures a participant's consciously perceived control over their mind, body,

and the immediate environment. The Perceived Disability Social Stigma Scale (PDSS) measures to what degree participants believe that people with disabilities are stigmatized in their respective communities. Confirmatory research into these two variables offers an interesting insight into how the degree of stigmatization a person feels may affect the degree to which they feel they are in charge of their own life. It was predicted that the degree of stigmatization that participants perceived would relate to their sense of agency. There was a moderate negative correlation between perceived stigma and positive sense of agency (r=-.26, p=.015, 95% *CI* [-.439, -.051], N=90).

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN DIGITAL TRANSFORMATION: ENHANCING EFFICIENCY, AUTOMATION, AND DECISION-MAKING
Blake Pickett

Flexible AC Transmission Systems (FACTS) devices enhance power distribution networks by improving voltage control, reducing power losses, and increasing system stability. This study examines the integration of Thyristor-Controlled Series Capacitors (TCSC) and Static Synchronous Compensators (STATCOM) into a 200-kilometer transmission line, using MATLAB Simulink modeling to assess their impact on power efficiency and stability.

In this research, TCSC devices placed at the sending end of the transmission line were found to significantly improve power transfer capacity by reducing line reactance and enhancing voltage stability. Conversely, STATCOM devices, when placed at the sending end, provided superior reactive power compensation and minimized voltage fluctuations, leading to enhanced system stability. The findings indicate that TCSC is more effective in increasing power flow, while STATCOM is critical in stabilizing the system and improving overall power quality. Furthermore, the optimal placement of these devices reduces transmission congestion, minimizes energy losses, and enhances the economic performance of power networks.

However, deploying FACTS devices near high-emission power plants may increase carbon footprints, necessitating strategic placement to balance efficiency and environmental concerns. The research underscores the need for further studies on hybrid optimization techniques for FACTS integration in modern power networks.

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The Role of Growth Mindset and Grit in Mathematics Tutoring
Trevor Thomas

Mathematics is a subject where a lot of students struggle (Aransado & Prudente, 2024), but having a growth mindset can help change their mentality. This research investigates how setting goals can help a student's grit and growth mindset and can ultimately lead to greater success in math courses. Research questions include if goal setting and tutoring can help a student develop a growth mindset and how students can be successful in their math classes while utilizing this developmental focus. This literature review investigates how students could be successful in their math courses using a growth mindset when setting academic goals.

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The Third Freshman Year: Understanding the Post-College Transition for First-Generation and Low-Income Students
Melissa Laseter

The transition from college into post-graduate life represents a critical, yet underexamined, phase in a student's development. For first-generation, low-income (FGLI) graduates, this transition—coined as the "third freshman year"—presents unique challenges, including future planning, career development, financial wellness, and social-emotional adjustment. Despite extensive research on college access and persistence, limited studies address the structural and personal obstacles these students face after earning their degrees.

This study aims to explore the barriers and support mechanisms influencing FGLI graduates' success post-college. By identifying critical areas of need and evaluating existing interventions, this research will inform policy and programmatic changes aimed at enhancing institutional support for FGLI graduates beyond the college experience. The findings will contribute to a growing body of work that challenges institutions to rethink their role in ensuring equitable post-graduation outcomes.

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The Value of a Second Chance: Exploring Job Attitudes of Justice-Involved Individuals
Sawyer Robinson, Audrey Pennington

Approximately one in three Americans have a criminal record (ACLU, 2017). It is known that stable employment can help reduce recidivism, yet 75% of justice-involved individuals (JIIs) remain unemployed a year post-release (Nally et al., 2014; Visher et al., 2011). Some claim that JIIs are loyal and hardworking when given an opportunity to make a living but there is little empirical evidence to support it (ACLU, 2017). Our team conducted a research study to test whether organizational commitment, or an employee's feeling of dedication and responsibility toward an organization (Klein et al., 2012), and their intentions to quit their job differs between JIIs and non-JIIs. This study consisted of 167 survey responses from 91 JIIs and 76 non-JIIs collected through community-based organizations and Prolific (an online survey data collection platform). We found a significant difference in commitment between JIIs and non-JIIs. We did not find that JIIs had significantly different intentions to quit their job than non-JIIs.
Companies care about attitudes like commitment because of the implications it has for outcomes such as satisfaction, job involvement, and turnover (Meyer et al., 2002). One perspective on organizational commitment breaks it down into three types: affective, normative, & continuance (Meyer & Allen, 1991). Affective commitment represents an emotional connection to the organization, continuance represents a more practical need to remain employed, and normative represents a sense of loyalty or obligation that keeps a worker committed. We tested for differences in all three types of commitment and found that normative commitment was significantly different between these two groups. Interestingly, normative commitment is a result of an employee feeling that their commitment to the organization is the *right thing to do*. This finding directly aligns with and supports the claim discussed above about the potential loyalty of justice-involved workers. This

research may help inform hiring decisions that could benefit both organizations and a population in need.

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Thermal Conductivity of Argon Using Molecular Dynamics
Nathan Tipton

The thermal conductivity of Argon was calculated at three different phases: solid, liquid, and gas by using the molecular dynamics software LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator). To calculate the thermal conductivity, a script/code was created and ran within the LAMMPS software that simulated the specified conditions within the code. This was done using two different methods within LAMMPS: equilibrium and non-equilibrium. It was determined that the equilibrium method had to be used for the solid and liquid phases and the non-equilibrium method had to be used for the gaseous phase. The equilibrium method gave inaccurate results for the gaseous phase of Argon so the non-equilibrium method had to be used. Once the thermal conductivities were calculated, they were compared to published literatures and it was concluded that the created codes were giving accurate results. This research could be continued to see how the thermal conductivity of Argon changes with temperature and pressure.

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Threats of Mass Violence: The Construction of a Moral Panic
Rachel Gilreath, Tammy Garland

Recent mass shootings within educational settings have resulted in the pervasive fear nationwide that schools are dangerous places and juveniles are becoming increasingly violent. While such events are rare occurrences, a number of legislative efforts have been made to prevent gun violence especially among youth; however, such laws are often punitive rather than restorative. The Nashville shooting at a private school resulted in legislation targeting “threats of mass violence” in schools and reclassifying such threats to a Class E felony. The current study examines the construction of school shootings emphasizing not only how media, political actors, and the public frame moral panics but the role social media plays in creating and furthering the impact. As the Tennessee law (§ 39-16-517) went into effect at the beginning of the 2024/2025 school year, the study focuses on police enforcement and reporting of juveniles involved in threats of mass violence and responses by the public to such threats on social media.

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TITAN - A Suite of Reliability Analysis Tools
Samuel Andrews, Brett Craig, Rowdy Tucker

The TITAN project is a software solution developed to enhance contingency analysis workflows within the Tennessee Valley Authority (TVA) by improving the accuracy, efficiency, and automation of model-building and contingency studies. TVA has specific challenges when integrating forecast

data from the Eastern Interconnect Planning Model into its state estimator model, ensuring that contingency analyses reflect the same topology and system conditions as those used by system operators. Leveraging TARA and Python-based automation, TITAN enables TVA to build more accurate models and conduct faster, more precise reliability assessments. The research question driving TITAN is how can automation and data integration improve the accuracy and efficiency of TVA's contingency analysis processes? TITAN achieves this through automated model building that integrates forecast data and real-time system topology, streamlined input file generation for contingency analysis studies, automated data processing and output formatting for improved decision-making, integration of next-day peak load forecasting to enhance system reliability planning. By automating key steps and ensuring seamless data integration, TITAN significantly reduces manual workload, improves analytical accuracy, and accelerates decision-making for grid operators and engineers. TITAN represents a major step forward in contingency analysis automation, providing TVA with a robust toolset for maintaining grid reliability.

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Transformational Leadership & Job Satisfaction: A Comparative Study of the U.S. and Vietnam
Will Richmond

Job satisfaction and motivation has always been a complicated issue within the United States, and after working in Vietnam for several weeks, I have taken notice of how the topic is perceived locally. Factors such as income, job autonomy, and opportunities for career growth all seem to play a part in how committed employees are to their companies, yet as research reveals, leadership is one of the most important aspects in making employees feel committed to their organizations, and thus satisfied with their jobs. This study utilizes this benchmark in order to compare the effectiveness of transformational leadership across workplaces in both the United States and Vietnam, accounting for the role of leadership in maintaining organizational commitment and decreasing absenteeism. Ultimately, this analysis shows that although both the United States and Vietnam reap similar benefits from the practice of transformational leadership, they ultimately show differences in the implementation process, both because of cultural differences and preexisting workplace biases. Although further research may be able to draw more definite conclusions, the United States and Vietnam currently sit with a similarly effective practice that is underutilized by one of the countries due to the drastic difference in their collectivist and individualist organizational structures.

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Uncertainty Quantification of Turbulent Premixed Flames
David Brown

Premixed flames may suffer from uncertainties stemming from chemistry, turbulence, and operating conditions. These uncertainties negatively impact the confidence in the predictive capabilities of computational tools. By utilizing Uncertainty Quantification (UQ), these uncertainties can be quantified and improve confidence in such tools. There are two non-intrusive techniques for UQ—surrogate modeling and direct modeling. This study utilizes surrogate modeling techniques to perform UQ of operating conditions on turbulent premixed flames. Three operating conditions are considered as the uncertain parameters for this study: equivalence ratio,

pressure, and temperature. The associated quantity of interest is the normalized consumption speed. Results show the efficacy of the computational framework created, which can be used

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Uncovering key biomarker gene in pancreatic and breast cancer progression using molecular docking method with potentials for targeted therapeutic interventions

Jannatul Ferdoush, Noah Smith, Chloe Hagemann, Caroline (Sky) High

Background

One in sixty women, and one in fifty-six men will be diagnosed with pancreatic adenocarcinoma (PAAD) during their lifetime, while approximately one in eight women will be diagnosed with breast cancer. Although early diagnosis of breast cancer has significantly improved, PAAD is often diagnosed at more advanced stages, leading to lower survival rates. Understanding the roles and interactions of differentially expressed genes (DEGs) provides insight into the molecular mechanisms of these cancers and aids in the discovery of diagnostic biomarkers. This study analyzes DEGs expressed in both PAAD and BRCA to enhance our understanding of these diseases and support earlier detection while identifying potential pharmaceutical targets. In conjunction with wet lab research, this dry, computational approach has the potential to change the direction of future cancer research and treatment options.

Methodology

This study compared DEGs between BRCA and PAAD through NCBI and GEPIA's databases to obtain a comprehensive list of genes associated with the development and progression of both cancer pathways. This list was inputted into the Cytohubba plug-in of Cytoscape to visualize their protein-protein interaction network and identify the top 10 hub genes involved in the metabolism of BRCA and PAAD. GEPIA's stage plot, box plot, and heat map tools confirmed the expression of each hub gene. An additional survival analysis was used to assess the progression and survival projection of individuals with differential expression of each gene. Finally, PyRx AutoDockVina wizard and BIOVIA visualizer aided in optimizing molecular docking of the most significant hub gene ligand and various possible pharmaceutical compounds to be pursued for future drug design.

Findings

Three hundred and five DEGs were shared between BRCA and PAAD after initial data analysis. The top ten hub genes were established through their PPI network as follows: *BUB1, TPX2, CCNB1, KIF2C, CDCA8, KIF20A, DLGAP5, CDK1, KIF11,* and *BUB1B.* Via various supplementary analyses, *CDK1* was determined to be the most crucial gene in the progression of both cancers. Irinotecan, Cycloartobiloxanthone, Amorphin Flavonoid, Quillaja saponin, and Sarsasapogenin proved to be the most promising compounds in molecular docking with CDK1.

Conclusion

Our findings enrich understanding of the mechanisms and pathogenesis of BRCA and PAAD, and unveils vital biomarkers that provide valuable insights into potential treatment strategies.

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Understanding Community Violence, Anxiety, and Substance Use in Black Adults
Berri Rawls, Liam Medina

The impact of community violence on individuals, particularly among Black communities, remains a concern. Despite the well-documented statistics showing the disproportionate rates of violent victimization among Black individuals, there is a gap in understanding the effects on Black adults. This research aims to address this gap by focusing on the relationship between exposure to community violence (ECV), anxiety, and substance use among Black adults. We will be drawing from the cognitive appraisal theory, which suggests that individuals' perceptions of events shape their emotional responses. This study examines how the perception of community violence influences anxiety levels among Black adults. It is suggested that heightened anxiety, stemming from chronic exposure to violence, contributes to maladaptive coping mechanisms, such as substance use, as individuals attempt to alleviate distress. It is hypothesized that there will be a positive correlation between (i) ECV and substance use, (ii) ECV and anxiety, and (iii) anxiety and substance use. It is also expected that the (iv) association between appraisals of community violence and anxiety will vary by appraisal and (vi) the relationship between ECV and SU will be moderated by anxiety. Ultimately, this research will help in creating interventions and support systems to address the mental health ramifications of community violence within marginalized communities, with an emphasis on reducing anxiety and preventing substance use as a maladaptive coping mechanism.

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Understanding Molecular Mechanisms of UPS Regulation ofTranscription Factors
Maya Minkara, Luna Omeragic, Emily Wood, Jannatul Ferdoush

This research investigates how the Ubiquitin-Proteasome System (UPS) regulates transcription factors, focusing on Paf1 (Polymerase Associated Factor 1) and Taf2 (TATA-binding protein-associated factor 2). While UPS is known for protein degradation, its role in transcription regulation is unclear. This study aims to uncover the molecular mechanisms behind UPS-mediated transcription factor regulation. Yeast (Saccharomyces cerevisiae) is used as a model due to its evolutionary conservation with humans (Ferdoush et al., 2017), with findings to be validated in human cell lines (Ferdoush, 2019).

Research Questions: (1) Is Paf1 regulation by Not4 transcription-dependent? (2) Which E3 ligase regulates Taf2? Hypothesis: If Paf1 degradation is co-transcriptional, its levels will increase when transcription is inhibited (Brueckner et al., 2008). Taf2 upregulation suggests defective UPS-mediated degradation (Finley, 2012).

Methods: Western Blot analysis, α-Amanitin treatment (to inhibit transcription), and gene knockout screening of E3 ligases (Finley, 2012). Actin served as a control. E3 Ligase Knockout Library was used (Horizon Disc.).

Results: No increase in Paf1 after α-amanitin, suggesting transcription-independent degradation (Barman et al., 2024). Rad16, Rad18, and San1 are unlikely Taf2 regulators (Finley, 2012).

Future Work: Continue E3 ligase screening (Nandi et al., 2006), validate findings in human cell lines, and further explore Not4-Paf1 regulation (Barman et al., 2024).

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Understanding PTSD: The Role of Distress Tolerance, Anxiety Sensitivity, and Intolerance of Uncertainty in Young Adults with Trauma Histories
Cassandra Almond

Distress tolerance is significantly associated with PTSD (McGrew et al., 2020), and higher anxiety sensitivity and intolerance of uncertainty are also linked to PTSD (Clauss et al., 2023). However, the combined effects of these variables on PTSD have not been explored. This poster examines how distress tolerance, anxiety sensitivity, and intolerance of uncertainty predict PTSD symptom severity in young adults with a history of trauma. I hypothesize that the combined effects of these variables will significantly predict PTSD severity, while the individual contributions are exploratory. The sample consisted of young adults (n = 33) who endorsed one or more traumas, selected from a larger study (n = 86). Measures included the Anxiety Sensitivity Index Version 3 (ASI-3; Taylor et al., 2007), the Distress Tolerance Scale (DTS; Simons & Gaher, 2005), the Intolerance of Uncertainty Scale (IUS-12; Carleton et al., 2007), and the PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013). At the bivariate level, ASI-3, DTS, and IUS-12 scores were significantly correlated with PCL-5 scores, rs .39, ps .01. A multiple regression showed these predictors together explained a significant portion of PTSD variance, F(3, 29) = 3.28, p = .035, adj. r^2 = .25. However, none showed unique significance when controlling for one another, all coefficient βs .29, ts 1.52, ps .14. Future research should consider the collective roles of these constructs, in addition to evaluating them separately. Further implications, limitations, and future directions will be addressed in the poster.

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Understanding the Positive and Negative Aspects of Different Calling Intensities
Sally Hoffman

This study examined the relationships among occupational calling intensity (OCI), personal calling intensity (PCI), occupational engagement (OE), personal engagement (PE), and need for resource recovery (NFRR). OCI, an all-consuming desire to have a significant positive impact through employment, is often associated with high OE but may also be linked to high NFRR, suggesting that OE mediates the relationship between OCI and NFRR. This study also explored whether PCI, which refers to a calling outside of employment, exhibits the same relationships with PE and NFRR as OCI. Data from 193 participants were analyzed using correlational and regression techniques. The findings revealed a negative relationship between OCI and NFRR, with work identity salience (WIS) serving as a significant mediator. Both engagement types were positively related to both calling intensities and negatively related to NFRR. These results deepen our understanding of calling intensities, engagement, and their complex links to WIS and NFRR.

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United Hosiery Mills: Rethinking a Capitalist History
Trinity Anthony

United Hosiery Mills was a Chattanooga-based clothing mill that produced Buster Brown-themed garments for children and operated independently from 1904 - 1979 and as a subsidiary in Chattanooga until 1999. Gustavus H. Miller and his brother Frank Lubbock Miller Sr. founded the company with Chattanooga business partners in 1904. For two semesters I have been processing the *Miller Family papers* at the University of Tennessee's Special Collections, which details the complete history of the United Hosiery Mills. Throughout processing archival materials and developing a finding aid a narrative was missing from the primary sources: the workers. Using the primary sources from the *Miller Family papers* in conjunction with academic literature about Southern Textile workers' I investigate the missing narrative of the 1917 and 1934 strikes that impacted United Hosiery Mills.

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Upper and Lower Stroke Rehabilitation Robot
Brenden Lippard, Aaron Campbell, Nick Clark

Stroke rehabilitation is essential for addressing the neuromuscular impairments caused by strokes, which are the leading cause of motor disabilities worldwide. With one in six individuals experiencing a stroke in their lifetime, 30% of these cases result in permanent motor disabilities. Current insurance coverage only supports three one-hour physical therapy visits per week, limiting access to necessary rehabilitation.
The stroke rehabilitation robot, though not yet tested on human participants, has met all mechanical requirements set by the development team. Human testing will focus on improving patients' range of motion and rotational strength. The device is designed to exercise the talocrural and radiocarpal joints through controlled rotational movements, using a circular motion equation for both clockwise and counterclockwise motions. Individual servo control ensures precise cardinal movements, aiding in effective therapy.
Powered by a Siemens 12V supply and controlled by a Raspberry Pi 5 with a Sequent servo driver hat, the system is designed to meet the force requirements for joint mobilization. A MATLAB simulation guided the selection of 35kg servos, providing the necessary torque for effectively mobilizing stiff joints.
The robot is designed for at-home use to complement the limited physical therapy sessions covered by insurance, offering a versatile and modular solution suitable for people of various sizes and capabilities. The programmable motion system enables active, therapeutic recovery, providing significant benefits for stroke patients by filling gaps in their rehabilitation process.

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Use of Biopsychosocial Data and Predictive Algorithms for Individualized Athlete Health Management
Gary Wilkerson

This study focused on the potential value of using introspective dysfunction ratings and self-reported injury history to quantify sport injury risk among college athletes. Prior to participation in the first pre-season practice session, 143 Division I athletes completed the Global Well-Being Index (GWBI) survey, which includes items relating to general pain or discomfort, sleep-related problems, mood-related problems, musculoskeletal problems, and performance limitations. The responses to each

question provided a 0-10 numerical rating of the frequency, temporal proximity, and severity of a problem, which were added to create a 0-50 risk score. The results of receiver operating characteristic and cross-tabulation analyses revealed that a sleep problem rating of 4 or greater was associated with 2.4 times greater odds for the subsequent occurrence of a core or lower extremity sprain or strain. A rating of 6 or greater was associated with 4.54 times greater odds for the subsequent occurrence of a sport-related concussion. The design of the GWBI survey was based on the biopsychosocial model of health status, and the introspective self-ratings derived from it appear to have strong clinical value for identification of athletes who possess elevated injury risk.

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Using Artificial Intelligence to Solve Math Word Problems
Kristin Spykerman

Major breakthroughs in AI in the past years make the topic of Mathematical Word Problem (MWP) solvers very important, as AI programs have had significantly lower success rates in relation to MWP's than other tasks. In fact, a study at Stanford suggests that state of the art MWP's are only about 36% accurate. My research project aims to answer the question of How to create a program capable of solving elementary level mathematical word problems? After much research into Large Language Models, I discovered that due to their lack of accuracy in solving math as well as how difficult they are to create from scratch, I needed to figure out a different approach. I discovered that I could use the order of words in a sentence to solve a certain type of MWP with high accuracy. By parsing word problems and assigning each of them a variable that will then be placed into an equation, my program can solve a simple MWP of a format similar to "Johnny has six apples. If he give Mary three apples, how many does he have?" While the use of this strategy with extensive if, then statements can cover for a wide array of MWP's, using artificial intelligence ultimately has the potential to solve a much wider array of word problems. Therefore, future research would include figuring out how to harness the power of AI into creating a python program for each individual word problem, an idea explored in Program Aided Language models, which would proceed to solve with incredible accuracy. All of this is significant as it can be a helpful tool in the classroom, but also a building block for creating something more powerful that can solve MWP's which even humans have not figured out how to solve.

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UTC Fencing Strip
Emerson Shuping, Mason Bunch, Alex Martinez, Noah Wood, Watts Alexander, Jacob Frost

The UTC Fencing Club is a fencing club that trains and practices epee and sabre fencing recreationally that plans to prepare members for tournament competitions. Currently, the team has to practice with cones lined up in the length and width of a fencing strip that complies with FIE regulations. Because of this, they lack an accessible, FIE-compliant fencing strip that simulates fencing competition conditions.

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UTC Off Campus Housing
Summer Olmstead

The Off-Campus Student Services (OCSS) project aims to create a customizable online housing search tool that gives the University of Tennessee at Chattanooga (UTC) full control over the off-campus housing marketplace. Unlike the current system, which is limited in functionality and property options, this new platform will allow UTC to manage listings, accept payments, and provide customizable search filters for students. The platform will also provide a secure login system, role-based access for different users (students, property managers, staff), and approval controls for property listings.
By developing this tool, UTC will improve the housing search experience for students, giving them easier access to properties that meet their needs. Property managers will also benefit from a streamlined listing and management system. The platform will generate valuable data insights for UTC staff, including property trends and user behavior, and provide a new revenue stream from listing fees. This system will offer a more efficient, user-friendly, and controlled environment for off-campus housing.

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UTC Safe Classroom Project
Drake Souder, Zack Tenhundfeld, Marcus Odeny, Merrick Smith, Preston Lavey, Patrick Joyner

Our presentation is about our device that we designed and created that is able to both prevent UTC classroom doors from being opened from the outside, as well as provide alternate escape routes through the windows on the first-floor classrooms in the case of a lockdown emergency.

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Utilizing Nuclear Magnetic Resonance (NMR) Architecture to Construct a Small-Scale Quantum Computer
Anna Stoddard

Quantum computers are at the forefront of the current technological revolution. However, the computers' high-level computation remains largely inaccessible because of their steep price tag, limiting progress in this emerging field. Small-scale single to multiple qubit systems bring quantum computers out of highly controlled lab environments and into the hands of communities. We researched several quantum architectures to arrive at nuclear magnetic resonance (NMR) architecture. NMR computers do not require specialized lasers, supercooling, or superconducting magnets, but instead use radio frequencies to encode information onto a half-spin solution, where entanglement can occur. Although they are not as scalable, we plan to control qubits with this architecture and to determine the entanglement efficiencies of available half-spin solutions which range from transcrotonic acid to acetone. We have sourced the magnets and measured the magnetic field strength to map their homogeneity. We have also secured several half-spin solutions,

NMR 5 mm test tubes, and a radio frequency generator. The Larmor frequency of our system has also been calculated for several half-spin solutions, such as water and phosphoric acid. Future work will include measuring the emitted frequencies and developing corresponding quantum gates to encode information onto the particles. Our work with these small-scale systems could introduce affordable quantum computers to schools and communities, broadening the accessibility of this groundbreaking technology for educational and experimental purposes.

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Versatile 3D Manufacturing
Kollin Holligan, Nathan Enos, Chris Powers, Danny Wensink

The Versatile 3D Manufacturing Project addresses the limitations of stationary 3D printing systems by creating a compact, mobile, and resilient solution for field use. Our design centers on a robotic arm that replaces the gantry, enabling precise control in a more space-efficient configuration. Combined with intelligent temperature regulation, real-time sensor feedback, and modular system architecture, this printer is engineered for performance in demanding environments.
The system runs on a custom-tailored version of the Marlin firmware, supporting advanced motion control, reliable safety systems, and power-efficient operation. The goal is to provide a 3D printer that can be easily transported, quickly deployed, and confidently used in engineering, humanitarian, and technical education scenarios — without sacrificing quality or reliability.
This project demonstrates that with the right design choices, high-quality additive manufacturing can extend beyond the lab and into the field.

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Vision and Inhibition: Exploring Executive Function and Intelligence via Eye-Tracking
Rozena Akbar

The relation between executive function (EF) and intelligence is complex, with research showing how these cognitive abilities interact and influence each other in nuanced ways. EFs, a set of cognitive processes primarily associated with the prefrontal cortex, are vital for regulating behavior, planning, attention allocation, and task management. They enable individuals to make decisions, resist impulses, and adapt to new information (Kiefer et al., 1998). Intelligence, often defined as the capacity to analyze information, solve problems, and engage in logical reasoning, closely relates to cognitive performance. However, previous studies have struggled to clarify the nuanced relation between EF and intelligence (Friedman et al., 2006).

Despite substantial research advancing our understanding of EF and intelligence, key questions remain. This study aims to clarify some of the questions by examining individual differences associated with these two constructs. We will employ a novel eye-tracking technique in addition to a traditional go/no-go task (Casey et al., 1997) to capture additional variables, such as fixation count, gaze duration, and the number of visited interest areas. Fixation count refers to the number of eye movements between points, while gaze durations represent the length of an individual look. The number of visited interest areas reflects how many predefined regions (e.g., the colored shapes) are fixated in during the task.

This approach may provide a more robust dataset, increasing the likelihood of our ability to identify key factors underlying these important cognitive processes.

Undergraduate students at a medium sized Southeastern university act as participants in this project. They complete a demographic questionnaire before engaging in the go/no-go task. In this task, they are instructed to press a button when they see a red circle while inhibiting responses to all other shape/color combinations. After this task, participants complete the Wechsler Abbreviated Scale of Intelligence Second Edition (WASI-II). Students receive class credit for their contribution.

Preliminary analyses indicate that fewer fixations, longer fixation durations, and fewer visited interest areas appear to be correlated with full-scale intelligence scores However, due to the small *n* (data collection ongoing), the correlations (while relatively strong) are not yet significant.

As the study progresses and we gather a larger sample, we anticipate that enhanced statistical power will yield clearer insights into how these visual scanning metrics during the go/no-go task relate to intelligence. Understanding this relation is essential, as it could provide valuable insights into the intricate cognitive processes involved in the relation between EF and intelligence, potentially informing educational strategies and guiding future research directions.

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Fabrication of Magnesium based Nanocomposite Biomedical Implants
Tooba Tanveer

In recent years, a quest for finding biocompatible, corrosion resistant and high strength materials have been initiated to develop biodegradable implants that can help eliminate post-recovery hardware removal surgeries. As a result, magnesium-based metal matrix composites reinforced by boron nitride nanoparticles (70-80 nm) are being investigated in this study due to the low density, resorbability and biocompatibility of magnesium. Powder metallurgy has been used as the main fabrication technique and the process comprises of powder mixing, hot compaction and sintering. The study is focused on optimizing the fill-level of the mixing container, time and acceleration during the powder mixing step of powder metallurgy using a three-factor three-level factorial design. The samples are to be characterized by determining the density distribution of the mixed powder, density and porosity of the sample, corrosion resistance, microhardness, and cytotoxicity. The tests include scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), Vickers hardness test, and electrochemical corrosion test. The purpose of the research is to achieve the best combination of strength and corrosion resistance using optimum parameters.

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