The 20th Annual

2025 RESEARCH & CREATIVE INQUIRY DAY

Tennessee TECH

tntech.edu/research/research-day

U.S. House of Representatives Resolution

H. Res. 1654

IN THE HOUSE OF REPRESENTATIVES, U. S.
NOVEMBER 16, 2010

WHEREAS, close to 600 colleges and universities in the United States and thousands of undergraduate students and faculty pursue undergraduate research every year, providing research opportunities that will shape the trajectory of students' lives and careers and researchers' and institutions' purpose and contributions to academia and the research enterprise;

WHEREAS, students and faculty engaged in undergraduate research contribute to research across many disciplines, including arts and humanities, biology, chemistry, health sciences, geosciences, mathematics, computer science, physics and astronomy, psychology, and social sciences;

WHEREAS, research at the undergraduate level provides both students and faculty members opportunities for improving and assessing the research environment at their institution, develops critical thinking, creativity, problem solving, and intellectual independence, and promotes an innovation-oriented culture;

WHEREAS, undergraduate research is essential to pushing the Nation's innovation agenda forward by increasing the interest and persistence among young people in the crucial science, technology, engineering, and mathematics (STEM) disciplines, and to cultivating the interest of would-be researchers who pursue a new aspiration of graduate education after participating in undergraduate research; and

WHEREAS, the week of April 11, 2011, would be an appropriate week to designate as ''Undergraduate Research Week." Now, therefore, be it

Resolved, That the House of Representatives—
supports the designation of ''Undergraduate Research Week'';
(1) recognizes the importance of undergraduate research and of providing research opportunities for the Nation's talented youth to cultivate innovative, creative, and enterprising young researchers,

in collaboration with dedicated faculty;
(3) encourages institutions of higher education, Federal agencies, businesses, philanthropic entities, and others to support undergraduate research and undergraduate researchers and their faculty mentors;
(4) encourages opportunities, including through existing programs, for females and underrepresented minorities to participate in undergraduate research; and
(5) supports the role undergraduate research can and does play in crucial research that serves the Nation's best economic and security interests.

Attest: *Clerk.*

Foreword

Welcome to the 2025 Research and Creative Inquiry (RCI) Day, the 20th annual celebration of student scholarship, research, and creativity at Tennessee Tech University! From humble beginnings nearly two decades ago, when fewer than 50 posters were presented, RCI Day has grown into a dynamic event showcasing over 200 posters representing a diverse array of disciplines.

College education is a game changer, and undergraduate research is an accelerator for students to take off for productive careers. This is because college education and research are now essential for students to learn skills essential to solve real-world problems. In addition, students develop skills for leadership, communications, collaboration, analytical and critical thinking through research.

To our students: Congratulations on your outstanding accomplishments and your commitment to sharing your research experiences and findings with the broader community. For many, today marks your first public presentation—an important milestone signaling the beginning of your professional journeys. Embrace this experience as an invaluable step toward mastering the interdisciplinary skills necessary to address global challenges in human health, sustainable resource management, cybersecurity, energy innovation, food security, and national security.

To our dedicated faculty, staff, and campus community: Thank you for your steadfast mentorship, encouragement, and active engagement in student research activities. Your ongoing support enriches our students' educational experiences and strengthens our collective pursuit of knowledge and innovation. Please continue to inspire and nurture collaboration and experiential learning across disciplines, fostering groundbreaking discoveries and meaningful innovation.

We extend heartfelt appreciation to everyone involved in making this milestone 20th annual RCI Day possible. Special recognition goes to our judges for their assessments, as well as the staff from the Office of Research and Economic Development and the many volunteers across campus who have dedicated their time and talents.

Congratulations once again to all student presenters, collaborators, and mentors whose passion and hard work embody Tennessee Tech's unwavering commitment to academic and creative excellence. Together, let us celebrate the remarkable achievements displayed today and look forward to even greater accomplishments ahead. WINGS UP!

Dr. John Liu
Vice President for Research
On behalf of the **Tennessee Tech Research & Economic Development Team**

Special Appreciation & Acknowledgments

Tennessee Tech Offices, Departments and Staff

Exercise Science

Information TechnologyServices

Library Services

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Printing Services

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Tennessee Center for Rural Innovation

We would like to extend a special thanks to **Kristen Deiter**, professor of English, for coordinating the paper portion of the event; and the Volpe Library, for providing poster-design resources.

We especially wish to acknowledge **David and Sherri Nichols** for their endowment to that continues to support student research and creative inquiry.

The 20th Annual Research and Creative Inquiry Day

Memorial Gym
Schedule of Events

Monday, April 21

10 a.m. – 5:30 p.m. ..... **Poster Setup**

Tuesday, April 22

8 a.m. – 6 p.m. ..... **Poster Judging**
Students may be present if desired. Student presence will not impact judging evaluation.

Wednesday, April 23

9 a.m. – 11 a.m. ..... **Poster Display for Campus and Community & Faculty Innovation Showcase**

11 a.m. – 12 p.m. ..... **Faculty Innovation Showcase Presentations**

1 p.m. – 4 p.m. ..... **Poster Display for Campus and Community & Faculty Innovation Showcase**

Thursday, April 24

8 a.m. – 11 a.m. ..... **Poster Display for Campus and Community & Faculty Innovation Showcase**

11 a.m. – 12 p.m. ..... **Awards Ceremony**

12:30 p.m. – 3:30 p.m. ..... **Poster Pickup-Cleanup**

Abstracts

College of Agriculture & Human Ecology

Agriculture

Undergraduate Students

Wildflower Species Bloom Counts Present in Organic Farming Pest Management

Primary Author: Knicki Hopper-Hart

Faculty Advisor: Hannah Kinmonth-Schultz, Biology

Native wildflowers are being studied for their ability to encourage biological pest management in organically produced crops. In this research, Tennessee native wildflowers are planted next to eight crop plots, scattered among eight control plots without wildflowers. The wildflower plots were planted from a bag mixed with 15 different flower species that contained a mixture of annuals and perennials with varying inflorescence types, some requiring cold temperatures to germinate. The seeds were planted in April, and each species bloomed in differing amounts and were present for various lengths of time during the growing season. What flower blooms were observed compared to what was planted? What was in bloom over the course of the growing season?

Pictures of the wildflower plots were taken at two-week intervals for the duration of July 15, 2024, to November 15, 2024. These pictures were then analyzed using imageJ to count the species and blooms present in each picture.

The flowers that were the most pervasive throughout the growing season were the head inflorescence type flowers, particularly the Gaillardia pulchella. The least present species seems to be Solidago speciosa, a species requiring at least 60 days of cold stratification.

The excess presence of the head inflorescence flowers might be due to their hardiness but could also be the result of the number of seeds present in the wildflower seed mix. The lack of Solidago speciosa is most likely due to an absence of adequate cold stratification, as the seeds were sown in April.

How Did COVID Influence the Cattle Prices and Number of Cattle in Carthage, TN?

Primary Author: Maggie Miller

Co-Authors/Collaborators:
Addison Freeman, Animal Science
Daniel Metzgar, Agriculture

Faculty Advisor: Lianqun Sun, Agriculture

Carthage, Tennessee, has long been known for its large cattle industry. Along with most of the agriculture community, the region's cattle farmers faced significant challenges when the COVID-19 pandemic disrupted supply chains, labor availability and consumer demand. The immediate effects of the pandemic included a drop in the demand for beef due to restaurants closing and consumers spending less. This led to a surplus of cattle, mostly in the spring and summer of 2020, as producers struggled to get their cattle processed due to temporary shutdowns and slowdowns at meat processing plants. Processing plant closures and labor shortages caused an excess, and farmers in Carthage were faced with difficult decisions about how to manage their herds. In this research, we will explore the influence of COVID-19 on cattle prices and the number of cattle in Carthage, TN, examining the local economic, social and agricultural factors that contributed to changes in the region's cattle industry. We will be using the United States Department of Agriculture as a data source for this project. We will compare the factors effecting the cattle numbers from before, during, and after COVID-19. We will create charts and graphs demonstrating the data and its relation to the COVID-19 virus. The purpose of this project is to demonstrate how COVID-19 created a downfall in the number of cattle for sale and an increase in the price of cattle. It will also show the other factors influenced by COVID-19.

Impact of 4-H on Youth Development in the Upper Cumberland Region According to 4-H Agents

Primary Author: Briona Agee

Faculty Advisor: Dennis Duncan, Agriculture

The purpose of this research was to determine the impact(s) of Tennessee 4-H programming on current and past 4-H member's personal growth/development in the Upper Cumberland Region, as perceived by 4-H Agents. The main areas of personal growth/

development consisted of leadership, character traits and contribution to society. In order to conduct this research, a mixed method survey created in Qualtrics was sent out to each Upper Cumberland 4-H agent (N=14) for them to answer anonymously. After TN Tech IRB approval, an introductory email was sent to each Agent, followed by the first survey link three days later. The initial response was lower than anticipated so the researchers sent three more invitations to participate to each agent on seven-day intervals. The final response rate was 50%. Results indicate that while youth are/were involved in the 4-H club activities, 4-H agents perceive that the 4-H members have shown an increase in improvements involving all focus areas - leadership, community involvement and character traits. More specifically, averages for each focus area were about 50% improvement. These findings suggest that 4-H in its entirety is an organization that can help improve beneficial areas of the 4-H members' lives in order to make them better citizens and human beings.

Land Management and Conservation Practices Utilizing Spatial Technologies

Primary Author: David Laws

Co-Authors/Collaborators: Wade Coons, Agriculture
Kayla Selby, Agriculture

Faculty Advisor: Abdul Momin, Agriculture

This project focuses on utilizing spatial technologies to enhance land management and conservation practices for agricultural producers. The primary objective is to assist farmers by applying precision agriculture technologies such as GPS, GIS, drones and soil measurement tools to identify inefficiencies and optimize land use. Specifically, the project will evaluate the Tennessee Technological University Oakley Greenhouse property, aiming to improve bee production and overall land management practices. Through the use of drones for aerial mapping, soil compaction testing and rainfall measurement devices, the team will gather data to assess existing land management practices and propose solutions for improvement. The project will incorporate techniques learned throughout the team's academic career, including spatial technologies such as applying GIS software (QGIS), soil testing and web-soil-survey tools to analyze the property's resources, soil health and management practices. The final results will include a comprehensive report detailing the property's current conditions, proposed solutions for problem areas and recommendations for sustainable land management practices. The ultimate goal is to inform producers about the benefits of precision agriculture and help them implement sustainable practices for improved land and resource management. This project not only aims to improve the specific farm under study, but also seeks to educate the broader agricultural community on the value of adopting advanced technologies in land management.

Evaluation of Four Lettuce Cultivars in a Hydroponic NFT System for Biomass Accumulation

Primary Author: Jon Mulderink

Co-Authors/Collaborators: Jaden Barger, Agriculture
Kenneth Pierce, Tennessee Technological University

Faculty Advisor: Douglas Airhart, Agriculture

Hydroponics is a sustainable food production method that allows for efficient plant growth without the use of soil, making it ideal for areas with nutrient deficient soils or challenging climates, and indoor commercial and home food production.

This study evaluates the growth performance of four different lettuce cultivars Salanova® Hydroponic Green Butter, Salanova® Hydroponic Red Butter, Salanova® Hydroponic Green Oakleaf, and Salanova® Hydroponic Red Oakleaf. Plants are being grown in a nutrient film technique (NFT) hydroponic system in a climate-controlled greenhouse over a six-week period. The experimental design consists of 12 replications of each cultivar in a randomized complete block design (RCBD). Evaluation parameters are growth rate, mature size, overall wet biomass weight and wet root weight. Environmental factors such as temperature, pH and electrical conductivity (EC) are monitored and adjusted as needed.

Statistical analysis, including least significant difference (LSD) tests, will be conducted to compare the cultivars' performance. The results will provide insights into the impact of genetic variation on harvest metrics and biomass accumulation, contributing to optimizing lettuce production in hydroponic systems.

Effects of pH on Ammonia Volatilization

Primary Author: Kimberlin Mann

Co-Author/Collaborator: Sonni Holaway, Agriculture

Faculty Advisor: Michael Nattrass, Agriculture

Volatilization of Urea is a process that heavily impacts crop production. Understanding how pH affects volatilization could inform producers of the rate and timing they should apply to maximize effectiveness and minimize pollution. Zero percent moisture and a higher pH will increase volatilization. At high pH, the soil environment has a low concentration of H^+ ions, which shifts the $NH_4^+ \rightleftharpoons NH_3 + H^+$ equilibrium toward the production of ammonia gas (NH_3), increasing volatilization. Conversely, at low pH, the high concentration of H^+ ions favors the stability of ammonium (NH_4^+), preventing its dissociation into ammonia gas. As a result, NH_4^+ remains less prone to volatilization in acidic soils.

We are conducting a controlled experiment to investigate the effects of soil pH on ammonia volatilization. Soil samples with pH values of 8 (high pH) and 5 (low pH) were placed in sealed urine analysis cups. Urea fertilizer (46-0-0) was applied at a rate of 200 lbs. per acre. Following the incubation period, soil samples will be analyzed for ammonia (NH_3) and nitrate (NO_3^-) concentrations, allowing for a back-calculation of volatilized nitrogen relative to the initial urea application.

We hypothesize that soils with high pH and low moisture content will exhibit the highest volatilization rates, whereas soils with low pH and 25% moisture content will experience minimal volatilization. These expected results align with existing literature, which suggests that higher pH facilitates ammonia loss by shifting the equilibrium toward gaseous NH_3, while increased moisture and lower pH stabilize ammonium (NH_4^+) in the soil.

Animal Science

Undergraduate Student

Cattle Composition Throughout History

Author: Jackie Jarosz

Faculty Advisor: Dennis Duncan, Agriculture

This study examines the evolution of beef cattle composition throughout history and forecasts potential changes in composition over the next 25 years. Beef cattle composition encompasses the genetic, physiological and phenotypic characteristics of cattle breeds that contribute to the overall beef supply. Understanding these shifts is crucial for predicting trends in production, efficiency, and sustainability in the beef industry.

A timeline including major changes in composition, breeding systems used, breed importations, and the beneficial characteristics of the new breeds was created. Through an online survey, 30 industry professionals, including cattle ranchers, breeders, veterinarians and beef supply chain experts were asked to provide insights on factors influencing changes in cattle composition and their predictions for the future. Of the 30 surveyed professionals, 14 responses were collected, reflecting a diversity of perspectives on key drivers of change, such as advancements in breeding technology, climate change, consumer preferences and market demands.

The data gathered from these responses was analyzed to identify common themes and trends. This research aims to contribute to a more comprehensive understanding of how the beef industry will adapt to evolving environmental, economic, and technological challenges, ultimately providing stakeholders with valuable foresight to make informed decisions regarding breed management and industry policies.

Community Health & Nutrition

Graduate Students - Master's

Effects of Dietary Changes on Symptoms of Polycystic Ovary Syndrome

Author: Sophia Dunn

Faculty Advisor: Darcie Bell, Human Ecology

Polycystic ovary syndrome is one of the most common causes of infertility, affecting 20% of women of reproductive age. There is no cure or cause for the condition, but lifestyle changes such as diet are recommended in decreasing the severity of the condition. The literature review analyzed the effects of three diets, the Mediterranean Diet, the Ketogenic diet and the DASH diet, on PCOS biomarkers and symptoms in women. The studies revealed that dietary changes that adhere to the ketogenic diet, Mediterranean diet or DASH diet can improve PCOS biomarkers.

The measurements showed improved testosterone levels, weight loss, insulin, follicle-stimulating hormone (FSH), luteinizing hormone (LH), LH/FSH ratio, sex hormone-binding globulin (SHBG) and insulin resistance index (HOMA-IR), which in turn helps with menstruation and fertility.

Lifestyle changes such as diet can positively affect the severity of polycystic ovary syndrome. The information given will provide healthcare professionals with possible dietary recommendations for patients who are diagnosed with PCOS. Additionally, the review will provide researchers with the groundwork to conduct further research to assess the long-term effect of these diets and cures for PCOS.

Super Seniors Staying Strong: Nutrition Education for Older Adults

Author: Piper Smith

Faculty Advisor: Samantha Hutson, Human Ecology

Rural areas contain fewer housing, grocery stores and resources than urban areas. Throughout rural communities, nutrition education resources are often limited due to lower populations. According to the National Institute of Minority Health, those living in rural areas are considered a health disparity group since they have higher rates of chronic disease and poor health outcomes including diabetes, obesity and heart disease. Older adults have lower calorie needs but higher nutritional needs than younger adults.

In 2022, Putnam County Tennessee experienced a 15.6% food insecurity rate. The purpose of this grant-funded project is to provide one nutrition education session for older adults at four different libraries in Putnam County. Each session will provide nutrition education, handouts, food boxes and kitchen utensils. Also, a checkout system will be installed at each library where library card holders can check out an electric skillet, air fryer, griddle or crock pot for a select amount of time.

As the graduate student, my job is to create a rental kitchen appliance recipe book and a set of checkout policies for this system. The ending goal of my capstone project is to increase nutrition knowledge, skill, and access among older adults in Putnam County, Tennessee. A survey will be provided at the end of each session and upon return of rented appliance. This could potentially test their knowledge and provide feedback for improving the check-out system.

Creating Low-Cost Recipes for Food Pantries

Author: Macie Long

Faculty Advisor: Samantha Hutson, Human Ecology

On average, Americans can only make five meals without having to look at a recipe for assistance. Since low-income individuals have difficulties buying groceries, many ask if food pantries and/or supplement programs can increase the variety of food items offered so they can consume different foods. Many studies support the claim that recipes increase the amount of time an individual cooks at home and aid in reducing food waste. Other studies have found that cooking meals at home can lower the risk of certain chronic conditions.

To increase the number of affordable meals low-income individuals could make at home, I created easy recipes that included items commonly received at a local food pantry by using my nutrition knowledge and relevant resources for guidance. The recipe book included vegetarian dishes as well as food safety and food storage tips, and can be accessed via QR code. I partnered with the food pantry at Woodmont Baptist Church and sent them the recipes I created to offer to their participants.

Potential limitations include personal food preferences, not having the required kitchen equipment and not having the knowledge to make these meals. Limitations need to be further explored to determine the impact they have. Specifically, food pantries offering cooking classes need to be tested in the future to establish the role they may have in improving this issue.

Improving Awareness of SNAP for Eligible Students at Tennessee Tech

Primary Author: Lia Nesbitt

Co-Author/Collaborator: Hannah Bailey, Community Health & Nutrition

Faculty Advisor: Samantha Hutson, Human Ecology

Numerous studies of food insecurity among college students throughout the last decade have indicated percentages ranging from 20% to more than 50%, which is greater than the overall US population's average of 12%. Higher rates of food insecurity among college students are caused by increasing numbers of low-income college students, higher college costs, increased financial hardship within low- and moderate-income families, Supplemental Nutritional Assistance Program (SNAP) regulations that particularly eliminate many college students from participation, etc.

Our capstone project seeks to increase awareness/participation in the SNAP program among eligible Tech students. We want to reach out to students and pique their interest through pop-up events, office hours and giveaways. Therefore, we can inform them on SNAP, how to satisfy its requirements and how to qualify for benefits. Establishing regular office hours allows students to express their questions about the program and gain assistance filing for benefits. This project is significant because it permits low-income students to have access to nutritious food, greatly enhancing their capacity to concentrate on their coursework, maintain their health and improves their likelihood of accomplishing their degree.

Supplying SNAP helps students conquer a barrier to their academic achievement, helping to ensure they have basic nutritional needs met. The primary goal of this capstone is to raise awareness of SNAP and its eligibility criteria among students. Secondly, identifying/addressing impediments to participation for this demographic while enhancing students' engagement by hosting pop-up events and office hours to inform them about SNAP and obtain assistance with the application.

Design Studies

Undergraduate Students

Hemp for Homes – Sustainable & Strong Solutions

Primary Author: Emma Minter

Co-Author/Collaborator: Brayton Ray, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

With homes and buildings being a necessity around the world, the use of building materials is in high demand, yet can vary depending on cost, functionality, dependability, resources, etc. To add sustainability and create well-rounded homes and buildings in a variety of ways, the material "hempcrete" has been found to show benefits to achieve these goals. This material can be applied in many ways such as in concrete, hempcrete, plastic, roofing, insulation, etc., which is extremely beneficial in this industry.

Not only this, but hempcrete also has resistance, robustness, a high capacity for energy efficiency, non-toxic and natural resistance to mold, insects, and fire, which ultimately delivers sustainable solutions (Yadav a et al., 2022). In the effort to create the most effective and eco-friendly resources, this research review will be helpful to those in construction that are purchasing and using these types of materials. Additionally, this article explores its cost effectiveness and how it compares to other resources that tend to be used.

Lending a Hand: Examining the Potential Disposal of New and Existing Textile Wastewater by Application of a Zero Liquid Discharge System, as Used in Coal-Fired Power Plants

Primary Author: Connor Cress

Co-Author/Collaborator: Katrina Smith, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

In our modern world of global capitalism, mass production = mass destruction, in most cases. The world economy is working harder than ever to keep up with growing consumer demand, population booms and even increased lifespans. The textile industry, being present universally everywhere on earth, produces 93 billion cubic meters of wastewater annually, and is thus responsible for one fifth of all wastewater produced on earth. Places that these textile factories call home (namely China, India) have experienced total destruction of their natural environment due to a lack of proper regulations on the industry and its factories. Materials contained in said wastewater such as toxic metals, sulfurous compounds and residual chlorine render the local watershed and soil completely unlivable by driving out essential flora and fauna. Not only is this industry lethal for local wildlife, but dyes and other materials contained in the wastewater can't be totally eliminated through human filtration efforts and are making people sick as well.

Luckily, other industries have developed more sustainable and environmentally friendly waste disposal practices that may yet provide a portable solution to the wastewater problem. The American coal industry, specifically coal-fired power plants, has in use many sustainable, EPA-regulated practices for promoting clean emissions and proper wastewater treatment and disposal. Analyzing these practices for potential implementation into the textile industry could create an entirely different and more sustainable process for textile production, aiming to eliminate current and existing wastewater in order to revitalize local watersheds and ground soil.

Are 3D and 4D Printing Replacing Traditional Clothing?

Primary Author: Hannah Cowan

Co-Author/Collaborator:
Jess Grossman, Design Studies

Faculty Advisor: Hannah Upole., Human Ecology

What if you learned that the process of 3D and 4D printing textiles is the new and upcoming future of the design industry? Throughout our research we found that three-dimensional and four-dimensional printing can provide the same products that are currently being used, but faster. Three-dimensional and four-dimensional printing is being used to create textiles for clothing and shoes in a more sustainable and practical way. Designers have discovered that using recycled materials such as nylon, thermoplastic polyurethane and polylactic acid to create 3D printed textiles helps reduce waste (Spahiu T, Canaj E, Shehi E. 2020). Not only is this technology being used for the sustainability aspect, but it can also be used in fields such as the healthcare industry.

There is research currently being done on the use of polymer filament in the 3D printing process which will open a window of research opportunities for disruptive solutions (Urquiza E., 2024). They are wanting to see if it is possible to incorporate drugs before 3D printing for the health sector, such as medical devices or splints printed to measure patients. The overall purpose of this paper will be to explain the uses of three-dimensional and four-dimensional printing in textiles to improve medical equipment, military equipment and clothing.

The Textile Waste Apocalypse: Can Sustainability Survive?

Primary Author: Hailey Hraba

Co-Author/Collaborator:
Elizabeth Rainwater, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

Twenty-five point zero two billion pounds of textile products are purchased a year and over 85% are thrown into landfills (Igini, 2023, n.p.). The average consumers of any product within the textile industry are also big benefactors. Textile waste is 8.2% of the 100 billion clothes produced a year, which is 92 million metric tons of waste a year.

The main reason that the textile industry is considered one of the biggest contributors is because it is made up of hundreds of thousands of companies that cater to over three billion people around the world. The struggle of sustainability within the textile industry is caused by both the producer and consumer. In response to the growing concerns about sustainability, the textile industry has explored numerous strategies to minimize the volume of waste generated annually. Some methods of recycling are chemical recycling, mechanical recycling, upcycling and take-back programs. These methods of sustainable recycling require all parties to participate and contribute. This research is an in-depth analysis and will aid in the education and application of sustainable solutions in the textile industry.

Powering Humanity's Future

Primary Author: Adriana Carter

Co-Author/Collaborator: Jacob Parish, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

How can you be more sustainable in your everyday life? Solar panels are an important part of future sustainability in the design world and more people need to use them. Solar panels are used to convert the power of the sun into usable electricity, but is the efficiency of this process worth the high upfront cost? The way the solar panels are constructed, manufactured, and installed is a main reason of the higher price that's it takes the get them into more homes, businesses, etc.

As you read this review, you'll go through four main topics over solar panels for our research. What are solar panels and how are they constructed? How do solar panels impact the design world? Are solar panels effective? Are questions that were asked to get to the answer of "Why are people not using solar panels?" Overall, there are many factors into why people do not use solar panels, and it all leads to this main reason: cost. This research will be helpful to those who want to learn more about solar panels as well as buy them for their home, business or building.

Microfibers or Macro-Concerns?

Primary Author: Grace Moss

Co-Author/Collaborator: Emma Peters, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

Did you know the production of synthetic textiles increased from 63 million tons to 67 million tons from 2021 to 2022 (Ka Man Chan, 2025)? Did you also

know the waste produced made its way to our water? Microfiber pollution is growing at a faster rate than ever before, which means its consequences could be closer than ever. Over the last 50 years, scientists have been studying the concentration of anthropogenic litter in the waterways and their impacts, both environmentally and to human health. Along with the production of these synthetic textiles, fast-fashion's growing popularity could also put us further into this environmental concern. Fast-fashion being "characterized by its rapid trend turnover contribute(s) to the overaccumulation of synthetic textile waste, [then] leaches out [microfiber] pollutants into the environment upon disposal" (McCay, 2024).

These problems point to the textiles industry being our main contributor. Almost every step in these processes leads to more pollution, and with loose regulations, the neglect from the commercial textile industry can end up poisoning aquatic ecosystems. It doesn't stop there, either. With recent studies showing that if this problem keeps growing, it could end up impacting the health of humans, as well. The condensed research in this review could help all consumers by holding the textiles industry accountable for the waste causing this crisis.

Operation Vicuna: Exploring Animal Rights in the Textile Industry

Primary Author: Nick Chisam

Co-Author/Collaborator:
Mariana Gaspar, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

What is the most expensive textile you have ever purchased? One animal that lives in the Andes Mountains in South America produces a fiber that is worth $770 per kilogram. This fiber is sheared from a very elusive animal called the vicuna. One reason the fiber is so expensive is because their fiber is so fine but surprisingly warm. Their rarity is another reason why the fiber is so expensive. In the 1960s, their population dwindled down to only 6,000 but has gone back up to 127,000.

Poaching would not generate revenue even if it was legal. South American governments have put in many conservation efforts, bans on poaching and restrictions on selling to revive the vicuna population. The method used to capture and shear vicunas is very unique and safe compared to other processes of shearing for other animals' fleeces. It is inspired by indigenous Incan tribes' method of capturing and shearing animals for their fleeces called "Chaku". This review will explore whether these methods of conserving the vicuna population, and how the Chaku could be used for helping populations of endangered animals with textile fabric in other regions.

Innovative Cacti-Based Textiles

Primary Author: Lucy Wright

Co-Author/Collaborator:
Ella Richardson, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

Imagine a future where the latest textile is created from a plant that can be grown in your own backyard. Cacti-based materials can be used to replace traditional leather, plastic and even additive substances for textile dyeing. In recent years, studies have shown the importance of sustainability in leather production and single-use plastics, seeing as the textiles industry is one of the world's largest polluters.

Although leather has independent benefits as a long-lasting, durable textile, it also has unfortunate downsides in the production process like water pollution, chemical use and animal warfare. Likewise, single-use plastics contain chemicals that have a lifelong cycle which produces upwards of 6,300 metric tons in the United States alone, with only 567 metric tons being recycled (Chen, 2020).

Cacti are a beneficial replacement because they are easy to grow and harvest, all parts of them can be utilized, and the products are overall less harmful to the environment. Cactus-based materials are quite similar to leather and are already being used for car interiors and fashion items. For plastics, a biodegradable cactus-based replacement is currently being developed and will soon be used for packaging and food. This synthesis of current research will be helpful to inform consumer opinions regarding textile alternatives such as cactus-based leather.

Tiny Degraders, Big Impact

Primary Author: Brant Billen

Co-Author/Collaborator:
Jazzania Romero, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

Did you know the US is responsible for over half of the carpet produced globally, contributing to the world's 92 million tons of textile waste produced every year? Twelve billion square feet of carpet is made and manufactured in the United States alone. Carpet made today is almost exclusively made of synthetic fibers, which can take hundreds of years to decompose. These synthetic fibers including nylon, polyester and polypropylene leak harmful chemicals into our environment, leaving a long lasting stain on our planet we as humans have done for years now.

There are very few eco-friendly carpet waste options available today, as most used carpet is thrown in landfills or burned in a process called incineration. Microbial biodegradation however, is "the process by which microorganisms break down organic matter, such as plastics dyes and environmental pollutants" (Shilpa, 2022). The process is "brought about by the metabolic and enzymatic actions of microorganisms like bacteria, yeast, and fungi" (Cia, 2020).

This new method reduces toxicity, is more sustainable, and can be a major contributor to a cleaner planet. This collection of current research will be helpful to consumers aiming to recycle their carpet, as well as give new avenues and readily available microbial decomposing options to environmentalists and the local governments responsible for managing waste services.

From Rags to Rooms: Textile Waste as Thermal Insulation

Primary Author: Valerie Maynard

Co-Authors/Collaborators:
Bayli Whitehead, Design Studies
Aaron Jerd, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

Each year, 92 million tons of garments end up in landfills and 500 billion USD is lost because of this, regardless of the fact textile waste is easy to recycle with proper knowledge (Igini, 2023). Moreover, discarded apparel has manifested in natural environments, like in the Atacama Desert and the beaches in Ghana (Deheyn, Ayesu, The Or Foundation, & Skinner, 2024; Duong, 2021).

To reduce textile waste, one solution is to recycle old garments into building insulation. Recycled insulation is a viable option as textile waste retains many of the same qualities as traditional insulating materials. This review will show the comparison of which recycled textile waste fiber or fiber blend is best for building insulation based off thermal performance, longevity, efficiency, accessibility and cost; with the intent of making recycled insulation more available and widely used for businesses and consumers. This analysis of textile waste being converted into thermal insulation will be helpful to the construction sector who work with different types of insulation with an abundance of health hazards, as well as the environment with the greenhouse gas emissions, non-renewable raw materials, and fossil energy being reduced.

Beyond The Hide

Primary Author: Amber Rodriguez

Co-Author/Collaborator: Itua Uduehi, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

The fashion industry is the second most polluting industry in the world, the oil sector being first (Burn, Ciccullo, 2022). It is without a question that leather is one of the most important textile materials in the fabric industry today. In order to preserve and ensure the continued use of this versatile material, research has been done to continue the production of leather or offer safer, more sustainable leather alternatives.

The data observed will be useful to textile manufacturers and consumers of leather products, as efforts for both parties will be needed to prevent the halt in production. When producing leather goods, the process involving preparing the skin of a hide to become a finished leather involves so many unsustainable chemicals to eliminate all the bacteria while also creating the look of the finished leather. The tanning process releases so many chemicals and toxins that are harmful to the manufacturers and the ecosystem. Seventy-five percent of the raw material becomes waste during the tannery process (Agnes, 2024). This review aims to determine whether leather alternatives or more sustainable methods would help to reduce air and water pollution in our ecosystem.

The Dark Side of Denim

Primary Author: Bella Hawn

Co-Authors/Collaborators:
Davis Hartman, Design Studies
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Faculty Advisor: Hannah Upole, Human Ecology

When it comes to unsustainable manufacturing, blue jeans are no stranger. The classic American garment has been spread across the globe, and due to their popularity worldwide, they are produced on a large scale that in turn increases their unsustainable footprint. Water consumption and air pollution are some of the biggest issues in denim production. Each pair of jeans uses just under 4,000 liters of water and emits roughly 33.4kg of carbon dioxide into the atmosphere (Asmi, Zhang, Anwar, Linke & Zaied, 2022, p. 1781). The social and environmental consequences of their manufacturing are far-reaching.

Although many of their consumers are unaffected, the workers who make blue jeans are not (Radhakrishnan, 2016, p.90). In addition, their production leaves behind large amounts of textile waste. There are many ways to reuse and recycle the waste created by blue jean manufacturing. This wasted fabric can become a totally new product by being synthesized into ethanol (Jeihanipour & Taherzadeh, 2008, p.1007). In addition, it can be reused by the textile industry by being turned into raw materials that can be woven into new fabric (Contin et al., 2022, p.5). Overall, research shows that the current manufacturing process for blue jeans could (and should) be improved and made more sustainable. This collection of current research will be useful for individuals in the clothing manufacturing industry who wish to improve the sustainability of their production process and their product.

Did you know you can 3D print a house? Sustainability of 3D printing concrete

Primary Author: Carley Johnson

Co-Author/Collaborator: Noah Spivey, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

Did you know that concrete contributes significantly to air and water pollution in the building industry? Although concrete has been significantly beneficial to the construction of buildings and homes, it is one of the least sustainable building materials and causes issues when it comes to carbon footprint. 3D printing has helped with advancements in so many ways, especially in medicine, the automotive industry and the plane industry. It can also help limit unnecessary waste and the need for raw materials.

Switching out regular concrete for 3D-printed concrete can solve many environmental issues that concrete and the construction process cause, like lowering the environmental footprint. 3D printing concrete can also help architects have more design freedom when it comes to geometrical shapes inside of buildings or geometrical shaped buildings as a whole, which can sometimes contribute to the air flow or energy efficiency of that building. 3D printing building materials has been around for decades, and although there are benefits to 3D printing, there are limitations such as durability, technological limitations and negative economic and social impacts. This review aims to investigate whether we can completely swap out regular building concrete for 3D-printed building concrete or if we can only switch it for some parts of the building cycle.

From Waste to Worth: Improving Upholstery Recycling for Sustainable Interiors

Primary Author: Alyssa Emory

Co-Author/Collaborator: Ethan Boles, Design Studies

Faculty Advisor: Hannah Upole, Human Ecology

Only 20% of the world's total textile waste is biodegradable (Yalcin-Enis, Kucukali-Ozturk, & Sezgin, 2019). Upholstery recycling is necessary to minimize environmental harm because furniture waste contains synthetic materials, foam and chemicals that can pollute landfills and require a lot of energy to produce new products. While the recycling of furniture and upholstery is possible, most current processes are ineffective or costly; however, research into low-cost and innovative methods for recycling and reusing such materials is still in its early stages.

With better material selection, more infrastructure and heightened consumer and industry engagement, the recycling of upholstery can be both effective and sustainable. The need for sustainable practice in the interior design industry is higher than ever, particularly in recycling upholstering. The knowledge gap exists in upholstery's material difficulties and recycling efficiency since current recycling practices are still inefficient or unaffordable. Closing this gap through new recycling technologies, advanced material design and consumer participation can help move the industry toward sustainability. This collection of research will be helpful to manufacturers producing goods involving upholstery and consumers who want to be more informed and involved with their environmental impact.

Goodnight, Sleep Tight, Dream of Chemicals Tonight

Primary Author: Adriana Roeder

Co-Author/Collaborator: Sara Pistole

Faulty Advisor: Hannah Upole, Human Ecology

Is your mattress causing harm to you, your family or others? What happens to a mattress at the end of its life? Who does this affect and why should we care? These are the questions that inspired the research conducted in this review. In this review, we will explore the differences between regular mattresses and organic or "eco-friendly" mattresses, in an effort to conclude which is better for the consumer and the environment. We will cover the various ways a mattress can be recycled and be used beyond the bedroom as well as the mattress industry's current production standards for both regular and organic mattresses.

The recycling of mattresses is important to this study, as mattresses are some of the most problematic types of waste, otherwise known as household waste (Conesa & Tomás, 2022). We will also explore what chemicals are utilized in your typical mattress (antimony trioxide, boric acid/zinc borate, decabromodiphenyl oxide, melamine and vinylidene chloride (Thomas and Brundage, 2006)) and why these chemicals are not present in any organic mattresses. This collection of research will be helpful to every mattress buyer and anyone looking to broaden their environmental knowledge in regard to textiles.

Environmental Sciences

Graduate Student - Doctoral

Soybean Quality Evaluation Using Artificial Intelligence and Hyperspectral Imaging

Primary Author: MD Bayazid Rahman

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Ahmed Avatar Tulsi, Agriculture

Faculty Advisor: Abdul Momin, Agriculture

This study aims to develop an advanced system for detecting and classifying Materials Other than Grain (MOG) in harvested soybeans using Hyper-Spectral Imaging (HSI) and machine learning (ML) techniques to enhance crop quality. HSI in the 400–1000 nm range is integrated with AI to enhance detection and classification accuracy. The experimental setup involves capturing hyperspectral images of harvested soybean samples followed by data processing to correct raw images and reduce noise using median filtering. Principal component analysis is used to reduce data dimensionality while retaining key spectral–spatial features. ML models such as Random Forest (RF), Support Vector Machine (SVM), and Spectral Angle Mapper (SAM) are applied to classify soybeans into four main categories: normal, split, diseased and other inert materials such as stems and pods. Preliminary results suggest that combination of HSI and ML enhances harvested grain classification accuracy compared to existing methods. Efforts are ongoing to fine-tune the models to ensure consistent performance across different soybean varieties. Final results, expected by the conference, aim to demonstrate the potential of AI-powered HSI systems for advancing soybean quality evaluation.

Human Ecology

Graduate Student - Doctoral

Fighting Food Insecurity on Campus

Primary Author: Alexandra Garcia

Co-Author/Collaborator:
Reagan Baker, Human Ecology

Faculty Advisor: Samantha Hutson, Human Ecology

Food insecurity among college students is a growing concern that impacts academic performance and well-being. This project aims to increase awareness and accessibility of Tennessee Tech University's on-campus food pantry by organizing monthly pop-up events that distribute shelf-stable meal kits and educate students on assistance options that are on campus.

A series of five pop-up events will be held in high-traffic campus locations over a semester. Each event will provide up to 25 shelf-stable meals kits and informational materials. Outreach efforts will include marketing and engagement with student organizations.

Pop-up events successfully engaged up to 25 students per event, with meal kits distributed at a rate of 80-100%. Food pantry visits increased approximately 25% each event, indicating improved awareness and utilization. However, stigma remained a barrier, as some students hesitated to take meals, believing others needed them more. Marketing strategies, including social media engagement and food pantry informational brochures were used to help increase participation. Additionally, event timing and location were found to be critical factors in maximizing

attendance. Limited funding required adjustments to meal distribution to ensure sustainability.

By directly addressing student food insecurity, this project promoted both short-term support through food distribution and increasing awareness of the on campus food pantry. The findings highlight the importance of targeted outreach, strategic marketing, and stigma reduction efforts in campus food security initiatives. Future efforts should focus on expanding marketing strategies, increasing funding sources and strengthening collaborations to enhance food pantry engagement.

Undergraduate Students

Societal and Economical Impacts of Childhood Poverty

Author: Sophia Enriquez, Mary Below Scholarship

Faculty Advisor: Rufaro Chitiyo, Human Ecology

Looking into my topic, how does growing up in poverty impact someone societally and economically later in life challenges the way someone's life can play out in society. This can result in a lack of self-confidence, challenges in finding a career, behavior issues and complications in financial situations. Investigating this research challenges bias towards the simplicity of escaping poverty.

Looking into the research, the focus was learning the effects of poverty in childhood and looking from there. In further investigation these participants were selected from a wide array and studied from birth to the age of 15. More collected data revealed how our economic issues can bound one to poverty, how your lifestyle growing up plays a part in your behavior and how through all the trials you can break the generational cycle.

Career-wise, anyone who is working with individuals who have been impacted, I suggest implicating learning about what this research has said and including the background knowledge while working with clinics. Connecting with them on a deeper level and guiding them to see that there are ways to break the cycle. In further notice, my desire is to open eyes to what has bounded millions to a lifestyle of brokenness.

Reintegration of Survivors of Childhood Human Trafficking Back Into Society

Author: Audrey Presley, Hope, Presidential, Federal Pell Grant, TN Student Assistance Award

Faculty Advisor: Rufaro Chitiyo, Human Ecology

Childhood human trafficking is an issue that affects individuals of all demographics and leaves survivors with the task of building back their lives. The purpose of this synthesis was to investigate what reintegration into everyday life entails for survivors of childhood human trafficking. The literature was selected using keywords and phrases such as childhood human trafficking, reintegration, survivors, traumatic and navigation. The literature focused on only childhood survivors, had to have a clear abstract, and the methodology used had to be quantitative. Literature focusing on adult survivors, with unclear parameters in the abstract, or with qualitative methodology was ruled out. The synthesis was organized into two themes: mental and emotional reintegration, and medical and physical reintegration. Similarities in the literature included that in general, participants experienced negative effects. Specifically, research findings showed high rates of mental illness, emotional difficulty, poor health outcomes, and trouble finding employment during reintegration. Future researchers should consider incorporating other domains of reintegration like social, economic and family adjustment. Professionals in the field should keep in mind all domains of reintegration to provide survivors with resources to equip them for smoother reintegration back into society.

The Connection Between Early Childhood Hospitalization and Perceptions of Healthcare in Adulthood

Author: Kaelyn Adams, Hope, Presidential Scholars, Human Ecology, Honors

Faculty Advisor: Rufaro Chitiyo, Human Ecology

The dissatisfaction with the healthcare system in the United States has led to an unwillingness to seek medical services. This literature synthesis explored the connection between early childhood healthcare experiences and perceptions in adulthood. I sought to answer the question of how negative experiences in early childhood affect general attitudes and willingness to seek healthcare services in adulthood. Research was selected based on age of participants and location, focusing on experiences in early childhood, birth to age six, and adult perceptions. All studies took place in a children's hospital or practitioner's office. The synthesis was organized as

follows: factors contributing to negative healthcare experiences and the use of experiences as a predictor for future behaviors and perceptions. There was a correlation between experiences in early childhood and negative perceptions in adulthood. There are gaps in why the negative experiences were impactful. Communication resulted as the most influential factor followed by establishing coping skills and proper care management. This indicates a need for child life specialists and care teams to focus on these areas as well as a need for team cohesion. More qualitative research is needed to bridge the gap between experiences and perceptions.

The Effects of Child Abuse on Cognitive Development

Author: Maya Most, Pell Grant

Faculty Advisor: Rufaro Chitiyo, Human Ecology

This literature synthesis is about how child abuse affects individuals in many ways, including their emotional wellbeing, how they function and their social connections. This project was meant to help expose the long-term effects that child abuse has on cognitive development. The research question under investigation is: "What are the long-term effects of child abuse on cognitive development?" To locate articles for this synthesis I used key terms like child abuse, cognitive development, child abuse into adulthood and effects of abuse. I excluded articles that didn't pertain to child abuse and focused on abuse in general.

Some of the findings in the reviewed research showed that child abuse can have many negative results; it can affect children's performance in the classroom leading to bad grades and high stress levels. Another result is loss of memory in victims. Lastly, it is linked to struggles in social environments, which makes it harder for people to form real social connections. This research puts an emphasis on the importance of early intervention and that is something professionals should consider. Future researchers must focus on effective ways to prevent child abuse. In conclusion, this synthesis explored the long-term effects of child abuse on cognitive development.

The Effects of Play on Child Development

Author: Sydney Crownover, HOPE Scholarship, Presidential Scholarship

Faculty Advisor: Rufaro Chitiyo, Human Ecology

This synthesis explored the topic of different types of play children engage in. The purpose of this synthesis was to discover the best practices for facilitating the development of children so they can become healthy members of society. I sought to answer how different types of play affect children's development. The literature included in this synthesis was chosen by searching key terms like play and children's development and was narrowed down by criteria such as participant age being preschoolers and similar types of play. The synthesis discussed first the effects of pretend play, then father-child play, and lastly outdoor play.

Results showed that adult interaction facilitated richer play experiences, and play helped develop cognitive skills like executive function. There are some gaps in the research, as not all of them looked at every age in the preschool years. Overall, the results showed that each of the different types of play examined positively impacts children's development. Implications that can be drawn from this synthesis for professionals would be to implement more fantasy and outdoor play in preschool settings, and to encourage more father-child play in the home for preschoolers. Future research must focus on broader age categories.

Children's Developmental Outcomes Based on Different Types of Play

Author: Sarah Wright, Hope Scholarship

Faculty Advisor: Rufaro Chitiyo, Human Ecology

In this project, I explored the developmental outcomes/effects of different play styles throughout childhood. The area of play is not thought to be important, and parents need to be educated about this topic. The purpose of this synthesis was to inquire the detrimental consequences that can occur if play is withheld, or if the children get little to no exposure to play. I selected literature based on whether it focused on play styles in children of all ages. I included articles from scholarly websites and also those based on the style of play that the research investigated. I excluded research that was based on one child specifically and focused on studies that looked at children in groups. Results showed that children who are exposed to play can cope, socialize and communicate better than those that aren't. In addition, pretend play drives motivation and self-regulation and play-based learning fosters trust and education through comfortable modalities. Professionals must provide parent education with a focus on incorporating play and address the impact of play on adolescence specifically related to social

success. Future research must examine how vital play is for children of all ages.

Parental Substance Abuse and Childhood Emotional Intelligence

Author: Cambridge Gables

Faculty Advisor: Rufaro Chitiyo, Human Ecology

Substance abuse is a complex problem that has been altering family dynamics for ages. Parental substance abuse is considered an Adverse Childhood Experience (ACE) for children in these families. The research question under investigation was, what is the relationship between parental substance abuse and the emotional intelligence and coping mechanisms of their children? I chose literature discussing parental substance abuse, family systems theory, and the emotional development and psychiatric morbidity of children. I excluded literature including children above the age of 12.

In my literature synthesis, I addressed emotional intelligence, child growth and development in substance abuse contexts, the relationship between emotional intelligence and substance abuse, and concluded with recommendations for professionals to prevent adverse effects and work with families to provide necessary support. Most literature agreed that any ACE will disrupt brain development, which can lead to poor mental health and coping mechanisms, but not on which mental aspect is most impacted by this ACE. Professionals should be educated on how to work with children during and after parental substance abuse to reduce the risk of negative outcomes. Future research must focus on different age categories of the children experiencing parental substance abuse and its consequences.

The Link Between Social Media Use and Mental Health Outcomes in Children

Author: Olivia Gonzalez

Faculty Advisor: Rufaro Chitiyo, Human Ecology

This study examines the relationship between social media and children's mental health outcomes. An alarming number of children on social media are repeatedly experiencing low self-esteem, poor quality of sleep and depression. The purpose of this research is to understand the potential harm of social media on children's behavioral health by analyzing factors such as: frequency, media platform used and screen time. A meta-analysis was conducted of six different studies which were published on government websites or referenced in parent advocacy articles. The studies were found using key terms "social media and concerns for children." The participants were children aged eight to 17; selected via school recruitment. The studies revealed with the age-restriction of 13 years old, children as young as eight are exposed to social media's content. Ninety percent of teens have a social media account. Children spending more than three hours a day on social media are at higher risk. Practitioners should recommend children only spending 30 minutes to two hours a day on social media and address the issues that accompany. Researchers' implications: examine parental involvement and work with psychologists. In conclusion, the research revealed a strong correlation between excessive social media use and several mental health concerns.

Factors Contributing to Child Life Specialists' Burnout

Author: Ali Hicks, Human Ecology Alumni Endowed

Faculty Advisor: Rufaro Chitiyo, Human Ecology

There are many contributing factors that lead to burnout in the field of Child Life. This results in a shortage of Child Life Specialists in the field. The purpose of this project was to examine the most common factors that contribute to Child Life Specialist's burnout. To locate research articles, I searched Google Scholar and used the key term child life specialist burnout. I selected articles based on relevancy. To keep the research relevant, I excluded articles that were more than 35 years old and that occurred outside of the U.S. The participants in the studies were Certified Child Life Specialists who had experienced burnout. The results proposed that the relationships between supervisors and staff, the number of years in the field, and the unit in which the Child Life Specialist worked were top contributors to experiencing burnout. Practitioners should implement effective self-care and a work-life balance. Researchers should examine Child Life Specialists' personality types and conduct a longitudinal study. In conclusion, Child Life Specialists are at a high risk for developing burnout and researchers have investigated the contributing factors.

Post Graduation Benefits of Life Skills Education

Author:
Hannah Frady, Gary-Bailey 4-H, Tech Pride

Faculty Advisor: Rufaro Chitiyo, Human Ecology

This literature synthesis explored the necessity of reintroducing Home Economics into rural Tennessee high schools to prepare students for independent adulthood. The research problem centers on the decline of Home Economics education due to shifting educational priorities, budget constraints, and persistent gender biases, leading to students' lack of essential life skills such as financial literacy, household management and career readiness. The purpose of this project was to analyze existing research on the impact of life skills education and advocate for its reintegration into school curricula to enhance student preparedness for adulthood. Methods for this research involved selecting peer-reviewed studies and reports from academic databases using key terms such as home economics education, life skills curriculum, financial literacy in high schools and gender bias in education. Results showed that life skills education improves financial independence and stability, project-based learning enhances students' problem-solving abilities, and addressing gender biases can increase male engagement in Home Economics programs. Implications for practitioners include incorporating project-based learning in curricula. Future studies should investigate the long-term economic impact of life skills education and explore strategies to increase male participation in these courses. In conclusion, reintroducing home economics can enhance students' preparedness for adulthood and economic self-sufficiency.

The Impact of Therapy Dogs on Hospitalized Children's Coping Skills

Author:
Addison Howard, Presidential Scholarship, Mary Lee B Stewart & William K Stewart Jr Endowed Scholarship

Faculty Advisor: Rufaro Chitiyo, Human Ecology

Facility (therapy) dogs have been used as a psychosocial intervention for children in the hospital for many years. This study questions if these facility dogs help increase coping skills for hospitalized children. Literature was selected based on the key terms, "therapy dog", "children", and "hospital". Literature had to include either analysis of either a prior or direct interaction between a child and a facility dog. Then, indicate how the child was affected by the interaction. Information about facility dogs and their effects was organized as follows; intended effects of facility dogs, child-reported effects and professional-reported effects. Literature found that interaction with a facility dog is beneficial for a child's coping. Studies agreed, when children interacted with a facility dog coping increased and stress decreased. Based on current research, it is unknown if this is the case with children with behavioral disorders. Overall, studies indicated that hospitalized children's coping benefits from interaction with a facility dog and that facility dogs are an effective psychosocial intervention. Future research should investigate the validity for specific patient populations. Recommendations are: facility dog programs should be more widely implemented in children's hospitals to promote coping, reduce stress levels and normalize the environment.

Child Neglect: A Common but Unclear Form of Maltreatment

Author:
Adia Byron, Honors Academic Scholarship

Faculty Advisor: Rufaro Chitiyo, Human Ecology

Child neglect is ambiguously defined despite being a common form of child maltreatment. The purpose of this synthesis was to examine and compare research on what qualifies as child neglect, methods for identifying child neglect, and proposals for prevention and intervention of child neglect. Research articles that discussed the definition of child neglect, identifying child neglect, and the impact of child neglect was included, while research focusing on other forms of child neglect was excluded from the synthesis. My synthesis was categorized into identification, intervention and prevention, and outcomes. The research identified impacts of child neglect, such as collective responsibility, gender norms, and obedience expectations, within different communities; additionally, research indicated that longitudinal studies may be beneficial for differentiating child neglect from other forms of child maltreatment. Results showed that child neglect negatively impacts the child by increasing the risk of dropping out of school, suicidal ideation and withdrawing from peer relationships. Suggested methods for intervention included supporting student-teacher relationships within schools. The negative impacts identified by a variety of research demonstrate why it is important to discuss methods for identifying child neglect and providing intervention for children and families.

Reviewing the Correlation Between the Mediterranean Diet and Diabetes Symptom Management

Author: Jadyn Norman

Faculty Advisor: Allison Coutinho, Human Ecology

The Mediterranean diet has been practiced around the world for cultural reasons and health. This diet consists of plants products and lean proteins. Since this lifestyle avoids processed foods, researchers hypothesize its benefits for certain illnesses like diabetes. Diabetes affects millions of people worldwide and is a pressing issue. The purpose of this literature review was to review the correlations between the Mediterranean diet and diabetes symptom management. Although there were no exclusion criteria, articles included had to be related to diet and diabetes. Primary peer reviewed articles date back to 2014, with only one article being from 2009. Key words used were Mediterranean diet, diabetes, type 1, type 2, prediabetes and gestational. Results showed that the Mediterranean diet improved glycosylated hemoglobin, fasting blood glucose and glycemic control in those with prediabetes, gestational and type 1 and 2 diabetes. Additionally, there has been proof of reduced incidence of diabetic kidney disease in those following this diet, although there has been no statistical significance in the occurrence of diabetic neuropathy or diabetic retinopathy. In gestational diabetes, results showed a 6.3% decrease in the incidence with those on the Mediterranean diet. With the Mediterranean diet, health care professionals who have not been thoroughly educated on nutrition or diet were ill-equipped when asked about components of the diet. This is important because if there is an association between diet and glycemic control of diabetic patients, education should be implemented to improve client care.

Is There an Association Between the Mexican Diet and Obesity in the Mexican Population?

Author: Jennifer Velasco-Perez

Faculty Advisor: Allison Coutinho, Human Ecology

About 75% of the Mexican population is obese or overweight which could be due to sugary drink intake, diet and behavior. The purpose of this literature review is to see if there is a correlation with sugar-sweetened beverages (SSB) consumption, the westernized diet and behaviors and the Mexican population being obese or overweight. Peer reviewed articles from 10 years previous were used along with keywords including: obesity, Mexico, sugary drinks, agua frescas, Mexican diet, traditional diet and westernized diet. Results showed that the Mexican population along with Mexican Americans consumed a large amount of sugar, including sugary drinks like agua frescas. Results also showed that the tax that was implemented on SSBs in 2014 did not stop the purchase or consumption of SSBs due to low cost of tax, preference and addiction. The studies also showed that about 68% of the Mexican population eat what is considered a "Westernized diet" which is low fruits and vegetables and higher meat and sugar consumption. A study also showed that mothers oversee nutrition while fathers are in charge of exercise when it comes to the children. Results also showed that when provided resources, the Latino population seems to be unaware of the resources provided.

Nutrition Strategies Associated with Improving Symptoms and Preventing Long-Term Complications in Women Diagnosed with Polycystic Ovary Syndrome

Author: Holly Jones

Faculty Advisor: Allison Coutinho, Human Ecology

Polycystic ovary syndrome is a hormonal disorder that is characterized by an increased production of androgens in the ovaries. Indicators for this disease are increased testosterone levels, increased acne, increased hair growth, infertility issues and abnormal menstrual cycles. Women diagnosed with polycystic ovary syndrome can also experience high blood pressure, systematic inflammation, obesity and insulin resistance. The purpose of this literature review was to determine what nutrition strategies may be associate with improving symptoms and preventing long term complications in women with polycystic ovary syndrome. Eight peer-reviewed studies that were conducted between 2013 and 2024 were used. Key words included the mediterranean diet, body composition, dietary approaches to stop hypertension, lipids, oxidative stress, glycemic index, insulin resistance, isocaloric, obesity, very-low calorie diet, metabolic syndrome, energy deficit, hyperandrogenism, magnesium, dietary patterns and meal timings. P-values indicated significant findings.

Results found that limited adherence to the Mediterranean was associated with increased testosterone, fasting blood glucose levels, and decreased consumption of ideal macronutrients. Dietary approaches to stopping hypertension was associated with decreased lipid levels, decreased insulin levels, improved hormone levels and improved anthropometrics. Restricted energy diets and low glycemic index diets improved anthropometrics,

insulin levels, lipid levels, blood pressure, hormone levels and physical symptoms related to polycystic ovary syndrome. Consuming meals at consistent times were congruent with decreased intake of junk food and improved laboratory values. Limitations included small sample sizes, reduction of participants, limited time frames and participant reporting. These nutrition strategies could be associated with assisting in polycystic ovary syndrome management.

Is Branched-Chain Amino Acid Supplementation Associated with Liver Failure Symptom Management?

Author: Sydney Ashby

Faculty Advisor: Allison Coutinho, Human Ecology

Liver failure is a condition affecting millions of adults in the United States and contributes to 4% of global deaths. The disease causes severe symptoms such as muscle wasting, appetite loss and impaired glucose metabolism. This literature review investigates the potential benefits of branched-chain amino acid (BCAA) supplementation for managing these symptoms in liver failure patients. BCAAs are critical for protein synthesis and muscle preservation, have been found to improve muscle mass, enhance energy levels and support better metabolic function. This review synthesizes research conducted from 2014 to 2024, which explores the effects of BCAAs in combination with exercise, late evening snacks and other dietary interventions. Findings suggest that BCAA supplementation reduces muscle wasting, improves appetite and supports liver function, with evidence of higher survival rates in cirrhosis patients. While the current data is promising, the studies reviewed often have limitations such as small sample sizes, short durations and lack of diversity. These findings highlight the need for further large-scale, long-term studies to establish the full therapeutic potential of BCAAs in liver failure management. Overall, BCAA supplementation offers a safe, non-invasive strategy with significant potential to improve quality of life and survival outcomes for liver failure patients.

The Correlation Between Maternal Nutrition and Fetal Neural Development

Author: Raygan Sain

Faculty Advisor: Allison Coutinho, Human Ecology

Maternal nutrition, encompassing the dietary needs of women before, during and after pregnancy, plays a pivotal role in fetal development, particularly in neural growth. This literature review explores the correlation between maternal dietary intake and fetal neural development, focusing on key nutrients such as docosahexaenoic acid (DHA), folic acid, vitamin B12, iodine and choline. Data from randomized controlled trials and cohort studies indicate that while balanced maternal diets rich in fruits, vegetables, lean proteins and fibers contribute to healthier birth outcomes, the effects of specific nutrient supplementation remain inconclusive. DHA supplementation has shown potential benefits for maternal oxygenation and fetal neural development, though further longitudinal studies are required. Folic acid has demonstrated a positive impact on cognitive development and IQ, while the role of B12 in neurodevelopment needs additional investigation. In contrast, supplementation with iodine and choline does not consistently enhance fetal growth and may pose risks. Study limitations, including small sample sizes, self-reported dietary data and short research durations highlight the need for broader, more comprehensive research. The findings emphasize the importance of tailored nutritional interventions during pregnancy to optimize maternal and infant health outcomes. Future studies should aim to bridge existing gaps to refine dietary recommendations and nurture long-term health benefits for the next generation.

Association of Social Media and Eating Disorders

Author: Ashley Shores

Faculty Advisor: Allison Coutinho, Human Ecology

Eating disorders can be defined as serious mental and sometimes physical illnesses that affect how you think about food, your body and your eating behaviors. Social media can be defined as platforms of electronic communication, including social networking sites and microblogging platforms, where users create online communities to share content with. It is hypothesized that social media may influence body image perceptions, self-esteem and eating behaviors, which might increase the risk of developing an eating disorder.

The purpose of this literature synthesis is to further investigate the role that social media might play in the development of an eating disorder. Peer reviewed and primary articles dating from 2014 to 2024 were found by keywords: eating disorders, disordered eating, social media, body dissatisfaction, body image, social norms, food, and body mass index. Results from most of the studies indicate a significant correlation

between social media usage and eating disorders, however some studies failed to show significant correlations between the two, indicating the need for further research on the topics and underlying factors. Although most of the studies found that social media is likely a factor in the development of an eating disorder, further research is important to understand this complex issue. These findings are important for dietitians to help understand the factors connected to eating disorders as they provide a foundation for creating strategies that promote healthy relationships with food and social media.

The Correlation of Diet Changes with Ulcerative Colitis: Active and Dormant Flare-Ups

Author: Hannah Schreader

Faculty Advisor: Allison Coutinho, Human Ecology

Ulcerative colitis (UC), is characterized as a chronic inflammatory bowel disease that significantly affects the patients' quality of life, resulting in the need for effective management strategies and interventions to minimize active flare-ups and maintain remission. This literature review explores the correlation between dietary interventions and UC disease activity within patients currently going through active flare-ups or in a state of remission. This review includes findings from peer-reviewed articles published between 2004 and 2023, identified using specific keyword searches through Tennessee Technological University's Eagle Search, concentrating on dietary factor influences within flare-ups and remission.

Findings reveal that anti-inflammatory and Mediterranean dietary patterns are a correlated factor in reducing flare-ups and maintaining remission status. Key findings include increased dietary fiber intake derived from fruits and vegetables and higher serum vitamin D levels were noted to independently reduce relapse risks. On the other hand, high consumption of red meats, processed foods and carrageenan containing foods were noted to aggravate the symptoms leading to active flare-ups. Food avoidance and restrictions were seen commonly within UC patients and were shown to be a factor in nutrient deficiencies without aggravating inflammation parameters. This review narrows down on the potential of tailored dietary interventions as adjunctive therapies in UC management while highlighting the need for future research on specific nutrient impacts such as micro and macro, and individualized patient responses to dietary changes.

Baby-led Weaning and Nutritional Intake in Infants

Author: Lillian Cicero

Faculty Advisor: Allison Coutinho, Human Ecology

Baby-led weaning (BLW) is a method of introducing solid foods to infants in which the infants feed themselves finger foods from the beginning. It is growing in popularity in many countries but is not included in official advice for parents in any capacity. Health professionals are concerned about nutritional intake with this method, so this literature review seeks to explore the relationship between BLW and nutritional intake in infants. Peer-reviewed articles dated 2014 and later were found using the keywords baby-led weaning, baby-led weaning nutrients and baby-led weaning intake. Articles with a main focus other than nutrient intake were excluded. The results showed that there is little evidence of differences in nutritional intake when using BLW compared to traditional weaning (TW) methods. The differences that were shown indicated that six- to eight-month-old BLW infants had less adequate intake, but the differences disappeared by nine months old. Baby-led weaning infants also received different food groups and proportions of energy from macronutrients, but energy intake was similar to TW infants. Health professionals can use this information to better educate parents who inquire about BLW.

College of Arts & Sciences

Biology

Graduate Student - Master's

Atrazine, It Leaches

Primary Author: Sarah Elliot

Co-Author/Collaborator: Windsor Kiefer, Biology

Faculty Advisor: Michael Nattrass, Agriculture

Atrazine is a common agricultural herbicide used to control broadleaf and grasses but has the potential to leach into aquatic systems. Organic matter (OM) can hold nutrients more than inorganic matter and would likely hold onto herbicides more. Organic matter is essential in improving cation exchange capacity and potentially increasing the sorption of herbicides and leachate collected. This experiment aims to determine the efficacy of OM content on decreased herbicide

leaching. Cone-tainers filled with 80ml pure sand, soil (75-85% OM), and a soil / sand mixture (50 / 50) were treated with 0X, 1X, and 2X the recommended rate of atrazine. The experiment was conducted as a randomized complete block design (RCBD) with nine treatments. Each treatment was replicated three times. On day one, 70 mL of deionized water was poured into the cone-tainers to simulate rainfall. On days 14 and 21, 35 mL was added. Leachate was collected and analyzed for atrazine content and the results were analyzed using SAS 9.4. The expected results suggest that increased OM content decreases the total amount of atrazine leached.

Undergraduate Students

Using Native Wildflowers as an Alternative to Pesticides

Author: Alexis Mears, 2024 CISE Recipient

Faculty Advisor: Hannah Kinmonth, Biology

Pesticide usage is a growing problem in the agricultural industry due to the biological damage that can result and the financial burden it puts on farmers. Native wildflowers have been used in earlier research projects as a habitat for beneficial insect predators and have shown promising results in lessening insect pest damage in nearby crop plants. This research investigates whether growing native wildflowers alongside crops is an effective alternative to pesticides. Using radishes as the test crop, a total of 16 plots were used at TN Tech's Shipley farm. These plots were 25 feet by 15 feet, and each separated by a five-foot wide grass buffer. Eight of the plots contained three-foot by 25-foot strips of wildflowers native to TN. The other eight contained only grass and served as controls. Once every two weeks, two leaves were harvested at random by an unbiased party from each plot. These leaves were then analyzed, using imageJ to find the total area of the leaves, total area of insect damage and total number of holes within the leaves. We expect to see a lower amount of insect damage in the plots containing wildflowers. This study is important because it is testing a potential biologically safe and less expensive option for farmers to use for insect pest control.

Project "Glypho-Safe": Computational Design and Docking of Novel 5-enolpyruvylshikimate-3-Phosphate (EPSP) Inhibitors

Author: Portia Phillips

Faculty Advisor: Derek Cashman, Chemistry

Glyphosate, the active ingredient in Roundup™, is one of the most widely used herbicides in agriculture due to its ability to inhibit 5-enolpyruvylshikimate-3-phosphate (EPSP) synthase in the shikimate pathway, a metabolic route that is essential for plant growth. Recent debates about glyphosate's impact on both health and the environment highlight the need for safer and more sustainable solutions. This study aims to design a potential competitive inhibitor targeting the active site of EPSP synthase with higher binding affinity. Using the molecular modeling software, MOE 2024, glyphosate and nine models of lead compounds from two previously published studies were constructed and docked into the active site of EPSP synthase to determine the interactions in the active site and binding affinity. Based on these results, modifications to these lead compounds were completed and new compounds were docked to the active site. The results of this docking study suggest several key modifications for EPSP synthase inhibitors that could potentially lead to novel, environmentally-safe herbicides.

Chemistry

Graduate Students - Master's

Double Salt Ionic Liquids from Trihexylphenidyl Cation

Primary Author:
Patience Nortey, Graduate Teaching Assistant

Co-Authors/Collaborators: Bailey Allred, Chemistry
Diana Popa, Chemistry

Faculty Advisor: Oana Cojocaru, Chemistry

Trihexyphenidyl hydrochloride is a prominent antispasmodic drug often used alongside NSAIDs in the treatment of Parkinson's disease. As a solid-state compound, it exhibits polymorphism, which can result in shifts between its biologically active and inactive crystal structures. To address these challenges, researchers have explored converting the solid-state drugs into a liquid form. This liquid transformation consists of replacing the inorganic, biologically inactive ion from a drug with various organic and biologically active ions. The resulting liquid formulations overcome issues associated with solid-state forms while offering several advantages such as potentially enhancing bioavailability, improving aqueous solubility and absorption as well as their therapeutic efficacy. This research focuses on

applying the double salt ionic liquids (DSIL) strategy to trihexyphenidyl hydrochloride. The new DSILs were synthesized by combining the Parkinson drug cation with anions such as docusate (a known penetration enhancer) and various carboxylates in various molar ratios while their purities, identities and properties were determined using known spectroscopic methods.

Kinetic and Computational Analysis of MKK7-JNK3 Complex

Primary Author: Muinat Zubair

Co-Author/Collaborator: Derek Cashman, Chemistry

Faculty Advisor: Xuanzhi Zhan, Chemistry

The activation of c-Jun N-terminal kinase 3 (JNK3) by Mitogen-activated kinase kinase 7 (MKK7) is a critical step in response to cellular stress. However, the assembly of the MKK7-JNK3 complex remains unclear. Here, we propose exploiting the MKK7-JNK3 interaction by combining two methods: kinetic analysis and structural prediction. This study will analyze the catalytic mechanism and kinetic constants for the phosphorylation of JNK3 by MKK7. These analyses will provide mechanistic and kinetic insights into MKK7-JNK3 signal transduction. Currently, the three-dimensional structures of only the kinase domains are available, which makes it impossible to predict the structural basis of the MKK7-JNK3 complex by computational method. To overcome these challenges, AlphaFold2 was used to predict the structures of whole kinases. Upon predicting the full-length structures, the binding of MKK7 to JNK3 was further analyzed using AlphaFold2 multimer and molecular dynamics simulation.

Leaching Potential of Juglone via SiO2 and ZnO Solid Supports

Primary Author:
Stephen Awuku, Graduate School Funding

Co-Authors/Collaborators: Twanelle Majors, Chemistry
Rachel Paris, Chemistry

Faculty Advisor: Andreea Cojocaru, Chemistry

Black walnut trees, native to 32 US states, are sustainable, completely biodegradable, all-natural and highly valuable resources for agriculture and economy. The trees are mostly grown for their edible nuts and for their high-quality wood used in the furniture industry. However, walnut trees produce juglone, an organic compound found through all parts of walnut trees (fruits, leaves, husks, roots) and with a wide variety of properties of interest (e.g., herbicidal activity, anticancer potential, antimicrobial, and antifungal activity, dermatological applications). Juglone exists naturally as a free acid and it can be deprotonated in basic medium to form its conjugated base, the juglone anion. Juglone's low water solubility and high volatility complicate its herbicidal potential and make it a less desirable option for existing herbicidal delivery systems. Our research focuses on finding ways for a controlled delivery of juglone into the environment. This can be achieved by using the solid support strategy: adhering juglone to solid supports such as mesoporous hydrophobic silica and zinc oxide materials could allow for a controlled delivery of the compound into various aqueous environments. This work shows the leaching potential of juglone from silica and zinc oxide into two different aqueous environments, namely a buffer of pH=5 and 1/1 (v/v) pH=5 buffer/ethanol mixture.

Unveiling Hydrogen Bonding Networks: A Computational and Spectroscopic Study of Guaiacol-Water Interactions

Primary Author:
Randi Iresha Dilani Kalahe Padikoralage

Co-Author/Collaborator: Mitchel Swann, Chemistry

Faculty Advisor: Ranil Gurusinghe, Chemistry

We explored the hydrogen bonding interactions of guaiacol (2-methoxyphenol) with water molecules in the gas phase using theoretical and experimental approaches. Theoretical calculations, including geometry optimizations and vibrational frequency analyses, were performed at the B3LYP-GD3BJ/Def2TZVP level of theory to determine the lowest energy structures of guaiacol monomers (anti-syn, anti-anti, gauche-anti)1 interacting with one and two water molecules through hydrogen bonding. Experimentally, these weakly bound complexes were studied using high-resolution Fourier transform microwave (FTMW) spectroscopy combined with a supersonic molecular beam. The FTMW spectrometer, featuring a frequency resolution of 2.5 kHz and equipped with a Fabry-Perot microwave cavity, allowed precise rotational spectroscopic measurements. A supersonically expanded gas mixture containing approximately 1% guaiacol and 1% water in argon provided the necessary cold conditions for stabilizing the hydrogen-bonded complexes, facilitating detailed spectroscopic characterization.

The ongoing results from both theoretical and experimental investigations will be presented, offering deeper insights into the nature of these weak hydrogen bonding interactions.

References,
(1) Gurusinghe, R. M.; Fox-Loe, A.; Tubergen, M. J. Structures of Guaiacol and the Guaiacol-Argon van Der Waals Complex from Rotational Spectroscopy of Guaiacol Isotopologues. J Mol Struct 2021, 1246. https://doi.org/10.1016/j.molstruc.2021.131233.

Assessment of Pesticide Residue Contamination in Surface Water and Wastewater Utilizing Solid Phase Extraction and LC-MS/MS

Author: Ademola Adeoye

Faculty Advisor: Tammy Boles, Environmental Studies

Pesticide contamination in natural streams from agricultural activities has gained significant attention due to its direct impact on water pesticide concentrations. The ultimate objective of this work was to develop, validate and optimize a method for routine determination and quantification of some commonly used pesticide residues in Tennessee surface water and wastewater samples. The target analytes for this research were carefully selected based on recent occurrences and frequent usage in Tennessee over the last few years, including chlormequat, recently found in oat-based food products.

Other target analytes were atrazine, simazine, azoxystrobin, tebuconazole, imidacloprid, chlorpyrifos and metolachlor. Prior to analysis, sediments were removed from the samples via filtration, followed by Solid Phase Extraction (SPE) using Oasis HLB cartridges. Analysis was performed using liquid chromatography tandem mass spectrometry (LC-MS/MS) in MRM mode.

The study demonstrates the analysis of these compounds over the concentration range 0.25 - 50 ng/mL (ppb), with Limit of Detection ranging from 0.4ppt to 1ppt, while Limit of Quantification ranged from 1.24 to 1.85ppt and R2 values greater than 0.99 for majority of the target analytes. The optimized method provided good repeatability and reproducibility range, high extraction efficiency, with over 70% recovery for majority of the analytes and low LODs. The method was applied to several surface water near agricultural areas and wastewater sources. This study offers insights to enhance water quality and safety, and it also support policymakers and health practitioners in mitigating pesticide pollution to protect human and environmental health.

Undergraduate Students

Flow Synthesis of Silver Nanoparticles

Primary Author:
Hannah Wasserman, Tech Transfer Pride

Co-Author/Collaborator: Sarah Putnam, Chemistry

Faculty Advisor: William Carroll, Chemistry

An investigation into changing aspects of the synthesis of a flow-reaction of silver nanoparticles to increase reproducibility. The nanoparticles were then characterized via scanning electron microscopy (SEM) and atomic force microscopy (AFM). This characterization was done to investigate the size disruption of the nanoparticles. This was done to find a way to reduce the size disruption to make the nanoparticles more reproducible.

Exploring Alternative Dyes for Enhanced Sensitivity and Specificity in the Bradford Protein

Author: Brooklynn McKenzie

Faculty Advisor: Jeffrey Boles, Chemistry

The Bradford protein assay is a widely used technique for protein quantification that is based on the binding of a specific dye to protein, leading to a color change measurable at a wavelength of 595 nm. This study tested the efficacy of various dyes as substitutes for Coomassie Brilliant Blue G-250, the standard dye used in the assay. Dyes evaluated included Rose Bengal, Methyl Orange and Carmine, among others. Each was selected for their distinct structural and spectral properties in the presence and absence of protein. Proteins such as bovine serum albumin (BSA) and lysozyme served as test proteins. Each dye's linearity in standard curves, and sensitivity to protein concentration were analyzed using scanning and single-point UV-Vis spectrophotometry. Results will be presented in this presentation. We hypothesize that some will perform sufficiently while others will lack sufficient specificity. The findings will likely highlight the potential for alternative dyes in the Bradford assay since the linear region utilizing Coomassie Brilliant Blue G-250 is very small. Optimization will be necessary for achieving consistency and precision. This study broadens the scope of protein quantification techniques and introduces potential cost-effective alternatives.

Inductive Analysis of Thought Processes of General Chemistry Students when Drawing Lewis Structures

Author: Adalyn Slater

Faculty Advisor: Chad Rezsnyak, Chemistry

Lewis structures are widely used in the field of chemistry as a tool to understand the physical structure and properties of chemical species (Cooper et al., 2010; Molvinger, 2024). During a student's education, the ability to draw Lewis structures is an important skill for success in upper-level chemistry courses, especially organic chemistry. Methods for drawing Lewis structures are usually taught in introductory and general chemistry courses. This interpretivist qualitative study sought to investigate the perceptions of undergraduate chemistry students at a four-year, public university on a Lewis structure teaching method in which electrons are "pooled" into a total value and distributed to the substituent atoms of a species.

Students from general chemistry courses were asked to draw Lewis structures for a number of chemical species and were interviewed over their thought processes during and after the assessment. The thought processes and general efficacy of these students were inductively analyzed, resulting in four major categories of 15 themes. These included factors of confidence to draw the structure, ranging from intuition to mathematical ability; personification of Lewis structures; accuracy, including processes of logic and correctness in final results; and difficulty, which could be attributed to self-blame or blame of the visual aspects of the Lewis structure. Findings can inform general chemistry teaching methods surrounding Lewis structures, to aid in the selection of what method to teach different students, and for use in comparison with other methods based on data collected from future replicated studies.

Synthesis of Prussian Blue Nanoparticles

Author: Sarah Putnam

Faculty Advisor: William Carroll, Chemistry

The research aims to improve the size distribution of the Prussian Blue nanoparticle to make a purer blue. This is done in the traditional batch reaction and the new flow reaction. Then drying the final solution. The concentrations are changed to determine the effect of concentration on consistency in size distribution. The dried solution is analyzed using scanning electron microscopy and atomic force microscopy. This will be used to determine which reaction creates more consistent and uniformly sized nanoparticle.

Determination of the Effectiveness of a Non-Ionic Surfactant for the Extraction of a Neonicotinoid Pesticide

Primary Author: Connor Boles

Co-Author/Collaborator: Riley Widdifield, Biology

Faculty Advisor: Kristen Johnson, Chemistry

Excess pesticides in agricultural run-off pose a threat to human and environmental health. For example, neonicotinoids are organic pesticides that have been found in wastewater and linked to the collapse of bee colonies. Cloud point extraction (CPE) has been established as a green way to extract pollutants from environmental matrices. CPE is a type of liquid-liquid extraction that works by exploiting the tendency of surfactants to form micelles in aqueous solution. Organic pollutants are trapped within the organic-rich micelle center. By adjusting parameters like temperature, the solution will phase separate allowing the extraction of the pesticide in the micelle phase. To implement this extraction technique the critical micelle concentration (CMC) must be known and can be determined by observing the changes in the fluorescence of pyrene, a probe molecule. CPE of the neonicotinoid (dinotefuran) was optimized using the non-ionic surfactant Triton x-114. First, the CMC was found by titrating different concentrations of the Triton x-114 and observing the difference in the fluorescence spectra of pyrene as the concentration of micelles increased. Next, the CPE technique was used to extract the dinotefuran. The extraction efficiency was measured using UV-visible spectroscopy to measure the concentration of dinotefuran left behind in the aqueous phase. This work will be a step towards a green extraction method for organic pollutants like pesticides from run-off. The next step in this research will be to further optimize the procedure for more environmentally complex matrices which will be a necessary step for the technique to be implemented.

Developing Standardized PET Microplastics to Determine Their Accumulation in Household Items

Author: Braden Greear

Faculty Advisor: Kyle Murphy, Chemistry

Microplastics are an ever-growing problem in our world, being found anywhere from dolphin's breath to the human brains. New problems require new solutions, and to create accurate solutions you need standardized data to detect the presence of microplastics. Using a coffee grinder at varying temperatures, then sieving to sort to desired sizes allows for a standardized yield of polyethylene terephthalate (PET) microplastics. This procedure is also cost effective, which is a beneficial step in advancing our research and understanding of these microplastics. These microplastics can then be put in a coffee maker, then using Infrared Spectroscopy (IR Spec.) to analyze the water for the PET's functional groups. This experiment hopes to show multiple low-cost ways for creating in-house PET microplastics and to explore the accumulation of them in many common items such as store-bought coffee.

N-Acyl and N-Sulfonyl Hydrazone Furfural and Methylfurfural Derivatives as Novel Tools for Disrupting Microbial Biofilm Formation

Author: Danielle Ferguson

Faculty Advisor: Kyle Murphy, Chemistry

In America, there is an overuse of antibiotics. The over-prescribed use of antibiotics has caused bacteria to adapt and form into multidrug-resistant bacteria. This research creates a library of pure hydrazone furfural derivatives that can create more opportunities for antimicrobial compounds. The research pertains to the organic synthesis of hydrazone furfural derivatives performed under sustainable and green chemistry conditions. Research is performed under short reaction times, with water as both the solvent and for filtration and purification of products. This project aims to synthesize hydrazones and characterize them via NMR spectroscopy and TLC to determine reaction success and purity. It is generally observed that these products can be synthesized in high yields (>85%). With future work pertaining derivatizing the compounds that have proved most successful against S. aureus and assessing if they are more suitable candidates for reduction of growth in bacteria as well as for biofilm inhibition.

Exploring the Quantum Tunneling and Structural Mysteries of Methylstyrenes: Insights from Spectroscopy and Computational Chemistry

Primary Author:
Mitchell Swann, Chemistry Scholarship

Co-Authors/Collaborators:
Thusitha Jayasekara, Chemistry
Cadence Miller, Environmental Sciences

Faculty Advisor: Ranil Gurusinghe, Chemistry

We present an ongoing spectroscopic and computational investigation into a series of styrene derivatives: 2-, 3-, and 4-methylstyrene. Our primary focus is on the intriguing interplay between molecular planarity, conformational structures and quantum tunneling phenomena in these compounds. While methylstyrenes exhibit conjugation along eight carbon atoms, promoting a planar geometry, the presence of the methyl group on the phenyl ring introduces steric effects that disrupt this ideal configuration. The quantum tunneling associated with methyl torsion in methylstyrenes is influenced by both local and non-local hyperconjugative interactions, as well as steric hindrances. As a result, tunneling properties exhibit a significant dependence on molecular geometry, conformation and the position of the methyl group on the phenyl ring.

To explore these phenomena experimentally, we employed cavity-enhanced microwave rotational spectroscopy in combination with a pulsed molecular beam setup. Our experiments are supported by quantum chemical density functional theory calculations conducted at the B3LYP-GD3BJ/Def2TZVP level of theory. The weak dipole moments and the quantum tunneling behavior near the free rotor limit in certain methylstyrenes present a challenging yet fundamentally intriguing problem. We will present the first vibrational ground state rotational spectra, along with the best-fit rotational and torsional molecular parameters. Additionally, we will evaluate the molecular geometry and tunneling properties, highlighting their contributions to our expanding fundamental understanding of molecular structure and internal dynamics.

Metal Separations using MOFs

Author: Juliette Brame, On-Ramps

Faculty Advisor: David Dan, Chemistry

Lanthanide metals have similar chemistries and are similar in size. Processes that require separation of one lanthanide from another become difficult to facilitate. When attempting to separate neighboring lanthanides the task becomes even more challenging. All lanthanides favor the 3+ oxidation state, and the ionic radius of neighboring lanthanides can vary by less

han 0.01 angstrom. This favoring of the 3+ oxidation state by lanthanides makes separation difficult because one can no longer rely on the traditional oxidative manipulation separation process used in traditional metal separations. Implementing metal organic frameworks (MOFs) aims to take advantage of the small yet present differences in ionic radius by utilizing various pore sizes and varying lattice structures that can help filter isotopes of similar sizes.

Changing linker length and linker mole ratios in the MOF structure can help make the filtration possible for even the smallest angstrom differences between isotopes. Altering linker length changes the pore size of the target MOF and mixing molar ratios of different linkers with different lengths allows for pores sizes somewhere in-between. The MOFs will be confirmed using powder XRD and single crystal XRD. This method will make it possible to fine tune the MOF pore size for the specific separation being performed. Experiments reported here have been performed using neodymium and samarium as proof-of-concept experiments before moving onto neodymium and promethium separations. The results of these separations have been confirmed with ICP-OES.

Method Comparison for Heavy Metal Detection from ICP-OES and XRF Spectroscopy

Author: Sydney Decatur, 2024 CISE Recipient

Faculty Advisor: Andrew Callender, Chemistry

Heavy metal contaminants in soil and food sources have been a large cause of concern in recent years. Commercial fertilizers, specifically phosphate-based ones, are one of the biggest contributors to this problem. These fertilizers have been found to leach heavy metals such as cadmium, lead and mercury in soil, which could pose long-term health risks. This research aims to compare different methods of determining heavy metal concentrations in fertilizers. Methods include natural leaching of fertilizer and hot plate acid digestion for ICP-OES analysis. As well as comparing ground samples with dried liquid samples for XRF analysis. This study will test six different fertilizers, five inorganic and one organic. Three inorganic fertilizers were phosphate-based from local East and Middle Tennessee co-ops. The samples will be analyzed for Ca, K, Fe, N, P, Cd, Pb, Hg and Cr.

Positive Environmental Effects on Asphaltene Aggregation Using Asphaltene Derivatives and Macrocycles

Author: Faye Anderson

Faculty Advisor: Kyle Murphy, Chemistry

This project intends to synthesize asphaltene derivatives and macrocycles using the method of Sonagashira coupling with dibromo and alkynyl linkers, followed by hydrogenation. These synthesized asphaltenes, of the archipelago architecture, are being used to synthesize porphyrin-like macrocycles in order to better understand the chemical and physical features of asphaltenes through assessing the interactions and flocculation mechanisms of their derivatives in an aquatic medium. New methods are required in order to effectively remove asphaltenes, found in crude oils and natural petroleum reservoirs, from water. Asphaltenes can have derivatives with the potential to bind to porphyrins that would remove them from water, thus being able to clean up oil spills. Understanding the mechanisms involving asphaltene macrocycles in solvents and aqueous systems is crucial for both petroleum science and environmental sustainability efforts in natural water bodies affected by petroleum-related aggregation. Analytical methods used to characterize the products include 1H NMR, 13C NMR, and thin layer chromatography.

Detecting a Novel Protein-Protein Interaction in the JNK Activation Cascades

Primary Author: Iroda Abdullaeva

Co-Author/Collaborator: Cayden Kirby, Chemistry

Faculty Advisor: Xuanzhi Zhan, Chemistry

The c-Jun N-terminal kinases (JNKs), represented by 10 isoforms, belong to the mitogen-activated protein kinase (MAPK) family and fulfill a myriad of roles in response to stress stimuli. JNK3, two of the isoforms, exhibits differential activity compared to JNK1/2 isoforms due to its subcellular localization in the nucleus. Several studies have identified JNK3 as a specific key modulator in CNS degenerative conditions (Parkinson's disease, Alzheimer's disease) and stressed neurons - making it a therapeutic target and biomarker for neurodegenerative and neurodevelopmental brain diseases. ASK1, apoptosis signal-regulating kinase 1 classified as mitogen-activated protein kinase 5, has been identified as an upstream activator of JNKs, but its specified relationship to JNK3 has not been reported. As upstream factors provide significant context for therapeutic target design, the direct interaction or lack thereof between ASK1 and JNK3 is of relevance.

This project aims to investigate whether JNK3 and ASK1 directly interact within the JNK MAPK cascade. To achieve this aim, JNK3 and ASK1 will be overexpressed in HEK 293 cells and their interactions will be explored through co-immunoprecipitation and Western blot.

English

Graduate Students - Masters

After Rana Plaza: Labor Exploitation and Corporate Deception

Primary Author:
Amina Begum

Faculty Advisor:
Brian Williams, English

This paper employs trauma and neo-colonial approaches to analyze the 2013 Rana Plaza collapse in Bangladesh, which resulted in the tragic loss of over 1,100 lives and thousands of injuries. A decade later, reconsideration of this catastrophic event continues to provide insight into how such trauma has been addressed and memorialized, and, how the survivors have been marginalized. My analysis of recent reports from both Bangladeshi and international sources suggests that responses to the tragedy remain largely superficial, with inadequate support and recovery efforts for the victims. The Bangladeshi government often prioritizes protecting the garment industry's interests over providing meaningful assistance to survivors. While international clothing brands have introduced safety monitoring programs under the umbrella of Corporate Social Responsibility (CSR), I argue that these initiatives function more as a public relations tool than an actual commitment to worker welfare. Examining the rhetoric involved illustrates how many of these programs focus on damage control and reputation management rather than addressing the root causes of labor exploitation.
My paper highlights how powerful international corporations continue to exert economic control over Bangladesh, forcing workers to remain in exploitative conditions. Despite CSR-driven safety initiatives, workers still endure poor wages, unsafe conditions, and limited labor rights, exposing the gap between corporate promises and workers' lived realities. This paper explores survivors' recovery, ongoing challenges, and the effectiveness of support efforts through a trauma lens. It also examines CSR's role in corporate responses, questioning whether these initiatives offer real protection or merely mask ongoing exploitation.

The Dead Women of Poe and Hawthorne

Primary Author:
Caroline Grugin

Faculty Advisor:
Michael Burduck, English

Edgar Allan Poe and Nathaniel Hawthorne together have killed off enough women in their short stories to fill a graveyard – a shared characteristic commonly analyzed throughout literary criticism. These dead women exist neither as narrators nor main characters of their tales, yet they remain permanently intertwined with the men who are. Often viewed as victims, I argue that, far from passive casualties, these women serve as the central figures of their stories. Even in death, they actively illuminate the darker aspects of their deeply flawed lovers, brothers, and fathers, ultimately wielding power far exceeding that possessed by their male counterparts.

In this paper, I explore the duality of death and power, along with the authors' representations of gender, sin, and mortality, through four key short stories. From Poe, I examine how "The Oval Portrait" and "The Birth-Mark" reveal the failings of individual hubris through the male characters' attempts to perfect or preserve their spouses; from Hawthorne, I analyze the ways in which "The Fall of the House of Usher" and "Rappaccini's Daughter" expose generational flaws that ultimately result in the destruction of a bloodline.

Altogether, I argue that the female deaths in these short stories exist as far more than mere literary devices. These women, though deceased, actively confront and expose the true nature of the men who survive them, challenging assumptions about gender, power, and mortality in early American literature.

Undergraduate Students

Breaking the Cycle: Generational Trauma, Black Masculinity, and Systemic Oppression in Fences by August Wilson

Primary Author:
Hannah Byers

Faculty Advisor:
Monic Ductan, English

In Fences, August Wilson uses the intense confrontation between the father and son, Troy and Cory Maxon, in Act 2, Scene 4 to deepen the exploration of the cycle of generational trauma and the strict expectations of Black masculinity. Fences is set between 1957 and 1965. This

time period is essential to our understanding of the story because it includes the Civil Rights Movement, where Blacks fought for racial equality and integration against the public. Cory wants to pursue football to prove something to himself, his father, and the Black and white communities. Troy, who struggles to express love, feels overprotective and jealous of Cory because of his past experiences with being a Black athlete, therefore controlling Cory by not signing the papers so he cannot have the opportunity to play collegiate football. This scene is an essential moment in the play because it shows how toxic masculinity, power struggles, and unspoken emotions can shape father-son relationships. Their argument represents a breaking point where the need to control overshadows understanding. Wilson ultimately uses this conflict to show how racism and systemic oppression impact Black families, making it harder for fathers and sons to connect and heal from past wounds.

Romeo and Juliet: The Human Nature of Romantic Love

Primary Author:
Olivia Cobble

Faculty Advisor:
Kristen Deiter, English

William Shakespeare's Romeo and Juliet remains one of the most enduring tales of tragic romance, with its central theme of forbidden love. The play's narrative, in which the lovers are kept apart by familial conflict and fate, taps into the universal human desire for what is unattainable. This longing is rooted deep within human nature, exemplified by the allure of forbidden love. The concept of Eros—passionate love marked by both pleasure and pain—drives the characters' actions, particularly as they yearn to overcome the obstacles in their path. This essay argues that the power of Romeo and Juliet lies in its portrayal of desire and the yearning for unity, which reflect fundamental aspects of human experience. The conflict and separation of the lovers create emotional tension that fuels the narrative, with the tragic ending amplifying the bittersweet sadness of their love. Ultimately, the story's timeless appeal stems from its exploration of idealized love, its psychological complexities, and the way Shakespeare crafts a romantic fantasy that transcends logic and reason. The play continues to captivate audiences due to its emotional depth and the human tendency to seek what cannot be had.

The Role of African American Culture in Fences

Primary Author:
Claire Harris

Faculty Advisor:
Monic Ductan, English

In Fences, a short play written by August Wilson in 1985, African American culture in the United States plays a prominent role in the characters' relationships Through it, Wilson seeks to bridge and expose the gaps between generations through two prominent things: music (blues and jazz) and baseball, which are both important in Black history and culture. Troy Maxson, the complicated lead of the play, is the patriarch of the Maxson family with only two children at the beginning of the play, Lyons and Cory; however, by the end of the play, we are introduced to his daughter, Raynell. Each of Troy's children has a sizable age difference that separates them from one another. Their relationship with their father is similarly distant for other reasons, be it physical or emotional absence or death. Even so, the culture that they share as Black Americans bridges, or further highlights, this distance, creating an interesting commentary on the role that such plays generationally in the creation of a larger identity: one that transcends any differences.

Much Ado About Nothing's Beatrice and Benedict as Shakespeare's Quintessential Lovers

Primary Author:
Emily Holman

Faculty Advisor:
Kristen Deiter, English

In this paper, I compare Beatrice and Benedict from Much Ado About Nothing to Juliet and Romeo from Romeo and Juliet in order to identify the quintessential Shakespearean couple. Romeo and Juliet are often regarded as the ultimate Shakespeare couple, the star-crossed lovers, by both fans of the bard and popular culture at large. But I believe that Beatrice and Benedict are the pair that best demonstrate William Shakespeare's skills at writing compelling romances. The comparison of the two couples is based on these four factors: shared history, compelling love language, maturity and insight at handling difficult situations, and support from friends and family. The star-crossed lovers meet and fall in love on the same night, speak their love in the style of Petrarchan sonnet, are young and handle difficult situations immaturely, and have their friends and family fighting against their love. On the other hand, Beatrice and Benedict had been in love with each other before their play began, use witty banter to flirt together, are mature enough to talk through their

tough patches, and have people around them backing up their relationship. Based on these criteria, Beatrice and Benedict are the true lovers of note in Shakespeare's body of work. I wrote this analysis of the relationships of Much Ado About Nothing and Romeo and Juliet for my Shakespeare course.

Laughing at Those Who Take: The Use of Humor for Resistance and Survival in Green Grass, Running Water

Primary Author:
Daisy Hudson

Faculty Advisor:
Brian Williams, English

American literature and art have long depicted Native Americans as savage and stoic, a trend which has continued into contemporary media. These stories took Native humor away and created the narrative that Indigenous people cannot be funny, due to either an inherent lack or a tragic past. However, Native Americans have been fighting to resist this narrative and prove such stories false. To combat this ideology, Indigenous authors have argued that their people must work with literature and art to reclaim their humor for resistance and survival against the stereotypes placed on them.

My paper delves into Thomas King's novel Green Grass, Running Water, and I argue that King uses parody and satire to reclaim Native humor. Instead of King coming right out and telling non-native readers about how comedic Native Americans are, he uses satire and humor to tell a story of Indigenous survival and resistance. In the novel, he proves that not only can Natives be funny, but humor itself empowers them to survive the assimilation and eradication they have suffered. Furthermore, the humor that King uses highlights resistance against the cliché division of Natives vs. Non-Natives. I argue that humor crosses boundaries and enables non-native readers to recognize the flawed stereotypes they have placed on Natives being savage and stoic. As a result, King tells a story about the importance of Native humor in resisting and surviving stereotypes while developing connections across cultures.

The Suppression of Native Identities: The Effects of Colonialism on Native Land in Tracks

Primary Author:
Sarah Keen

Faculty Advisor:
Brian Williams, English

Many works of Native American literature focus on identity; specifically, the struggles that Natives have faced historically and in modern day to preserve their heritages. Native works often depict the linguistic and cultural identity that colonialism stripped away; however, many Native cultures consider Natives and the land to be in a mutual relationship, where the land plays an integral part in developing and maintaining identity. Therefore, explorations of colonialism and resistance must also explore the taking over, renaming, and changing of Native land as tools to not just remove Natives from their land, but to eliminate Native identities.
In this paper, I will examine how Louise Erdrich's Tracks explores the land itself as a victim of colonialism. Erdrich analyzes the significance of land in individual Native identity within a larger context of culture, spirituality, and history. By reading the different narratives in Tracks, I argue that colonial changes to the lands affected Native identity as well as the ecological state of the land. Tracks supports that taking away Native presence, such as place names, from lands, impacts the environment directly, which further diminishes Native identity. Through Erdrich's exploration of the deep ties of place and identity held in Native cultures in Tracks, we can see that historical changes in lands caused by colonialism were another form of harming Natives. This consideration invites us to rethink contemporary devastation of Native lands as continued attempts to control and suppress Native identities. This paper was written for the course: Native American Literature.

The Generational Effects of Toxic Masculinity in Punch Me Up to the Gods

Primary Author:
Kyleigh Pitzer

Faculty Advisor:
Monic Ductan, English

In the memoir, Punch Me Up to the Gods, the author Brian Broome struggles with prejudice against him in several different ways. The issue I will be focusing on however, is the themes of toxic masculinity throughout the book and how they affect the author and the other people around him. Broome's father and friends all push the idea on him that he needs to be a tough, stereotypical Black man at that time. He cannot even find acceptance because he does not naturally fall under the umbrella of what society thinks that a Black man should be. The toxic masculinity also proves to be a generational problem and leads to kids that blindly follow

everything they are told by the older generation. Broome tells the stories of a young girl who is offered up to him for sex, and a young boy named Tuan on the bus who is being berated by his father for showing emotion. I will dive deeper into how generational toxic masculinity has affected Broome, the young girl, and Tuan. I will discuss the ways that toxic masculinity is taught, how it affects young girls and boys, and the importance of unlearning the stereotype.

Psychoanalysis of Shakespeare's Richard III

Primary Author:
James Searcy

Faculty Advisor:
Kristen Deiter, English

In The Tragedy of Richard the Third, Shakespeare defines Richard, Duke of Gloucester, by his lack of morality and desire for the throne of England. Throughout the play, many characters reaffirm that Richard is immoral, devilish, or ungodly. In this paper, by utilizing Freudian psychoanalysis, I explore Richard's hostile relationship with his mother, the Duchess of York, compare Richard's disposition towards the male and female characters throughout the play, discuss Richard's physical deformity and the resulting inferiority complex, and examine Richard's relationship to his masculinity to conclude that Richard is plagued with self-doubt and inner conflict rather than hellish intentions. Through a comprehensive analysis of these factors, my research seeks to provide a psychological interpretation of the motives behind Richard's words and actions within the play. This research proposes that the Duke of Gloucester's sinister impulses are built upon these psychological conflicts and aims to humanize Richard III as a neurotic man suffering from inner anxiety, uncertainty, and strife rather than being the defining Machiavel that literary history remembers. I wrote this paper for the course Topics in British Literature to 1667: Sixteenth-Century English Literature.

Environmental Sciences

Graduate Student - Doctoral

Integration of Local Business, International Specialty Supply, with Tennessee Technological University

Primary Author:
Olivia Cantu, NSF-NRT Spirit of Gadugi at the FEW Nexus

Co-Authors/Collaborators:
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Karen Wilson, International Specialty Supply Dessa Hix, International Specialty Supply

Faculty Advisor:
Pedro Arce, Chemical Engineering

International Specialty Supply (ISS), established in 1979 and based in Cookeville, Tennessee, is a globally recognized, vertically integrated business specializing in the production and distribution of sprouts, seeds and sprout-growing equipment. Operating primarily through a business-to-business model, ISS upholds values of safety, integrity, value creation and teamwork. Despite their global reach, ISS faces challenges penetrating the local market due to the niche nature of their products. This project aims to address International Specialty Supply's local market gap by developing a comprehensive business plan aligned with their core values and leveraging innovative marketing strategies.

Key recommendations include fostering community engagement through partnerships with Tennessee Tech University and regional organizations, creating visibility via local events and media and exploring collaborations with fitness centers, farmer's markets and nutrition shops. By emphasizing sustainability, community presence and customer engagement, International Specialty Supply can strengthen its regional influence, expand its customer base, and drive long-term business growth while fostering meaningful connections within the Upper Cumberland region.

Geosciences

Undergraduate Students

Morphometric Analysis of Flynn Creek's "Inverted Sombrero"

Author: Joshua Hillis

Faculty Advisor: Jeanette Luna, Earth Sciences

The Flynn Creek central uplift impact structure was formed in a shallow marine environment around 360 million years ago. The result of the impact formed a structure approximately 3.8km in diameter. After the impact, the crater was filled rapidly by marine sediments, which greatly influenced its preserved state. Despite these sediments covering much of the impact area, erosion along the Flynn Creek drainage area has exposed significant portions of the structure. These areas include the central uplift and parts of the rim. Factors such as these lead to it being one of the most well-preserved ancient impact structures in the world.

Due to portions of the Flynn Creek Crater being exposed at the surface, high resolution DEMs, along with drill cores, can be utilized to analyze the hypothesis of the "inverted sombrero" shape. This can be characterized by its annular, sloping rim which surrounds a nested bowl-shaped inner crater. By creating cross sections throughout the area of the impact structure, we should be able to determine features such as depth of the crater, rim height and central uplift characteristics. Additional analyses will compare Flynn Creek's morphometric parameters with other marine-target impact craters and incorporate subsurface data from USGS drill cores to further refine structural interpretations. Despite partial burial, the Flynn Creek impact crater still allows for comprehensive analysis by utilizing GIS tools. The goal is that by combining surface analysis with subsurface information we will be able to achieve a well-rounded understanding of the "inverted sombrero" morphology.

Hurricane Helene Post-Disaster Analysis of Tennessee and North Carolina Flooding: Estimating Peak Discharge and Comparison with FEMA Flood Zones

Author: Maggie Uehling

Faculty Advisor: Evan Hart, Earth Sciences

On September 27-28, 2024, Hurricane Helene caused severe flooding in western North Carolina and eastern Tennessee, damaged many stream gages, and several gages recorded stage heights that exceeded USGS discharge rating curves. This study estimates peak discharge for eight streams – four in each state – using peak stage measurements and LiDAR data. Elevation data from state agencies was analyzed in Esri's ArcGIS Pro to generate elevation profiles, and the Manning equation was applied to estimate peak discharge based on USGS stage heights. In Tennessee, estimated peak discharges range from: 150,000 ft^3/ sec for the Nolichucky River at Embreeville, 67,000 ft^3/sec for the Pigeon River at Newport, 105,000 ft^3/ sec for the French Broad River near Newport, and 28,000 ft^3/sec for the Doe River at Elizabethton. In North Carolina, estimated peak discharges range from: 140,000 ft^3/sec for the French Broad River at Asheville, 50,000 ft^3/sec for the Swannanoa River at Biltmore, 14,500 ft^3/sec for the Mills River, and 17,000 ft^3/sec for Cove Creek near Lake Lure.

Our initial results indicate that all locations experienced their largest recorded floods, except the French Broad River, TN. Post-flood imagery of the Nolichucky River, TN, the French Broad-Swannanoa River at Asheville and Biltmore, NC and the Broad River at Bat Cave, NC, was utilized in digitizing high water marks for comparison to FEMA-predicted 500- year flood zones. Our findings indicate that 40% of the Nolichucky, 7% of the French Broad-Swannanoa, and 25% of the Broad River digitized flooded area exceeded the predicted 500-year flood elevation.

Faults Associated with the Cumberland Plateau Overthrust, Spencer, Tennessee

Author: Juan Baez Trevino

Faculty Advisor: Michael Harrison, Earth Sciences

This field study focuses on the geospatial arrangement and description of faults and other geologic structures

that are present in rock outcrops around Spencer, Tennessee. These faults are associated with a larger regional feature called the Cumberland Plateau overthrust. The Cumberland Plateau overthrust is a network of faults that extend from the Emory River fault system near Kingston into the region of Spencer, Tennessee. These faults are part of a regional tectonic thrust sheet that formed in response to the formation of the supercontinent Pangea and the Appalachian Mountains. In Spencer, these faults were studied in outcrops of Pennsylvanian Sewanee Conglomerate, a 40-meter thick, yellow-brown, cross-bedded quartz sandstone.

Ongoing research has documented hundreds of centimeter- to meter-scale strike-slip faults with northeast and southeast trends that are often clustered together into fault-damage zones. These zones are often accompanied by white friable cataclasite that form talus slopes at the base of the outcrop. Thrust faults are also present but are not as abundant. Outcrop exposures 5 km east of Spencer show evidence of deformation in older, deeper rock including ductile structures in coal and veins in the Bangor Limestone. Some of these features were noted by Milici et al. (1965) but have not been extensively studied. Future work aims to understand how these faults relate to the regional tectonics of the Cumberland Plateau and how they influenced the local landscape and exposures of coal.

College of Business

Accounting

Undergraduate Student

Ollie's Effect: A Dive into Restraint Usage Post Visit Primary

Author: Aidnen Spires

Co-Authors/Collaborators:
Ashlyn Fults, Business Management Isabella Hale, Business Management Colton Berghoff, College of Business

Faculty Advisor:
Chelsea Dowell, Economics, Finance & Marketing

This study examines the impact of "Ollie the Otter," a safety education program, on child restraint usage during vehicle crashes in Tennessee. We got our data for Ollie the Otter from Tennessee Technological University's iCube, as well as Tennessee's Department of Transportation. We used this data to analyze child restraint rates by county and whether Ollie the Otter had visited that county or not between the years 2021-2023. Using the ordinary least squares regression model, this shows the relationship between variables like regions, number of visits, whether Ollie visited this county or not, and year. The results of our analysis suggest efforts targeted into Middle and West Tennessee, primarily in the counties with low restraint rates such as Beldsoe County, which could improve safety. The Ollie the Otter program helps not only the state of Tennessee, but if every state had a program like Ollie the Otter, it could be beneficial to communities across the country.

Business Administration

Graduate Students - Master's

The Financial Future of Tennessee's Public Universities: Risks and Sustainability
Primary Author: Mattea Trusty

Co-Author/Collaborator:
Ryan Salaman, Business Administration

Faculty Advisor: Sid Bundy, Accounting

State funding is critical to Tennessee's public universities, supporting operations, capital projects and student scholarships. However, financial pressures continue to mount due to declining enrollment, shifting policy priorities, and legislative changes. From 2015 to 2023, national college enrollment declined by 7.4%, with Tennessee experiencing a drop in its college-going rate. While 2023 saw a slight rebound, overall trends suggest continued financial challenges. Tennessee Technological University (TN Tech) has seen a 4.82% average increase in its operating deficit, raising concerns about funding adequacy and institutional sustainability.

Tennessee State University (TSU) is an example of why looking into a university's financial health is imperative. TSU saw a significant drop in enrollment and is now in a tough financial spot, possibly facing a $46 million deficit for the current fiscal year. By identifying key financial risks and disparities, this study displays the current financial situation and paints a picture of what may come.

This study evaluates TN Tech's financial health in comparison to five other Tennessee public universities and four peer institutions nationwide. Using audited financial reports and university dashboards, we examined trends in state appropriations, expenditures and revenue generation. The study also assesses how declining enrollment and shifting funding priorities impact TN Tech's financial stability.

Findings will inform policymakers, administrators and stakeholders on the current financial climate to ensure TN Tech remains financially sustainable while delivering high-quality education.

The Financial Impact of Cold Weather on Electric Utility Usage

Author: Robert Sircy

Faculty Advisor: Sid Bundy, Accounting

No one enjoys paying their electric bill, especially during the winter months when colder temperatures drive up energy consumption. Understanding how temperature fluctuations impact electricity usage can help consumers anticipate and manage increases in their monthly bills. This research quantifies the financial impact of cold weather on electric utility usage and gives residential customers the ability to estimate their future bills.

This study analyzes the relationship between monthly temperature variations and corresponding electricity usage. Average monthly temperatures were sourced from the National Weather Service, while electric consumption data was obtained from 10 customers served by Tri-County Electric Membership Corporation (TCEMC), a cooperative serving over 53,000 customers across Tennessee and Kentucky. TCEMC reported total revenues of approximately $144.5 million in 2024, with retail electricity sales accounting for 97.8% of revenue.

By examining trends over the past 10 years, the study identifies a clear correlation between lower temperatures and higher electricity usage. The analysis led to the development of an interactive widget that allows customers to estimate their utility bills by entering their historical average bill, a temperature threshold, and the number of cold days. This tool will also assist member service representatives with the ability to explain the fluctuations.

Beyond consumer insights, this research provides value to TCEMC's financial planning and reporting by examining how seasonal revenue fluctuations impact operating revenue, accounts receivable and cash flow. The findings may help the cooperative anticipate increases in income, adjust cash flow projections, and improve financial forecasting and strategic planning.

Economics

Undergraduate Students

Tennessee Tech: The Next OVC Powerhouse?

Primary Author:
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Dariusz Kuczynski, Economics
Elijah Phillips, Marketing
Maddux Richey, Economics

Faculty Advisor:
Chelsea Dowell, Economics, Finance & Marketing

This project focuses on the goal of raising funds for the new Tennessee Tech football stadium and facilities. The idea is to help out the Athletic Department, including Athletic Director Mark Wilson, and the Ticketing Office. Through this research we came up with a few ideas to increase revenue to fund the stadium that include but are not limited to merchandising, NIL opportunities, broadening concessions and playing a tougher strength of schedule.

The Educating of Teen Drivers

Primary Author: Gavin Edleson

Co-Authors/Collaborators:
Gretchen Mcguire, College of Business
Trent Bilbrey, College of Business
Malak Faisal, College of Business

Faculty Advisor:
Chelsea Dowell, Economics, Finance & Marketing

This project analyzes how to reach inexperienced drivers aged 15 to 19 more effectively. The authors determine if driving education campaigns are effective in different regions or if these regions need to do more or adjust these campaigns. The research question is whether driving education campaigns held at high schools actually decrease the overall crashes in each region of Tennessee. The data is from iCube, a non-profit organization. iCube is working with the Tennessee Department of Transportation. In this paper, we mainly use an ordinary least squares model. The main result was that as the number of locations increased by one, the number of crashes increased statistically significantly by about 174 crashes, holding all else constant. Additionally, we found that as the number of campaigns increased by one, the total number of crashes decreased by about three, But the result was insignificant. The conclusion is that these driving campaigns are not as statistically significant as one might think.

Finance

Undergraduate Student

From Policy to Practice: Evaluating U.S. Environmental Laws

Author: Chance Hale, 2024 CISE Recipient
Faculty Advisor: Nikki Panter, Biology

Since the passage of the Rivers and Harbors Appropriation Act of 1899, environmental laws in the United States have played a crucial role in conservation efforts. However, with increasing environmental challenges, such as habitat destruction, climate change and species decline, assessing which legislative measures have been the most effective has become imperative. This research, conducted as part of the Creative Inquiry Summer Experience (CISE) Grant, evaluated the impact of five major U.S. environmental laws:

1. The Migratory Bird Treaty Act of 1918
2. The National Wildlife Refuge System Act of 1966
3. The Marine Mammal Protection Act of 1972
4. The Endangered Species Act of 1973
5. The Magnuson-Stevens Fishery Conservation and Management Act of 1976

The project consisted of three phases: (1) data collection and analysis of legal documents, case studies and wildlife population data, (2) comparative assessment using criteria such as species conservation impact, habitat protection, regulatory compliance, stakeholder engagement and legal structure and (3) determining which law had had the most positive influence. The findings provided insights into the effectiveness of conservation legislation, offering a framework for policymakers to craft stronger environmental protections. This research not only enhanced legal scholarship but also served as a resource for future environmental advocacy and legislation.

College of Education & Human Sciences

Applied Behavior Analysis

Graduate Student - Doctoral

The Behavior Strategies During RTI^2 Implementation in Tennessee Elementary Classrooms: Teachers' Perspectives

Author: Wenyong Qu

Faculty Advisor:
Holly Anthony, Curriculum & Instruction

This qualitative study explores the experiences of elementary school teachers in Tennessee using behavioral management strategies within the Response to Instruction and Intervention for Behavior (RTI²-B) framework. The research examines how RTI²-B strategies implemented in the classrooms, including the implementation process, strategies, practical challenges, successes and contextual nuances of behavior management. Data were collected through interviews, document reviews and observations with three teachers in Tennessee. Findings contribute to the literature on RTI²-B implementation experiences from teachers' view and offer actionable insights into effective behavioral interventions to bridge the gap between theory and practice.

Counseling & Psychology

Graduate Student - Master's

Mad Topics in Education 2024: Building Partnerships With School Counselors to Support Teachers' Mental Health Literacy

Author: McClane Oakley

Faculty Advisor:
Kinsey Simone, Curriculum & Instruction

The most beneficial stakeholders for School Counselors (SC) are teachers (Atici, 2014), who observe student habits and can therefore offer greater insights into student behaviors. What can SC do to support their teachers in helping students? By expanding their mental health literacy, teachers can be more equipped to support students in collaboration with SC. This Mad Study examined data from a 2024 Mad Topics (MT) symposium hosted at Tn Tech (Tn MT) on Obsessive-Compulsive Disorder (OCD) and Attention-Deficit Hyperactivity Disorder (ADHD) in education, with a specific emphasis on the takeaways of attendees who were SC. While quantitative data were collected, this study was limited to qualitative data due to the small sample of present SC (two in-person out of 96 and one virtual out of ~75). Inductive analysis was used to interpret how SC can effectively use their knowledge to support teacher mental health literacy and in return better support their students, because of attending the panel. Findings indicated that the SC found the symposium beneficial, perceived increased understanding of OCD's and ADHD's "debilitating effects", and recognized the importance of mental health awareness. The 2024 Tn MT was perceived as beneficial for SC based on their perspectives; this type of intervention effectively resulted in increased SC understandings of OCD and ADHD in education. By expanding their knowledge and providing plentiful resources, MT symposia have the means to help SC educate their teachers on OCD and ADHD in education.

Undergraduate Students

A Phenomenological Examination of Existential Isolation among College Students Post-Pandemic

Author:
Gracie Conlon, 2024 Undergraduate Research & Creative Activities (URECA) Award Recipient

Faculty Advisor:
Matthew Zagumny, Counseling & Psychology

The study of existentialism focuses on the big five - death, meaningless, freedom, identity and isolation. Existential Isolation (EI) is the 'unbridgeable gap between oneself and any other being' according to Irvin D. Yalom. Existentialism's primary emphasis on death and meaninglessness often results in understudied existential isolation research. From this point, some scales look at the existential concerns separately, however, there is no reliable scale that looks at the five together. Looking at isolation separately, the focus is on the mental separation of person and environment. Participants were asked questions that dealt with physical separation but were asked to talk about feelings, emotions and thought processes. The findings showed that many experienced loneliness, relationship loss, trouble engaging in conversations, guilt and self-doubt. However, receiving outside support from others helped participants feel relief. With ongoing research, more participants will be questioned, more answers analyzed and future scale development.

Envy's Mediating Effects in the Relationship between Similarity and Performance

Author:
Joshua Thomas, 2024 CISE Recipient

Faculty Advisor:
Nicole Henniger, Counseling & Psychology

Envy is a subjectively negative emotion that arises after an upward social comparison and can increase subsequent task performance. Perceived similarity with the superior person is theorized to increase feelings of envy. Prosocial Behavior is a voluntary behavior to help another person. Study 1 sought to find out what traits Tennessee Tech students found warm, what accomplishments they found the most enviable and to clear up any confusions about the prisoner's dilemma. Study 2 seeks to test the full mediational model and to experimentally manipulate the perception of warmth as a unique way to affect perceived similarity, which should then affect levels of envy and performance. A sample of 166 participants will be recruited to participate in-person. After filling out their own profile, the participants will see a (fictitious) partner's choices of words to describe themselves, which are randomly assigned to be warm, neutral or cold in order to affect perceived warmth and thus perceived similarity. Participants will also see the partner's list of accomplishments they are proud of, which should serve as an upward social comparison. Participants will then be given two scales to measure envy, along with other responses to the comparison. To assess performance, participants will complete math questions, the Trail Making Test and report intentions to study. Two-Way ANOVAs will test group differences in envy and performance. The results of this study will assess whether similarity in perceived warmth has effects on envy and performance.

Curriculum & Instruction

Graduate Student - Master's

Group Morning Reading Sessions and Kindergarten Students' Academic Engagement: A Multiple Baselines Study in China

Primary Author: Yongmei Shi

Co-Author/Collaborator:
Krystal Kennedy, Tennessee Tech University

Faculty Advisor:
Kinsey Simone, Curriculum & Instruction

Academic engagement relates to children's learning outcomes (Fredricks et al., 2004); while structured morning routines may predict students' readiness to learn (Stevens et al., 2008), there is limited empirical research on these routines and engagement. This poster presents the proposed research design of a study to investigate kindergarten students' academic engagement throughout the school day in Daye City, China, with and without morning reading sessions. Additionally, we present a novel instrument created by Ms. Yongmei Shi, the Engaged Behaviors Tracking Table (EBTT), which will be formatively evaluated and modified prior to use based on pilot testing. The single-subject multiple baseline ABAB study will occur in fall 2025 with a sample of four kindergarten students in China who are identified as having difficulties with sustained academic engagement. Data collection will span seven weeks and will include staggered baseline observations without group morning reading sessions and intervention phases with sessions, using the EBTT to assess students' engagement levels. Descriptive and graphical statistical techniques will be used to examine behavioral trends.

The proposed study, including its design and instrumentation, is unique in that: (1) findings may bridge a gap in literature on instructional strategies in Chinese kindergarten classrooms, (2) the novel EBTT instrument can be adopted for comprehensive assessment of engagement behaviors across time periods and activities and (3) the chosen sample and method could produce implications for not only Chinese education but also bilingual students in American schools, contributing to cross-cultural education research and potentially benefiting Chinese ESL young learners.

Health Behaviors & Wellness Education

Graduate Student - Doctoral

Perceived Influences on Female Undergraduate Psychology Students' Career Choices

Author: McKenna Day

Faculty Advisor:
Holly Anthony, Curriculum & Instruction

This study explored the perceived influences on female undergraduate psychology students' career choices through an interpretivist lens. Given the limited literature on women in psychology and their career trajectories, this research aimed to provide insight into their perspectives. Using an interpretative case study approach, the study examined participants' experiences and perceptions of career influences. Data were collected through interviews and analyzed inductively to identify emerging themes. Preliminary findings suggested that female psychology students' career choices were shaped by personal interests,

faculty interactions and perceived barriers, such as limited exposure to applied psychology fields at the undergraduate level. Participants emphasized the importance of mentorship and practical experience in solidifying career decisions. These findings contribute to the broader discussion on gendered career pathways in psychology and highlight the need for increased support and guidance for undergraduate women navigating career options.

Literacy

Graduate Student – Doctoral

Policy and Performance: Understanding 3rd Grade Students' Achievement Before and After Implementation of Tennessee's Learning Loss Remediation and Student Acceleration Act

Primary Author:
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Co-Author/Collaborator:
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Faculty Advisor:
Kinsey Simone, Curriculum & Instruction

This study investigated Tennessee's Learning Loss Remediation and Student Acceleration Act and 1,335 3rd-grade students' English Language Arts (ELA) achievement, measured through the Tennessee Comprehensive Assessment Program (TCAP). Using a quantitative, correlational design, this research analyzed TCAP scores from students in one Tennessee school district before and after the policy's implementation. Hierarchical linear regression was employed to assess whether significant differences existed in ELA achievement before versus after policy implementation while controlling for sex, economically disadvantaged status, and prior ability. A moderation analysis was utilized via the PROCESS method to understand whether economically disadvantaged status moderated the relationship between policy implementation and 3rd-grade TCAP achievement while controlling for sex and prior academic ability. Results indicated that students assessed post-policy scored significantly lower than their pre-policy counterparts, suggesting that the law's implementation was associated with decreased achievement. Prior academic ability emerged as the strongest predictor of TCAP outcomes, while economically disadvantaged status did not significantly moderate the relationship between policy implementation and achievement. Additionally, females scored slightly lower than males. These findings highlight the potential unintended consequences of Tennessee's retention law and emphasize the critical role of early academic preparation. The study's results contribute to ongoing discussions about the efficacy of retention policies and their association with student achievement.

Program Planning & Evaluation

Graduate Student - Doctoral

Exploring Faculty Perspectives on AI Integration in Chemistry Education: Insights from a Qualitative Interview

Author: Mallory Matthews

Faculty Advisor:
Janet Isbell, Curriculum & Instruction

This qualitative study employed inductive analysis to explore faculty perspectives on artificial intelligence (AI) integration in chemistry education. Using inductive analysis, several key themes emerged, including student-focused teaching, generational gaps in technology adaptation and the evolving role of technology in teaching practices. Ethical considerations related to AI use also surfaced, along with discussions on AI as a useful tool, its impact on student retention and recruitment, and its broader integration into chemistry education. Findings revealed that AI's use in the classroom for higher education was perceived to be beneficial but came with concerns around academic integrity and the need for targeted professional development. The research question guiding this study was: How did chemistry faculty view the role of artificial intelligence in student learning experiences within their discipline? Based on an in-depth interview with a STEM faculty member, this study contributes valuable insights into the integration of AI in higher education and highlights the complexities and challenges involved in adopting AI tools in teaching practices.

Psychology

Undergraduate Student

Existential Guilt

Author:
Nick Wilford, 2024 Undergraduate Research & Creative Activities (URECA) Award Recipient

Faculty Advisor:
Mathew Zagumny, Counseling & Psychology

Experimental existential psychology explores five major concerns that all humans face: death, meaninglessness, isolation, identity and freedom. The existential concern of freedom arises from the choices individuals make and their responsibility for the outcomes. Existential guilt can emerge when individuals reflect on past choices and consider unrealized potential or alternative paths. Despite its significance, there is limited research on existential guilt and a lack of validated measures to assess it.

This study aimed to explore the experience of existential guilt and identify trends in its lived experience. Five participants were recruited and responded to a Qualtrics survey containing carefully designed access questions, followed by in-person interviews. Through a phenomenological analysis of participant responses, results indicated that existential guilt diminishes over time. Participants reported experiencing intense guilt directly before or after major decisions but described feeling more at peace with their choices as time passed. When choosing between spending time with family or friends, multiple participants prioritized family, even when it was not their personal preference. These findings suggest that existential guilt is strongly tied to perceived obligations and personal values but tends to lessen with time and acceptance. This study contributes to the understanding of existential guilt and freedom, offering insight into how individuals process the weight of their choices. However, further research is needed to develop a validated measure of existential guilt and explore its long-term psychological effects. ***Undergraduate Students***

Survival Processing Boosts LEGO Creativity

Primary Author: Dylan Taylor

Co-Author/Collaborator:
Spencer Moore, Psychology

Faculty Advisor:
Stephanie Kazanas, Counseling & Psychology

The current study extends investigations between creativity and cognition, using the survival memory paradigm (Nairne et al., 2007). Previous work demonstrates a robust, incidental memory advantage for words and pictures rated for their survival-relevance, relative to other scenarios, such as moving-relevance (Kazanas, 2021). Critically, these survival studies ask participants to reflect upon provided materials, such as whether 'a screwdriver' could assist them in a survival scenario. The current methodology diverges from previous studies investigating participants' attention and memory, and instead asks: Are participants more creatively engaged during survival processing than other types of processing?

Undergraduate psychology students were randomly assigned to build with red, blue, yellow or mixed-color LEGO bricks of varying sizes, shapes and functions. Participants built according to survival and moving instructions (order counterbalanced), and the number of objects (or tools, etc.) were summed and compared across survival and moving conditions, as were the number of bricks used for each build.

The results show survival instructions promoted significantly more builds ($p < .01$), with significantly fewer bricks ($p < .05$) than the moving instructions, suggesting both creativity and efficiency. Pictures of these builds will show the more numerous representations within the survival condition (e.g., canon, trap, lantern) relative to the moving condition (e.g., moving truck). Critically, this project contributes to the generalizability and replicability of the survival advantage, with materials beyond words and pictures. Of equal importance, it encourages researchers to return to in-person experiments, where these experiences inspire curiosity in students.

Defining Existential Identity Through Phenomenology: Steps Toward Scale Development

Primary Author:
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Belle Conlon, Counseling & Psychology
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Faculty Advisor:
Matthew Zagumny, Counseling & Psychology

Advancements in experimental existential psychology (XXP) cannot be made without first establishing valid definitions of each existential concern. This study was designed to examine underlying components and themes (meaning units) of Existential Identity (EID), and thereby use the concepts to form a valid, reliable measure of EID that can then be implemented into

scale development for future experimental existential research. Our phenomenological study collected participant responses to a series of access questions specifically formulated with the intent of prompting respondents towards the idea of self-authenticity, a previously proposed correlate/predictor of existential identity.

Participants' responses to the initial access questions and optional follow-up in-person interviews were analyzed for concurring themes. Notably, confidence in one's identity was associated with confirmation/validation of personal attributes and characteristics by others, specifically close friends and family. It is therefore important to consider the role of social validation of one's identity as it relates to defining existential identity in future XXP research.

Making Sense of Life: A Phenomenological Exploration of Coherence and Its Role in Life's Meaning

Primary Author: Christopher Stafford

Co-Author/Collaborator:
Nick Wilford, Counseling & Psychology

Faculty Advisor:
Matthew Zagumny, Counseling & Psychology

This phenomenological study examines the lived experiences of individuals in their search for meaning in life, focusing on the dimension of Coherence. According to Martela and Steger (2016), the meaning of life consists of three dimensions: Significance, Purpose and Coherence. This study will explore Coherence, defined as the "sense of comprehensibility and one's life making sense."

Understanding the Impact of Perceived Parental Marital Satisfaction on Adult Children's Depressive Symptoms: The Potential Mediating Role of Parental Authoritativeness

Author: Haley Kirk

Faculty Advisor:
Nicole Henniger, Counseling & Psychology

Adolescence is a delicate period for depressive symptoms to begin manifesting (Essau et al., 2020). In fact, research suggests that half of all adults who experience a mental disorder, such as major depressive disorder, reported experiencing symptoms during or before adolescence (Kessler et al., 2005). Further, family functioning and negative childhood experiences are predictive of depressive symptoms in adults (Beck, 2008; Cumsille & Epstein, 1994).

In this study, we examined how adult children's depressive symptoms relate to their memories of their parents' marital satisfaction during their adolescence and how perceived parental authoritativeness during adolescence may mediate this relationship. A sample of 116 undergraduate students took an online survey with scales measuring retrospective perceived parental marital satisfaction, perceived parenting style and current depression symptoms. Correlational relationships were found among the three variables; however, a regression analysis revealed a nonsignificant mediation effect. When accounting for parental marital satisfaction, authoritative parenting did not significantly contribute additional predictive value in the regression model. Marital satisfaction may already account for most of the variance in depressive symptoms, leaving little unique contribution from authoritative parenting, which may explain why each correlation was significant, but the mediation was not.

Sephora Kids: Does Aging Anxiety Increase Hopelessness in Young Adults?

Author: Zoe Bradshaw

Faculty Advisor:
Matthew Zagumny, Counseling & Psychology

Recent statistics show that young adults have adopted stricter anti-aging skin care routines and have increased mental health concerns. It was hypothesized that aging anxiety (AA) increased hopelessness in young adults. Ageism was hypothesized to predict AA with self-esteem acting as a cultural anxiety buffer, potentially impacting levels of hopelessness. We recruited 76 young adult participants. Ageism was measured using Kogan's Attitudes towards Older People. AA was calculated using the Aging Anxiety Scale. Hopelessness was measured using the General Hopelessness Scale. The Rosenberg Self-Esteem Scale measured self-esteem. The moderated, mediation was tested using a multiple regression analysis utilizing the Sobel test for mediation. The moderated and mediated results were both significant at $<.001$. The mediation is considered to be present after the Sobel test. These findings suggest that ageism and aging anxiety may increase hopelessness in young adults, with low self-esteem increasing the effect.

From Trends to Trust: Exploring the Factors That Influence Perceptions of Authenticity in Influencer Content Shifts.

Author: Anna Donalies

Faculty Advisor:
Matthew Zagumny, Counseling & Psychology

This study investigates the factors shaping consumers' perceptions of authenticity when an influencer transitions to a different content genre. Drawing on Nune's (2021) framework of six consumer judgments of authenticity—accuracy, connectedness, integrity, legitimacy, originality and proficiency—the research examines how these dimensions influence perceptions during such content shifts. Data will be collected through a qualitative online survey in which participants will respond to five open-ended questions by thinking back on examples of influencers' content and explain their authenticity judgments. Responses will be analyzed and coded to identify key themes and findings related to each factor.

Commitment Level as a Potential Moderator: Cross-sex Friendships Yielding Romantic Jealousy

Author: Kennady Campbell, 2024 URECA Recipient

Faculty Advisor:
Nicole Henniger, Counseling & Psychology

Cross-sex friendships can provoke jealousy in romantic partners, particularly when perceived as a threat to the relationship (Bleske-Rechek & Buss, 2001; Gilchrist-Petty & Bennett, 2019). The current study tests whether the level of commitment within a romantic relationship affects the intensity of this jealousy. Commitment can increase relationship stability but also can increase the value of the relationship, which could motivate more protective responses (Chung & Harris, 2018). Our study hypothesizes that stronger relationship commitment will intensify the jealousy elicited from a partner's cross-sex friendship. In an online survey, undergraduate students (N=195) from a university in Tennessee in relationships were randomly assigned to read hypothetical scenarios about their partner involving either cross-sex or same-sex friendships, both meant to induce jealousy. Participants completed the Communicative Responses to Jealousy Scale (CRJ), the Friendship Jealousy Measure (FJM), and the Investment Model Scale to assess commitment and jealousy. A multiple regression analysis revealed that commitment does not have a moderating effect on the model but that cross-sex friendships do incite more jealousy in romantic partners compared to same-sex friendships.

Parentification to Imposter Syndrome: The Roles of Perfectionism and Locus of Control

Author: Serephyne Bigger, 2024 URECA Recipient

Faculty Advisor:
Derrick Edwards, Counseling & Psychology

Parentification is associated with both positive and negative outcomes later in life, but some researchers have suggested that many of the risk factors for parentification mitigate the protective factors, leading to more overall negative outcomes (Schorr & Goldner, 2022). Parentification can also lead to identity issues and feelings of intellectual fraudulence, known as imposter syndrome (Castro et al., 2004). Additionally, an external locus of control strongly correlates with high imposter syndrome (Williams & Francis, 2010). In the present study, participants completed an online survey to measure parentification, perfectionism, imposter syndrome and locus of control.

Using regression analysis, we tested for an interaction between parentification and perfectionism and their effect on imposter syndrome, as well as the effects of locus of control in a moderated-mediation model. Using data from 109 participants, the results confirmed that parentification is positively correlated with both perfectionism and imposter syndrome. Furthermore, self-critical perfectionism significantly mediated the relationship between parentification and imposter syndrome. Locus of control did not directly correlate with the other variables in the study. These findings support the idea that addressing perfectionistic tendencies may mitigate the development of imposter syndrome in individuals affected by parentification.

Secondary Education

Undergraduate Students

The Generational Effects of Toxic Masculinity in "Punch Me Up to the Gods"

Author: Kyleigh Pitzer

Faculty Advisor: Monic Ductan, English

In the memoir "Punch Me Up to the Gods," the author Brian Broome struggles with prejudice against him in several different ways. The issue I will be focusing on however, is the themes of toxic masculinity throughout the book and how they affect the author and the other people around him.

Broome's father and friends all push the idea on him that he needs to be a tough, stereotypical Black man at that time. He cannot even find acceptance because he does not naturally fall under the umbrella of what society thinks that a Black man should be. The toxic masculinity also proves to be a generational problem and leads to kids that blindly follow everything they are told by the older generation. Broome tells the stories of a young girl who is offered up to him for sex, and a young boy named Tuan on the bus who is being berated by his father for showing emotion. I will dive deeper into how generational toxic masculinity has affected Broome, the young girl and Tuan. I will discuss the ways that toxic masculinity is taught, how it affects young girls and boys and the importance of unlearning the stereotype.

Laughing at Those Who Take: The Use of Humor for Resistance and Survival in "Green Grass, Running Water"

Author: Daisy Hudson

Faculty Advisor: Brian Williams, English

American literature and art have long depicted Native Americans as savage and stoic, a trend which has continued into contemporary media. These stories took Native humor away and created the narrative that Indigenous people cannot be funny, due to either an inherent lack or a tragic past. However, Native Americans have been fighting to resist this narrative and prove such stories false. To combat this ideology, Indigenous authors have argued that their people must work with literature and art to reclaim their humor for resistance and survival against the stereotypes placed on them.

My paper delves into Thomas King's novel "Green Grass, Running Water," and I argue that King uses parody and satire to reclaim Native humor. Instead of King coming right out and telling non-native readers about how comedic Native Americans are, he uses satire and humor to tell a story of Indigenous survival and resistance. In the novel, he proves that not only can Natives be funny, but humor itself empowers them to survive the assimilation and eradication they have suffered. Furthermore, the humor that King uses highlights resistance against the cliché division of Natives vs. Non-Natives. I argue that humor crosses boundaries and enables non-native readers to recognize the flawed stereotypes they have placed on Natives being savage and stoic. As a result, King tells a story about the importance of Native humor in resisting and surviving stereotypes while developing connections across cultures.

STEM Education

Graduate Student - Doctoral

Student Perspectives on the Transition from Eighth- to Ninth-Grade Mathematics

Author: Julia Grecol

Faculty Advisor:
Holly Anthony, Curriculum & Instruction

Since the TNReady assessment was introduced in 2016, the percentage of ninth-grade students scoring proficient in mathematics in Algebra 1 or Integrated Math 1 has dropped significantly from the number of eighth-grade students scoring proficient in eighth-grade math in the prior year. This interpretive case study was part of a research study that explored the transition from eighth-grade to ninth-grade mathematics from the perspective of students. For this case study, an 11th-grade student from a Middle Tennessee high school was interviewed. The transcript of the interview was then coded and categorized using an inductive analysis approach. The findings revealed several differences between both the structure and the culture of the two classes, which when added to the challenges of changing buildings, resulted in increased struggles for this student.

College of Engineering

Chemical Engineering

Graduate Student - Doctoral

Facilitating Interdisciplinary Team Communication via Card Decks in RFM Guided Approaches

Primary Author: Hoda Ross

Co-Authors/Collaborators:
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Faculty Advisor:
Robby Sanders, Chemical Engineering

Interdisciplinary collaboration is essential for addressing complex challenges at the intersection of food, energy and water (FEW) systems. This project presents a structured approach to enhancing teamwork within interdisciplinary groups through a card deck designed to facilitate communication, problem-solving and action planning. The framework integrates the Renaissance Foundry Model, critical thinking techniques, and community engagement strategies to promote holistic and effective collaboration. The card deck serves as a practical tool for guiding interdisciplinary teams in problem identification, ideation and the development of actionable solutions.

Key techniques include team role assignment, root cause analysis using the "5 Why's" method, and structured decision-making through the Hierarchy of Control framework. These strategies are applied to real-world challenges, such as water contamination, demonstrating their effectiveness in fostering innovative solutions. By emphasizing cultural training, interdisciplinary communication and systematic problem-solving, this project aims to bridge disciplinary gaps and enhance the efficiency of collaborative efforts. The proposed framework empowers teams to tackle pressing societal challenges, fostering sustainable and community-driven solutions.

Enhancing Acetaminophen Degradation in Wastewater Using TiO_2 Thin-Film and Suspension Photocatalysis: AOP Enhancers, Photocatalytic Kinetic Modeling

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Robby Sanders, Chemical Engineering
Sabrina Buer, Environmental Sciences

Faculty Advisor:
Pedro Arce, Chemical Engineering

The increasing presence of pharmaceutical contaminants in wastewater necessitates advanced treatment solutions. Advanced Oxidation Processes (AOPs) using TiO_2 thin-film and suspension photocatalysis offers a promising approach for degrading these pollutants. This presentation explores acetaminophen (ACT) degradation using AOP enhancers like hydrogen peroxide (H_2O_2) and aeration to boost reactive oxygen species (ROS) generation, including hydroxyl radicals ($\cdot OH$) and superoxide radicals ($O_2 \cdot -$). Aeration maintains a steady oxygen supply, enhancing ROS formation and improving contaminant mineralization.

Guided by the Renaissance Foundry Model (RFM), this study organizes knowledge acquisition through literature reviews and experimental research to optimize process parameters. Building on prior research from Tennessee Tech's Environmental Catalysis Group, a comparative assessment of thin-film and suspension photocatalysis evaluates catalyst stability, degradation efficiency, and system scalability. Photocatalytic kinetic modeling, inspired by Buer (2022) and Rawal (2021), applies pseudo-first-order kinetics and the Langmuir-Hinshelwood model to predict degradation rates. The study also examines film deactivation due to byproduct accumulation and radiation losses, both of which affect long-term performance. Knowledge transfer integrates experimental findings with modeling insights to develop a scalable, energy-efficient wastewater treatment prototype. This research aligns with the FEW Nexus and regulatory frameworks like the Clean Water Act (CWA). Collaboration with Cookeville Wastewater Treatment Plant ensures real-world applicability. Ultimately, the findings enhance TiO_2-based AOPs, contributing to sustainable and cost-effective water treatment solutions.

Fostering Holistic Understanding of Sustainability through a Mixed-Methods Study in Foundry-Guided Courses at Tennessee Tech. University

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This study examines how Teamwork and Communication as a sustainability principle was integrated and emphasized within a graduate-level course guided by the Renaissance Foundry Model (Foundry) at Tennessee Tech University. The Foundry is an innovation-driven learning framework designed to foster interdisciplinary collaboration, critical thinking and prototype development within real-world, community-centered challenges. The research context includes one Foundry-guided course in the Interdisciplinary Training at the Food-Energy-Water Nexus Graduate Certificate which incorporates the Engineering for One Planet (EOP) framework. The EOP framework outlines nine sustainability principles,

including Teamwork and Communication, Systems Thinking, Social Responsibility, Materials Selection and Environmental Literacy, fostering a holistic understanding of sustainable design. Students engage in prototype development addressing community-centered issues, promoting practical application of sustainability concepts. This study will focus on how Teamwork and Communication competencies, as defined by Integrated Communication measures, to evaluate how sustainability concepts are embedded and demonstrated in the learning process. Analysis will include an examination of curriculum concepts that helped students develop Teamwork and Communication competencies coupled with a preliminary quantitative analysis of rubric items relating to Integrated Communication. The findings aim to inform future course development and the broader integration of innovation-driven, sustainability-focused education in STEM fields.

A Novel Hierarchical Approach for Teaching Conservation Principles Based on a Learning Taxonomy

Primary Author: Shanae Tyree

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Faculty Advisor:
Pedro Arce, Chemical Engineering

Understanding conservation principles – such as mass, energy and momentum conservation – are fundamental concepts in chemical engineering education, yet inconsistencies in textbook presentations can lead to conceptual misunderstandings. After a review of various chemical engineering textbooks, several inconsistencies and potential sources of confusion in how the principles are presented were noted.

Structuring conservation principles within a hierarchical learning framework could foster a deeper understanding of how conservation principles apply across different engineering contexts. This contribution introduces the motivation and pedagogical foundations that led to the development of an innovative approach to solving total mass conservation by aligning it with a structured taxonomy of conservation principles. The proposed learning systematization framework integrates the Renaissance Foundry Model (RFM), an innovation-driven learning platform, which has shown great success for facilitating student learning in engineering courses. Leveraging the RFM as a systematic approach to understanding total mass conservation provides scaffolding for students to untangle complex assumptions related to these fundamental concepts.

Additionally, this systemization approach pairs the RFM with a well-known hierarchical model (Bloom's Taxonomy) as a visual aid to enhance student comprehension. The approach encourages critical thinking, minimizes confusion arising from inconsistent textbook presentations, and provides students with a systematic method for applying conservation principles in complex problem-solving scenarios. Implications for incorporating educational research methods and evaluative techniques will be discussed as part of this contribution, as well as future steps.

Quantitative and Qualitative Analysis of Microplastics in Cookeville Wastewater Treatment Plant

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Microplastics (MPs) are of increasing societal and scientific concern due to their environmental ubiquity and potential health effects. Wastewater treatment plants (WWTPs) are locations where waterborne MPs can concentrate at high levels, providing an opportunity to remove them in ongoing efforts to reduce this environmental burden. MPs have been found in oceans, rivers, protected areas, food, drinking water and nearly every conceivable environment. Wastewater treatment plants typically contain several microplastic particles, originating from commercial and household materials such as textiles, detergents, pharmaceuticals, cosmetics and packaging. In this study, guided by the Renaissance Foundry Model as our research approach, we collected, processed and analyzed wastewater from three different Cookeville Wastewater Treatment Plant units to perform a quantitative and qualitative analysis of microplastics and predict their behavior within the plant.

We collected samples from the influent, aeration tanks (biological reactor) and effluent. Then, we processed them through two-phase filtration and

digestion before analyzing them with a Microscope FTIR (Fourier Transform Infrared Spectroscopy) to obtain the necessary data. During the analysis, we observed fewer microplastics in the effluent but a higher concentration in the aeration tanks, suggesting the sludge-holding tanks capture most of them. This is important because the sludge, processed and used as fertilizer, still introduces a significant amount of microplastics into the environment despite fewer being released into the local creek. This study will guide future research on microplastic degradation, aiming to find ways to break them down before they reach the sludge and are released back into the environment.

Foundry-Guided Energy Sustainability Research at a Rural Appalachian Wastewater Treatment Plant

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This research focuses on understanding the viability of sustainable solution with respect to energy consumption by a Wastewater Treatment Plant (WWTP) in rural Tennessee. As part of the research conducted in this project, the Renaissance Foundry Model (Arce et al, 2015) was utilized to engage in design thinking processes to help not only identify challenges associated with this WWTP but also provide an insight to a viable and sustainable energy solutions. Originally built in 1984 and completed its expansion in 1995, this 14 MGD capacity activated sludge treatment plant that receives wastewater from more than 165 miles of sewer lines has undergone some updates and adjustment.

Although remarkable energy cost saving technology was successfully implemented in 2016, the energy costs still comprise of a large portion of the plant's operating cost. For example, in 2022, the utility expenses surged to nearly $500K and exceeded $550K in 2023. In addition to the energy cost, the insufficiency of the plant in completely removing the complex organic pollutants such as pharmaceuticals, microplastics, dyes and insecticides, among others is also an environmentally and socially pressing concerns. In this contribution, an overview of the Foundry-guided design thinking process as well as a viable prototype of innovative technology related to this challenge will be offered. Implications are made with relation to the rural community partner for this project, as well as the NSF-NRT Engendering the Spirit of Gadugi at the FEW Nexus program.

Impact of Selected Energy Measures on Cost, Energy Use, Payback and Emissions in Distilleries – A Field Data-Driven Approach

Author: Mohammad Seyed Sabour

Faculty Advisor:
Ethan Languri, Mechanical Engineering

Energy efficiency is a critical factor in optimizing production processes and reducing operational costs in distilleries, where energy-intensive systems such as boilers, compressed air and heat recovery play a significant role. This study analyzes recommendations from multiple industrial energy assessments conducted by the Industrial Training and Assessment Center (ITAC), focusing exclusively on distillery operations to evaluate the economic and environmental benefits of targeted efficiency measures.

A quantitative ranking framework is developed to compare recommendations based on implementation cost, payback period, energy savings, cost reduction and CO_2 emissions reduction. By applying a weighted decision model, this study identifies the most cost-effective and sustainable energy efficiency measures specifically for distilleries.

This research provides a data-driven strategy for sustainability in distillery operations, offering industry stakeholders a scalable ranking methodology to prioritize energy efficiency investments based on both financial and environmental impact.

Graduate Student - Master's

Wireless Gas Sensors in Soil

Primary Author: Christopher Elson

Co-Author/Collaborator:
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Faculty Advisor: Holly Stretz, Chemical Engineering

We are developing sensors to detect the microbial health of the soil, which could be used to reduce how much fertilizer, pest and herbicides, and reduce the carbon/energy footprint of farming. Respiration gases are the target, including CO2 and CH4. In the immediate part of the project we are evaluating the diffusion of various gases across an inexpensive Teflon membrane, formed from plumber's tape. CO2 diffusion rates have been measured using a unique experimental apparatus, bag diffusion. The rates have been determined to be fast enough to accomplish measurement chamber refresh within two minutes potentially with minimal or no pressure gradient, driven only by concentration gradient.

Undergraduate Students

Analysis of Trends in Corn Yield in Tennessee

Primary Author: James Rankin

Co-Authors/Collaborators:
Andrew Thompson, Agriculture
Clay Buchanan, Agriculture

Faculty Advisor: Lianqun Sun, Agriculture

Corn is grown in some form in every state in the United States of America. The state of Tennessee ranks 17th in the country in acreage dedicated to corn production. Every 5 years, the United States Department of Agriculture (USDA) conducts a census of crop production in the state of Tennessee. The USDA collects data on total farms and total acreage of corn production, as well as the total amount of corn harvested in bushels. For this report, data on farms, acreage, and bushels of corn harvested was compiled from every county in the state spanning from 1997 to 2022. From this data, trends in corn production across the state can be analyzed to understand the causes of these trends for each county and region, predict trends of corn production and provide solutions for a positive outcome for corn production in the future.

Modeling Heat Transfer Effects in Cancer Tumor Treatment: A Foundry Guided Plan

Author: Hailey Burroughs

Faculty Advisor: Pedro Arce, Chemical Engineering
Developing mathematical models for hyperthermia treatment in cancer tumors could eventually enhance significantly the effectiveness of the treatment. In this research plan, we present a strategy to construct a mathematical model for cancer treatment domains using the Renaissance Foundry model as the key guidance.

Focusing on a rectangular domain and by identifying key features of the heat transfer taking place within the cancer tumor, a transient mathematical model will be developed. Then, by taking particular cases of the heat transfer process, we will identify the role of the separation of variable technique for obtaining analytical solutions. Furthermore, the important Sturm–Liouville mathematical theory will be implemented for the determination of eigenvalues and eigenfunctions that allows to achieve the model solution via Fourier series. Illustration of these results will be presented as well as the suggested steps to achieve the description of more accurate models helpful for guiding doctors in the hyperthermia conditions most favorable for patient's treatment.

The Relationship Between Age and Cancer Risk: A Statistical Analysis

Author:
Emily Ender, Koltowich Engineering Scholarship

Faculty Advisor:
Kehelwala Maduranga, Mathematics

This data analyses age and risk of receiving cancer, and the risk of mortality to find a correlation between an increase in age and an increase in risk. This study aims to raise awareness across different age groups regarding the appropriate time to begin cancer screening. The data was run in R-Studio for summary statistics surrounding each age groups risk, the total risk and the risk of dying including mean, median, and standard deviation. The correlation between cancer risk and age was analyzed to determine their statistical relationship. A simple linear regression model was applied to examine the relationship between age and cancer risk. Statistical significance was evaluated using p-values and confidence intervals. Plots and graphs were calculated to visually compare the data more accurately. Overall, the means were vastly different between age groups, there is statistically significant data to support that the linear models intercept is not equal to zero ($p < 0.5$) and neither is the slope. There is a correlation between the plots and the increase in age compared to the risk of cancer, and the risk of mortality. As the age increases the cancer risk model spikes around age 40 but significantly lowers as age increases further. This study utilizes publicly available cancer risk datasets; therefore, no IRB approval was required.

White, Mary C, et al. “Age and Cancer Risk: A Potentially Modifiable Relationship.” American Journal of Preventive Medicine, U.S. National Library of Medicine, Mar. 2014, pmc.ncbi.nlm.nih.gov/articles/PMC4544764/table/T2/.

Multiscale Modeling of Ammonia Cracking Reaction: Investigating Solvent and Electric Field Effects

Author: Yulieth Mercado, Honor

Faculty Advisor: Ali Estejab, Chemical Engineering

The increasing global population and rapid technological advancements are driving a growing demand for energy. As a result, fossil fuel consumption continues to rise, despite its significant drawbacks. These fuels release large amounts of greenhouse gases into the atmosphere and are non-renewable resources. Hydrogen, as a clean energy carrier, is an attractive alternative since its combustion produces only water. However, hydrogen production and storage present challenges related to cost and safety. Ammonia (NH_3) offers a promising hydrogen source, requiring only about 5% of the thermodynamic cell voltage (0.06 V) needed to produce hydrogen from water.

To reduce the cost of hydrogen production via ammonia electrolysis, a deeper understanding of reaction kinetics is essential. While experimental techniques are the primary approach for studying kinetics, particularly on monometallic surfaces, theoretical modeling provides critical insights into reaction intermediates that are often undetectable through conventional methods. This is especially relevant for monometallic, bimetallic and polymetallic surfaces.

In this work, a multiscale modeling approach—integrating molecular dynamics and quantum mechanics—will be employed to study ammonia dissociation reaction through electrolysis on platinum catalyst. Solvent molecules will be explicitly simulated, and an external electric field will be applied to examine its influence on reaction mechanisms. The findings will be compared to the authors’ previous work, which did not consider solvent effects or electric fields, providing a more comprehensive understanding of the process and its potential for improved hydrogen production efficiency as well as effects of solvent and applied potential in the model.

Wireless Sensors in the Soil

Primary Author:
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Co-Author/Collaborator:
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Faculty Advisor: Holly Stretz, Chemical Engineering

Healthy soil produces crops that support food security and strong economics. Managing the chemical footprint without sensors in the soils leads to overfertilization, pollution and a poor energy and chemical footprint. The overall approach is to research and develop inexpensive wirelessly powered sensors for soil microbial health. These sensors, which detect respiratory gas levels using a micro-cantilever, must be protected from water, dirt and organisms. The chemical engineering team is developing a protective inexpensive membrane/envelope and mass transfer design. A simple over the counter PTFE film (plumbing tape) has been selected. Using bag diffusion, we determined the gas phase diffusion coefficient of CO2 at nominal low pressures/partial pressures. Data collected from the CO2 experiment showed that passive diffusion is a viable option for mass transfer design given the requested refresh time of two minutes. The membrane excludes water ingression. Diffusion coefficients are being coupled with mass transport calculations to inform device design for CO2 and CH4.

Civil Engineering

Graduate Student - Doctoral

Consolidation Behavior of Highly Overconsolidated Clays

Author: Brendan Atarigiya

Faculty Advisor:
Daniel VandenBerge, Civil & Environmental Engineering

Traditional consolidation methods developed for testing soft clays have typically focused on stress ranges between 0.8 and 1.5 MPa. However, a recent review of apparent yield stress has uncovered a significant phenomenon in highly overconsolidated clays, also referred to here as low void ratio clays, which exhibit two distinct yield stresses: an apparent yield stress and a primary yield stress. The apparent yield stress, consistently occurring at lower stress levels than the primary yield stress, has often been

attributed to factors including sample disturbance.

This study, however, conducted on laboratory-consolidated soils to eliminate the effects of disturbance, suggests that the apparent yield stress may be an inherent property of highly overconsolidated clays rather than a sampling or testing artifact. Tests on two clay soils across varying stress levels confirm this double-yield behavior, with the primary yield stress emerging only at higher stresses. Understanding this dual-yield phenomenon is essential for improving geotechnical design in critical applications such as slope stability, excavations, and the construction of dams and levees, and in recent times, the stability of deep radioactive waste repositories.

Computer Engineering

Undergraduate Student

Prototype Haptic Designs for Human-Machine Interfaces

Author: Katherine Larkins

Faculty Advisor:
J.W. Bruce, Electrical & Computer Engineering

Technology is pervasive in modern professional and personal life. Many traditional human-technology interfaces have limited effectiveness or are not practical for individuals with sensory impairments. Haptic feedback has proven to be an effective means of enhancing accessibility by providing tactile cues that enable alternative forms of interaction. For individuals with disabilities, haptic feedback can provide a crucial alternative communication mechanism. For non-disabled individuals, haptic interfaces can offer an additional channel for interacting with technology.

This work aims to create wearable haptic device prototypes to facilitate advancements in accessibility and human-computer interaction. The prototypes developed are capable of delivering vibrotactile feedback. These devices may be used in medical rehabilitation, augmented/virtual reality, human-machine interfaces, tele-robotics, training, simulation and education applications. The prototype haptic devices can be worn on the hand, the antebrachium (forearm), and brachium (upper arm). The glove device is designed to provide localized feedback to the fingers and palm, aiding in fine motor control. The antebrachium-mounted device offers broader feedback, delivering directional cues for movement, while the brachium device facilitates posture correction and overall arm positioning.

A flexible test regime is established to assess the device functionality and determine the most effective operation modes -- vibration patterns, timing, placement strategies, etc. Multiple form factors, such as gloves, sleeves and arrays of actuators, are considered to ensure both comfort and adaptability. Additionally, various materials and structural elements will be tested to ensure a secure and stable fit. This work focuses on device design and prototyping.

Computer Science

Graduate Student - Doctoral

System and Methods for Ongoing SMS Phishing Campaign Visualization, Monitoring and Characterization

Primary Author: Seyed Mohammad Sanjari

Co-Authors/Collaborators:
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Maanak Gupta, Computer Science
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Faculty Advisor: Mir Mehedi Pritom, Computer Science

Smishing (SMS phishing) is a growing cyber threat that deceives users to interact with fraudulent URL links or reply with sensitive information, such as name, address, date of birth and SSN. To tackle these threats, researchers have recommended preventive approaches like detecting individual messages. However, these approaches may not cover the broader pattern of coordinated attacks, which may leave many messages go undetected for a longer period. Since attackers try to remain stealthy by using different URLs, sender information and message templates, existing blacklisting-based and keyword-based detection techniques lack effectiveness.

In this work, we propose a new research direction where we propose to utilize graph-based visualization mechanism to continuously monitor smishing messages and connect these messages into campaigns and campaign-operations based on message templates and underneath web infrastructures (e.g., website domain names). Our proposed visualization system named SmsihViz can not only effectively group message campaigns that are targeted for the same theme and closely related templates but also connect

multiple campaigns of different topic themes to form campaign-operations connected with common web infrastructures.

Our proposed mechanism is effective because more than 88% of messages contain a URL, based on which analysts will be able to find campaigns that share infrastructures, indicating the same campaign owners. Furthermore, Smishviz system enhances threat intelligence and incident response by providing a structured and scalable method for smishing campaign graph analysis. Lastly, even though this method currently focuses on smishing, it can be effectively adjusted to other phishing threats.

Graduate Student - Master's

Adversarial Robustness and Explainability of Machine Learning Models for Cybersecurity Applications

Author: Seyed Mohammad Sanjari

Faculty Advisor: Doug Talbert, Computer Science

Machine learning (ML) plays a crucial role in modern cybersecurity by enabling automated intrusion detection, threat prediction, and anomaly detection. However, ML models are vulnerable to adversarial attacks, where manipulated inputs deceive classifiers, leading to potential security breaches. Additionally, the lack of interpretability in ML decision-making creates challenges for security analysts in trusting and verifying predictions. This research explores the dual challenges of adversarial robustness and explainability in ML models for cybersecurity applications. Using the NSL-KDD dataset, the study examines adversarial attack strategies, evaluates defense mechanisms such as adversarial training and input preprocessing, and integrates explainability techniques like SHAP and LIME to enhance model transparency. By bridging adversarial defense with Explainable AI (XAI), this work aims to improve the security, reliability, and trustworthiness of ML-based cybersecurity systems, ensuring effective threat detection and informed decision-making.

Face Counting Optimization Challenge

Primary Author: Jonathan Seals
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Israel White, Computer Science
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Faculty Advisor:
William Eberle, Computer Science

Accurately counting faces in images remains a crucial yet often difficult undertaking, particularly when dealing with overlapping subjects, scale variations, and cluttered backgrounds. In this project, multiple face-counting approaches—including YOLO, Faster R-CNN, CSRNet, DeepFace, and direct regression methods—are systematically explored. The dataset, derived from the Vista CodeFest challenge, provides labeled images encompassing both sparse and dense crowds, complete with bounding box annotations and overall face counts. By measuring each model's performance through Root Mean Squared Error (RMSE), this project aims to uncover the strengths and limitations of various strategies. Additionally, an ensemble model is evaluated to see whether combining these approaches can further enhance accuracy. Through this comparative analysis, the project seeks to offer a practical perspective on which method—or combination of methods—is most effective for robust face counting in real-world applications.

Comparing Deep Reinforcement Learning and Traditional Methods for Adaptive Portfolio Management

Author: Blaine Swieder

Faculty Advisor: Doug Talbert, Computer Science

In this project, we will aim to provide a comparative analysis of Deep Reinforcement Learning algorithms for optimizing algorithmic trading strategies; more specifically, Proximal Policy Optimization, Advantage Actor-Critic, and Deep Q-Networks. Our principal goal is to identify which deep learning architecture delivers superior risk-adjusted returns when applied to dynamic financial markets. Moreover, to establish a performance benchmark, we will utilize traditional machine learning models such as gradient boosting machines and deep neural networks to provide further evaluation. We will utilize historical price data, technical indicators (that is, MACD, RSI), and macroeconomic variables, as well as interest fluctuations, to create a robust trading environment. The models will be trained and tested across multiple different market regimes, bullish, bearish and sideways, to allow a comprehensive assessment of adaptability and robustness. In addition, we will measure performance using key financial metrics such as the Sharpe Ratio, Sortino Ratio, Maximum Drawdown and annualized returns. In addition, this project will incorporate cost analysis to assess real-

world trading viability and evaluate the impact of market volatility on algorithmic performance. The expected outcome of this project is to generate empirical insights into the comparative strengths and limitations of each algorithm, which will offer practical guidance for developing robust data-driven trading strategies in dynamic financial environments.

Can AI distinguish between AI-generated vs. Human Art

Primary Author: Ethan Owens

Co-Authors/Collaborators:
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Faculty Advisor:
William Eberle, Computer Science

With the rapid advancement of generative AI, distinguishing AI-generated art from human-created pieces has become an increasingly relevant challenge. This study explores the ability of Convolutional Neural Networks (CNNs) to classify and differentiate AI-generated and human-made artwork by analyzing learned visual features. Using a dataset of 270,000 images spanning 27 artistic genres, we trained a CNN model to detect subtle distinctions, such as inaccuracies in fabric rendering, facial structures and shadow details. Our model achieved an overall accuracy of 98%, though performance varied by genre, with lower accuracy observed in complex styles such as Baroque, Realism and Romanticism. Future work includes expanding our research to modern AI art techniques and testing the model's capability in identifying AI-generated content beyond traditional artwork.

Undergraduate Student

Predicting Length of Stay: A Machine Learning Approach to Hospital Resource Management

Primary Author: Riley Grimaud

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The COVID-19 pandemic exposed inefficiencies in hospital management, with prolonged patient stays straining healthcare systems. Accurately predicting patient length of stay (LOS) can improve resource allocation, treatment planning and patient outcomes. This research explores machine learning approaches for LOS prediction using hospital and patient data from Analytics Vidhya's Healthcare Analytics Hackathon.

We begin with exploratory data analysis (EDA) to identify patterns and relationships between factors such as hospital type, patient demographics and admission details. Key insights from EDA inform data preprocessing steps, including handling missing values, encoding categorical variables and feature scaling. Treating LOS as a classification problem, we evaluate logistic regression, neural networks, random forest, XGBoost, and k-means clustering. Logistic regression serves as a baseline due to its simplicity and interpretability, while random forest and XGBoost leverage ensemble learning to improve accuracy and highlight key predictors. K-means clustering helps identify patient groups with similar characteristics. Neural networks are powerful models that perform complex deep learning tasks by recognizing patterns. Model performance is assessed based on accuracy and consistency, aligning with the competition's evaluation criteria. Our findings contribute to improving hospital management by enabling more efficient patient flow and resource distribution.

Advancing Foundry Training Through Virtual Reality: A Low-Cost, Immersive Learning Environment

Author:
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Traditional metal casting foundries present hazardous working conditions, making traditional training methods costly and time consuming. Virtual Reality (VR) education and training has been shown to be an effective solution to otherwise dangerous or difficult methods. With advancements in VR technology, low-cost, immersive and realistic simulations of many manufacturing processes can be built to serve as training and educational tools.

This study investigates how VR training in metal casting can serve as a cost-effective and safe

alternative or supplement to the dangerous conditions that early training in metal casting creates. Built using Unreal Engine, the VR simulation replicates key foundry processes, such as furnace operation, crucible handling, mold preparation, casting and post-processing. The system offers interactive training steps to improve hazard recognition and procedural accuracy in the virtual foundry environment. Preliminary findings have shown that VR training creates transferable skills and increases safety awareness, allowing a virtual foundry training tool to reduce training costs and injuries in newer or younger workers. While challenges such as haptic feedback limitations and accessibility in current VR hardware exist, VR training tools present a scalable, cost-effective approach to industrial training. This research highlights the transformative potential of VR in training and manufacturing safety, showing significant potential for widespread adoption in many industries as technologies improve.

GoDaddy Microbusiness Density Forecasting Project

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The microbusiness density forecasting project focuses on using data science and machine learning to predict the density of microbusinesses in United States counties by month. Microbusinesses are defined as businesses with an online presence and fewer than 10 employees. The density of these businesses will be calculated as the amount of businesses per 100 citizens of majority (people over the age of 18) per U.S. county. Utilizing data provided by Kaggle, we plan to leverage tools like linear and polynomial regression to forecast what future microbusiness density will be. We additionally plan to retrain and optimize our models using SMAPE as the performance metric. This allows us to also compare our model's efficacy to the current Kaggle competition winners. The end goal of the project is to accurately predict microbusiness density in the US to give prospective interested parties a two-year head start on the collected census data.

Forecasting River Flow Volumes: A Machine Learning Approach to Predictive Hydrology

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This project investigates the application of machine learning techniques to forecast river water volumes using historical flow data. The dataset comprises monthly water flow measurements collected over several years from various rivers across different geographic locations. By leveraging both temporal (month, year) and spatial (location) dimensions, the study aims to uncover underlying seasonal patterns and long-term trends that influence river behavior.

We employ a range of predictive models, including time series forecasting and ensemble methods, to generate accurate predictions of future water flows. The data preprocessing phase involves handling missing values, normalization and feature engineering to enhance the models' ability to capture seasonal variability and other environmental factors. Model performance is evaluated using standard metrics such as RMSE and MAE. Preliminary results indicate that machine learning approaches can outperform traditional statistical methods, offering a more robust framework for anticipating future water availability. These findings have significant implications for water resource management, environmental planning, and the mitigation of risks associated with extreme hydrological events.

Predicting Regional Temperature Anomalies Using Climate Model Data

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William Eberle, Computer Science

Accurately predicting regional temperature anomalies is a critical challenge in climate science, essential for mitigating the risks associated with extreme weather events and long-term environmental changes. This project investigates whether temperature anomalies

at a regional scale can be effectively predicted using historical and neighboring climate observations.

Our study utilizes data from the Climate Forecasting 2022 challenge by CNRS, which includes 10 years of surface temperature anomaly data from 22 climate models. The dataset comprises 3072 global points, with target data representing average temperature anomalies for 192 regions over the next five years. Key features include spatial coordinates, time, mean and variance of observed anomalies. Model performance will be evaluated using two primary metrics: the coefficient of determination (R^2), which assesses how well predicted values align with observed data, and reliability, which measures the accuracy of the spread in predictions. By exploring the predictive power of historical climate data, this research aims to contribute to more accurate regional climate forecasting, ultimately supporting climate adaptation and resilience efforts.

Football: Can you guess the winner?

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Sports analytics has become an increasingly integral part of professional sports, whether it be for sports betting, fantasy leagues or general discussion, it's becoming more and more sophisticated as technologies get better. In this research, we will take a look at numerous attributes that make up a team, from team-wide statistics to player specific statistics within the team. Given two teams, our models will determine the game winner or if the game ends in a draw. The teams themself come from many different leagues, so the matchup may be domestic or international. Our models will have to decide based on the strongest features of each team to get a high accuracy result.

Cross-Sell Prediction

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The problem we are trying to solve is to predict whether current health insurance policy holders for our client will also be interested in vehicle insurance or not. The goal of this solution would be to identify current customers who would be interested in vehicle insurance so that our client can more effectively market vehicle insurance to those customers. We do this by using data about customers, including demographic data, vehicle data and previous insurance data and combining that with our data models.

Predicting Diabetes in the Unites States using Logistic Regression

Author: Gavin McDuffee

Faculty Advisor:
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Early detection of diabetes is crucial for effective treatment and prevention. This study evaluates whether logistic regression is a suitable model for predicting diabetes using demographic and health indicators. If effective, this approach could aid early diagnosis and intervention strategies.

The dataset, sourced from Kaggle, contains 100,000 patient records with 17 features, including age, sex, BMI, HbA1c levels, blood glucose levels, hypertension, heart disease status, 5 Booleans describing race and smoking history. To ensure model validity, the study tests for multicollinearity between features using Variance Inflation Factor (VIF) and evaluates performance with accuracy, precision, recall and F1-score.

Preliminary results suggest that logistic regression provides reasonable accuracy but may struggle with complex relationships between variables. The assumption of linearity could limit its predictive power, particularly for interactions between health indicators. Future studies should explore alternative models such as random forests and decision trees, which do not require linearity and can capture non-linear patterns in the data.

These findings highlight the strengths and weaknesses of logistic regression in medical predictions. While logistic regression remains a strong baseline model due to its interpretability and efficiency, further research should compare it with more advanced techniques, such as support vector machines (SVMs)

and ensemble models, to identify the most effective approach for early diabetes detection.

Multilingual Natural Language Inference: Classifying Logical Relationships Across Languages

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William Eberle, Computer Science

In this project, we address the task of Natural Language Inference (NLI), focusing on classifying the logical relationship between pairs of sentences as contradiction, entailment, or neutral. This task is inherently challenging due to the complexity of human language, including diverse phrasing, implied meanings and contextual subtleties. The difficulty is further amplified by the multilingual nature of our dataset, which spans over 15 languages and introduces additional linguistic variations that impact sentence interpretation. Our dataset, sourced from Kaggle, contains labeled sentence pairs that reflect a wide range of languages, structures and writing styles. To tackle this problem, we aim to develop a model capable of accurately identifying logical relationships across linguistic boundaries. Model performance will be evaluated through cross-validation, and we will conduct an in-depth analysis of common misclassifications to guide future improvements. Ultimately, our goal is to create a robust, language-agnostic NLI model that generalizes well and effectively captures the nuanced relationships between sentences in a multilingual context.

Identifying Disasters with Natural Language Processing

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The modern prevalence of social media has enabled communication much faster than what was available in even the recent past. As a result, alerts of disastrous situations can reach news and relief organizations more quickly than would otherwise be possible. However, manually monitoring millions of posts daily is impractical, necessitating automated systems to expedite this process. Human language is interspersed with figures of speech that overlap with similar statements that have literal meanings. As such, it can be difficult for a machine to distinguish between those posts that are announcing real disasters, and those that are not.

Our project leverages a Kaggle-hosted dataset consisting of over 7,500 manually labeled tweets categorized as disaster-related or non-disaster-related. Using this dataset, we aim to train machine learning models to accurately classify tweets based on detected patterns and similarities. To enhance the data's interpretability for our models, we will apply Natural Language Processing (NLP) techniques to make the data more manageable for machine learning. The NLP tasks, along with our data analysis and model development, will be carried out through the utilization of various Python libraries. Our primary objective is developing a model capable of effectively identifying real disaster tweets while minimizing false identifications of unrelated posts. Successfully achieving this balance will significantly enhance the efficiency of news and disaster response agencies, enabling quicker and more precise responses to genuine disaster situations while filtering out irrelevant social media noise.

Analyzing Global Happiness

Author: Michael Clinton

Faculty Advisor:
Mary Daniels, Computer Science

Happiness is a key indicator of well-being, but what factors influence it most? This study examines the relationship between economic, social and political factors and national happiness using data from the 2021 World Happiness Index. The goal is to determine whether GDP per capita alone drives happiness or if other factors play a larger role.

Using data from 149 countries, multiple regression was applied to identify significant predictors of happiness. ANOVA was conducted to analyze regional differences in happiness scores, while ordinal logistic regression was used to determine the likelihood of a country ranking in the top or bottom quartiles of happiness.

The results show that while GDP per capita has a strong positive correlation with happiness (r = 0.79), other factors, such as freedom to make life choices (r = 0.60) and corruption perception (r = −0.42), also play significant roles. Notably, some lower-income countries ranked higher in happiness than wealthier nations with political instability, suggesting that beyond economic status, governance, personal freedoms and social support contribute significantly to well-being.

These findings challenge the assumption that wealth alone determines happiness and highlight the importance of improving governance, reducing corruption, and enhancing personal freedoms to increase national well-being. Future research should explore causal relationships and policy implications in greater depth.

Monet creation using a Gan

Primary Author: Kenneth Adams

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Faculty Advisor:
William Eberle, Computer Science

Our research is using a generative adversarial network (GAN) in order to create 7,000 Monet style images. The GAN should be able to produce images that look like Monets and produce a large amount of them. In order to do this the GAN will be made of two neural networks: a generator model and a discriminator model. The generator will be the model that creates all the images while the discriminator will judge the images. The generator will try to make the discriminator believe that the generated images are real Monets. The final art submissions will be judged by MiFID (Memorization-informed Fréchet Inception Distance) which is the standard for evaluating GANs by comparing them against real images. The data comes from the Kaggle competition, "I'm Something of a Painter Myself" in the form of four datasets: monet_tfrec, monet_jpg, photo_tfrec, and photo_jpg. The monet directories contain Monet paintings for reference, and the photo directories contain photos that are going to be turned into Monet style using the GAN.

Electrical Engineering

Graduate Students - Doctoral

Design of a Robust Observer for Sensorless Speed Control of Multi Three−Phase Synchronous Reluctance Motor Drives

Author: Musayyibi Shuaibu

Faculty Advisor:
Ali Rizvi, Electrical Engineering

Advancements in electric machinery and drives are pivotal for industrial automation, vehicle electrification and all-electric propulsion systems. Thus, the demand for high-power and high-speed motor-drives. Multiphase motor designs are considered as solutions to increase in power and speed ratings. Furthermore, sensorless control of motor-drive systems brings about cost-effective operations. Therefore, dynamic modeling of observer-based speed estimation is established for nominal three-phase systems.

However, these design settings are not applicable to multiphase machines due to complexity of flux interactions between the various groups of windings hosted in the same stator. The advantages of multiphase machine design could be extended if sensorless control is explored. Recently, a dynamic model and speed controller were designed for a triple three-phase synchronous reluctance machine (TTP-SynRM). Moving forward, a speed sensorless controller will be designed based on the estimation of the extended flux linkage of the TTP-SynRM. First, the estimated flux linkage will be used for the calculation of absolute position (rotor angle) and motor speed. These quantities will then replace encoder readings in the feedback control of the overall motor-drive system.

Machine Learning Based Maximum Volume Change Prediction of Battery Electrode Materials

Author:
Mary Vinolisha Antony Dhason, Hasan A. Hejazi Memorial Endowed Engineering Scholarship

Faculty Advisor: Doug Talbert, Computer Science

Batteries power many devices, from electric vehicles to portable electronics. Battery electrodes expand and contract during charging and discharging, which can cause damage over time. Predicting these volume changes is important for designing stable batteries. This study explores machine learning (ML) methods

to predict the maximum volume expansion of battery electrode materials. Traditional approaches, such as experiments and simulations, are expensive and time-consuming. ML offers a faster and more efficient way to make predictions. Using data from the Materials Project, this study applies an XGBoost model to estimate volume changes. Explainable AI (XAI) techniques, such as SHAP, identify key material properties influencing expansion. The findings aim to improve battery design, enhance durability and support the development of safer energy storage solutions.

Efficient Operation of Modular Multilevel Based DC-DC Converter for Distributed PV plants in HVDC Transmission

Author: Mohamed Mansour

Faculty Advisor:
Indranil Bhattacharya, Electrical & Computing Engineering

The rapid growth in HVDC grids is becoming inevitable for long-distance power transmission. Therefore, the idea of interconnection between the point-to-point links becomes essential. However, these point-to-point connections face several challenges such as the requirement of DC fault blocking capability, interfacing of different grounding schemes, offering multi-vendor interoperability, and difficulty to achieve high DC voltage stepping. DC-DC converters are considered the optimum solution to tackle these challenges in DC grids interconnection. This paper investigates the integration of distributed PV plants in HVDC applications as a renewable energy resource. A minimized backflow power technique is proposed to reduce the RMS current under varying voltage gains, mitigating the effects of PV system voltage fluctuations. To enhance performance, a thyristor-based modular multilevel converter (MMC) is employed, chosen for its advantages such as reduced conduction losses, a smaller footprint, and cost-effective implementation.

Graduate Student - Master's

Enhancing Flood Forecasting in Connectivity-Challenged Regions Using LoRa-Based IoT and Machine Learning

Author: Grace Dadzie

Faculty Advisor:
J.W. Bruce, Electrical & Computer Engineering

Flood detection in rural and remote areas is often hampered by limited monitoring infrastructure and poor cellular connectivity, leaving vulnerable communities at high risk. This project presents a novel, cost-effective flood monitoring solution that integrates Internet of Things (IoT) technology with a dual-network communication strategy. Initial attempts using a cellular-based sensor in a remote canyon at Window Cliffs State Natural Park failed due to inadequate connectivity in this isolated and challenging terrain. The challenging topography created unreliable communications connectivity, so a repeater network using a custom LoRaWAN protocol was developed. In this configuration, a LoRa transmitter collects water level data from the sensor, forwards it to a repeater that extends the communication range and finally relays the data to a gateway situated at the surface where cellular access is reliable. Additionally, a lightweight multi-layer perceptron (MLP) model was trained to predict flood events using the collected sensor data, demonstrating promising results in early flood warning. This integrated approach addresses connectivity challenges, significantly improving data transmission reliability in remote, flood-prone areas. The solution is scalable and adaptable, offering a robust platform for real-time flood monitoring, forecasting and enhanced watershed management.

Undergraduate Students

Design of a Magnetocardiography Device

Author: Dakota Moye, 2024 CISE Recipient

Faculty Advisor:
Ali Alouani, Electrical & Computer Engineering

An electrocardiogram (ECG) is the primary technique to observe and measure the heart activities. However, ECGs require electrodes to be placed on the skin. These electrodes cause irritation and obstruct everyday activities. The attachments are not reusable and cause waste. ECGs rely on detecting the electric field from the heart. On the other hand, every moving charge produces a magnetic field. This magnetic field can be detected and analyzed like the electric field. A magnetocardiogram (MCG) uses this principle and is an alternative to ECGs. MCGs can be designed to be completely noninvasive, where detectors are unobstructive and reusable. The goal of this project is to design an MCG that can detect the magnetic

field produced by the heart. Due to the weak signal produced by the heart, this will require signal processing and filtering techniques. A sensor will need to be designed and constructed using proper implementation.

Ferrite Core Optimization of Spiral Planar DD Coil for Efficient Wireless Power Transfer Applications

Author: Tuan Kiet

Faculty Advisor:
Indranil Bhattacharya, Electrical & Computer Engineering

While wireless power transfer (WPT) has been commercialized in many designs, its application in electric vehicles (EVs) remains limited due to the challenges posed by power transmission efficiency. The coil structure and its core configuration, including shielding, play a crucial role in improving power efficiency. Although the Spiral Planar DD-Coil has demonstrated high efficiency, modifications can still enhance the WPT performance. This paper optimizes DD-Coil parameters and proposes an optimized ferrite core structure to minimize weight while maintaining low power losses. Our results indicate that the new core structure not only provides better efficiency compared to the shaped-bar core but also performs comparably to the traditional rectangular core. Additionally, our findings show that increasing the initial radius of the coil enhances power efficiency, while highlighting the trade-off between core thickness and core power loss.

Engineering Technology

Undergraduate Student

Golden Eagle Green Ecosystem (GE)^2

Author: Jake Officer

Faculty Advisor:
Ismail Fidan, Manufacturing & Engineering Technology

As the demand for 3D printing continues to rise, so does the need for sustainable and cost-effective processes on college campuses. This process for converting discarded water bottles into high-quality Fused Filament Fabrication (FFF) filament offers a sustainable solution to the growing plastic waste problem. The proposed method combines plastic bottle recycling techniques with filament extrusion technology to create a closed-loop system. It also outlines the process for creating and maintaining a system to allow students and faculty to print parts while removing waste from campus.

Mechanical Engineering

Graduate Students - Doctoral

Pressurized Testing of Solid Oxide Fuel Cells Utilizing Desulfurized Jet Fuel

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Faculty Advisor:
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A tubular solid oxide fuel cell (SOFC) was successfully tested at multiple pressures using pre-desulfurized JP-8 in Tennessee Tech's pressurized SOFC test stand. Polarization curves were acquired at 1,2,3, and 4 BarA and SOFC peak performance was found for each. These tests were run as fixed-flow-rate polarization curves due to the small amount of fuel needed for the single cell testing. A baseline hydrogen curve was also run at 1 BarA as a baseline and it was found to perform better than jet fuel at lower pressures.

As expected, jet fuel at 3 and 4 BarA produced a higher peak power density when compared to the baseline 1 BarA hydrogen test. After the test stand was cooled down and disassembled, suspected carbon deposits were found throughout the colder portions of the test setup. Specifically, it was found on the anode inlet heat exchanger as well as inside the SOFC itself. It is unknown if this occurred during testing or during cool down or if it had any effect on the performance of the SOFC.

Enhanced Performance of Nanoparticle-Infused Polymers: Characterization, Post-Processing and Vibration Analysis in Material Extrusion

Author: Vivekanand Naikwadi
Faculty Advisor:
Ismail Fidan, Manufacturing & Engineering Technology

Material Extrusion (MEX) is a widely used additive manufacturing (AM) technique that builds 3D

structures by depositing semi-molten thermoplastic materials layer by layer. The incorporation of nanoparticles, particularly Multiwalled Carbon Nanotubes (MWCNTs), introduces new possibilities for enhancing material properties, making this an emerging focus in AM research. This study explores three key aspects of nanoparticle-infused MEX technology. First, it examines the mechanical behavior of both virgin polymers and MWCNT-reinforced composites, assessing the impact of post-processing techniques such as annealing, vapor smoothing, and epoxy coatings on their mechanical performance. Second, it investigates the vibrational characteristics of these materials, analyzing parameters like damping coefficient, logarithmic decrement, and natural frequency before and after post-processing. Lastly, this research evaluates the effects of processing techniques at the micro level, optimizing carbon weight percentages to mitigate nanoparticle agglomeration. The findings contribute to the development of advanced fabrication strategies for producing high-quality 3D-printed components with enhanced mechanical strength, dimensional stability, surface finish and vibration resistance.

A Radiative Cooling Review for Engineering Applications

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Faculty Advisor:
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Heat generation and the management of that heat are common problems to address in engineering applications. These thermal management systems require energy input to achieve proper cooling. A promising passive cooling technology is radiative cooling. Radiative cooling materials can achieve a subambient temperature even during peak solar incidence. The high emissivity of these materials within the infrared atmospheric window allows for thermal radiation to be exchanged with space instead of the upper atmosphere. A high reflectivity of the solar spectrum allows for the daytime heat gain to be reduced. At a solar reflectivity above 90%, a net cooling effect can still be achieved due entirely to thermal radiation heat transfer.

Recent research has shown that paints can be synthesized with a comparatively low cost that can be applied easily while still exhibiting strong radiative cooling properties. Other materials such as multilayered nanostructures create a composite radiative cooling structures that utilizes each layer to achieve the desirable radiative properties. A limitation of radiative cooling is the requirement for the surface to have a high sky view factor, the surface must be exposed to the sky with minimal blockages. To remove this reliance, a mid-infrared reflector can be utilized to increase the sky view factor and increase the radiative cooling capacity. In this work, the underlying physics, existing research and some of the unique future research pathways are presented.

Development of High-Efficiency Cooling Systems for Electronic Modules Using PCMs and Bionic Geometries

Author: Mohsen Pourfallah

Faculty Advisor:
Ethan Languri, Mechanical Engineering

Efficient cooling remains a significant challenge in the development of modern electronic components. Thermal management is critical to the efficiency, performance and durability of electronic devices, as operating temperatures directly influence these factors. Traditionally, electronic modules are cooled using external heat sinks or cold plates, relying on air or liquid cooling. However, these conventional techniques often fail to provide adequate cooling or maintain uniform temperature distribution across the modules.

PCMs offer a promising alternative due to their superior heat capacity compared to air cooling, and higher temperature uniformity than liquid cooling. However, PCM cooling systems face challenges, such as low thermal conductivity and difficulties in fully releasing the absorbed heat, which can lead to reduced heat transfer efficiency and a sharp decline in heat dissipation capacity. To overcome these limitations, metallic foams such as aluminum and copper have been proposed to enhance the thermal conductivity of PCMs. Given the low thermal capacity of air, maximizing the heat transfer area becomes essential. While conventional fins are widely used to increase heat transfer surfaces, they often cause significant pressure loss. The bio-inspired design aims to enhance the heat transfer area with minimal pressure loss, offering a more efficient cooling solution. The ultimate goal of this research is to design a compact cooling system for electronic modules, such as microprocessors and CPUs, that achieves low weight, high efficiency and reasonable cost.

Lithium-Ion Battery Thermal Management Using Multi-Scale Porous Foams with Phase Change Materials for Electric Vehicles

Author: Mohsen Pourfallah

Faculty Advisor:
Ethan Languri, Mechanical Engineering

The shortage of fossil fuel resources and the increasing environmental pollution from conventional vehicles have driven us to increase the use of Electric Vehicles (EVs) and Hybrid Electric Vehicles (HEVs), as they are eco-friendly, long-lasting and safer. The performance and lifetime of batteries in all environment temperatures rely on the thermal management system. An optimal Battery Thermal Management System (BTMS) should be able to maintain the maximum battery surface temperature and minimize the temperature difference. A hybrid cooling strategy including phase change material (PCM) and multi-scale metal foam is being proposed in this research to improve the thermal management system during charge and discharge.

In this study, the experiments are carried out on different charge and discharge rates to measure the surface temperature of the 18650 lithium-ion cylindrical battery. The electrical circuit model (ECM) is employed to simulate the heat generation and temperature distribution in lithium-ion battery on environmental temperature. The simulation results of surface temperatures at three different locations during charge and discharge were validated by comparing the experimental curves at various charge and discharge rates ranging from 0.5 to 2.5C under the natural convection heat transfer. Then heat transfer and phase change flow inside a cylindrical Li-ion battery enclosure filled with a metal foam embedded in PCM are evaluated numerically. Single, two, and four layers of aluminum and copper metal foam with uniform and non-uniform porosity and pore density (PPI) were considered to present a comprehensive thermal analysis.

Graduate Students - Master's

Development of Epoxy-Infused Composite Materials for Enhanced Isotropy and Watertightness in 3D-printed Structures

Author: Mushfig Mahmudov

Faculty Advisor:
Ismail Fidan, Manufacturing & Engineering Technology

Additive Manufacturing (AM) is gaining widespread recognition for its ability to produce complex geometries with high precision. Despite its advantages, AM components often suffer from limitations such as anisotropy caused by layer-by-layer construction, weak interlayer bonding and directional infill patterns. Moreover, waterproofing remains a significant challenge for 3D-printed parts exposed to water.

This study proposes a novel approach to overcome these issues by developing a new composite material with enhanced isotropy and watertight properties. The methodology involves the combination of different materials—primarily ABS, carbon fiber-reinforced ABS (CF ABS) and ABS with fiberglass (ABS FG)—and customized infill designs fabricated using Material Extrusion (MEX) technology. Infill patterns such as gyroid, simple cubic and body-centered cubic (BCC) are employed at various lattice sizes to create voids for subsequent epoxy infusion. The epoxy resin is selected based on its curing time, viscosity and compatibility with the glass transition temperature (Tg) of the 3D-printed material to ensure thermal and mechanical stability. To ensure complete resin infiltration and eliminate air bubbles, the infusion process is conducted in a vacuum chamber using a custom-designed system that allows simultaneous epoxy pouring into multiple specimens. After curing for seven days, tensile and compression tests are conducted to evaluate the mechanical properties of the new composite material. Preliminary results indicate the feasibility of the proposed materials and methods, with significant potential for applications in the marine industry, particularly in the construction of boats, underwater drones and similar water-exposed systems.

Fatigue Behavior of Nanoparticle-Reinforced Polymers in Material Extrusion

Author: Elijah Hudson

Faculty Advisor:
Ismail Fidan, Manufacturing & Engineering Technology

Additive manufacturing, specifically material extrusion, has become a defining technology of the current digital revolution in manufacturing, offering rapid prototyping and the creation of bespoke

geometries that enable new levels of material efficiency in many fields. Due to being limited to thermoplastics, the adoption of material extrusion has been limited in areas where high strength is needed, however recent advancements in using carbon fiber thermoplastic composites have alleviated this.

A more recent breakthrough in the field of composite material extrusion printing is implementing carbon nanotubes into the matrix material, a combination that improves resistance to electrostatic discharge, a highly desirable quality in robotics and other fields where electronics are implemented. However, due to this being a more recently adopted material, its mechanical properties are largely unknown, hindering its widespread use. This study undertakes the task of analyzing the tension fatigue properties of carbon nanotube infused PETG and ABS, comparing these to virgin materials and determining that the inclusion of carbon nanotubes hinders the fatigue resistance of both materials compared to virgin.

Undergraduate Students

Finding Weld Path Geometries with Deep Learning

Author: Scott Schmitz

Faculty Advisor:
Stephen Canfield, Mechanical Engineering

Collaborative robots are quickly finding commercial success in the US manufacturing sector with an increasing number of small and medium enterprises expanding automation via robotics for the first time. These robots mitigate the initial complexity of installation and operator training. This can be used in welding operations where operators are required to have technical expertise in welding in addition to robot operation skills. One large limitation of robotic welding applications for products that have a low volume and complex geometries is the time upfront that it takes to train the weld path. Methods to automate or correct the weld path generation process can significantly improve overall efficiency. One of the sensors used to identify weld seams is a laser line profiler. Defining the profile is generally done with closed form approaches. This work investigates the approach of creating a solution by development of a neural network to serve as an object detector of key features returned from a laser line profiling of a typical weld seam. A description of the experiment, design of the neural network, training and results are presented.

Development of a Combustor for Integration with a Solid Oxide Fuel Cell Bundle for Hybrid-Electric Aircraft Power Applications

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As the aviation industry continues to address the environmental impacts of aircraft operation, hybrid electric propulsion systems have been identified as a potential solution. These hybrid electric aircraft engines could incorporate solid oxide fuel cells as a relatively lighter weight means of electric power generation, when compared to traditional batteries.

However, several issues have arisen with regard to their integration within these larger propulsion systems. Two of which are the need for continuous thermal control of the fuel cell bundle during operation and the combustion of excess fuel exhausted from the fuel cell bundle. Both issues can be addressed with the implementation of a robust combustion process of the anode-off gas with the incoming cathode air supply. An investigation was conducted to develop a combustor capable of maintaining a robust flame for a variety of flowrate conditions imitating operation with an SOFC bundle when fed a CH4/Air mixture.

College of Interdisciplinary Studies

Chemistry

Graduate Student - Doctoral

A Comprehensive Adsorption Study of Simazine Interactions with a Range of Microplastics: Mechanisms and Environmental Implications

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Microplastics are well-known vectors for the transport of organic contaminants, and the ubiquity of microplastics has raised growing concerns about their potential adverse effects on ecosystems and human health. Pesticides, such as Simazine, a second most widely used chlorotriazine herbicide, are one of the frequently found organic contaminants alongside MPs in aquatic environments. Due to its moderate persistence, limited biodegradability and high ecological toxicity, Simazine has become a significant environmental concern. Despite the growing awareness of both MPs and Simazine contamination, the interaction between these two pollutants has been underexplored.

This study focuses on understanding the adsorption of Simazine onto two common types of microplastics, polyethylene terephthalate (PET) and polystyrene (PS). Using Liquid Chromatography-Mass Spectrometry (LC-MS/MS), we investigate the adsorption and desorption dynamics under environmentally relevant concentrations of Simazine (2.5 mg/L). Batch experiments are conducted to explore the influence of environmental parameters on adsorption, including variations in pH (6.5 to 9), temperature (25°C to 27°C), and contact time, simulating conditions under which aquatic organisms can survive in surface waters. Additionally, kinetic models and isothermal equations are applied to elucidate the adsorption mechanisms.

The results of this work will be applied to future studies, including the assessment of toxicity arising from the interaction between microplastics and Simazine, further enhancing our understanding of their combined environmental impact and informing the development of effective mitigation strategies.

Environmental & Sustainability Studies

Graduate Student - Doctoral

Foundry Guided Sustainable and Innovative Designing of the Tennessee Tech's Engineering Building Site Storm Water Retention Pond into the Curriculum

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The stormwater retention pond located by Ashraf Islam engineering building provides opportunity to integrate sustainability practice into engineering design that not only complements curriculum but also creates value to the community. With the goal to reduce the amount of pollutants in stormwater and improve the quality of surface water, the university's Municipal Separate Storm Sewer System (MS4) permit allows it to discharge this stormwater into local water bodies. With the proposal of developing it into a sustainable design of technical and administrative operation and management, our team blended following key concepts in this project design— (1) Adapting murmuration pattern for enhancing teamwork spirit; (2) EOP and Biomimicry principles; (3) Renaissance Foundry Model; (4) Design Thinking concepts; (5) Community Engagement and (6) Analysis of optimization loop among Desirability, Viability, and feasibility.

Undergraduate Students

A Water Quality Assessment of a Reclaimed Coal Mine at Meadow Creek Park

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Operating for 18 years in the late 1900s, Clear Creek Coal Mine has left its mark on Monterey, TN. Specifically, in the form of Acid Mine Drainage (AMD) at Meadow Creek Park, located at the site of the closed mine. This occurs when old mines expose rock to water and air, which reacts chemically to form sulfuric acid. This acid dissolves heavy metals from nearby rock, contaminating water sources. Through visual observation and water sampling, we can determine that this process is occurring at the park.

Over the course of this project, we've tested for various things including pH, heavy metals and oxygen content. In doing so, we've specifically found high levels of iron, manganese, aluminum and low levels of oxygen, all of which are indicators of pollution. Our research has shown connections between each of these factors and an unhealthy ecosystem, including reduced biodiversity and health impacts on humans, so restoring this ecosystem is essential to mitigating the long-term effects of past mining activity. Moving forward, our goal is to find natural and economically mindful ways to boost and restore the ecosystem at Meadow Creek, including constructing a wetland and lime dosing.

Index of Biotic Inventory at Meadow Creek Park

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The Cumberland Plateau is recognized for its current and past use for agriculture, mining and homesteads. Located in Monterey, TN, lies a 19.0-mile stream within the Obey River watershed. Our research focuses on assessing the general health of the stream by conducting a biological inventory of the fish species present. Our sampled areas comprise part of a coal mine reclamation site known for leaking acid mine drainage afflicted water into the stream.

We conducted an Index of Biotic Inventory (IBI) with Tennessee Wildlife Resources Agency biologists on two different portions of Meadow Creek. With the collected data, we compared our sites' stream health to other sites within the watershed on the Cumberland Plateau. Meadow Creek's IBI scored "very poor." This was because the stream had low diversity, and all inhabitants are rated as tolerant species. In comparison to other streams on the plateau, the biota score was slightly below average. In the future, we aim to gain data on macroinvertebrates to determine how the stream conditions are affecting non-fish species and minimize possible confounding variables. Additionally, we will be working with other teams on riparian buffer projects to improve stream water quality and increase stream biodiversity.

Restoring Meadow Creek Park: Designing a Riparian Plant Border for Ecological and Community Benefits

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Meadow Creek Park, located in Putnam County, TN, encompasses a 90-acre lake and an expanding network of hiking and biking trails under development by the town of Monterey. Previously a coal mining site, the park now serves both as a recreational space and a secondary water source for the community. This study examines the park's natural area and plant life to develop a riparian plant border designed to enhance water retention and filtration into the lake, improve habitat for local wildlife and provide visual and educational benefits for park visitors.

The proposed plan integrates ecological restoration principles to support both conservation efforts and public engagement. By implementing this riparian plant border, Meadow Creek Park can further its transformation from a former mining site into a thriving ecological and recreational resource that benefits both the environment and the community.

Romeo and Juliet: The Human Nature of Romantic Love

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William Shakespeare's "Romeo and Juliet" remains one of the most enduring tales of tragic romance, with its central theme of forbidden love. The play's narrative, in which the lovers are kept apart by familial conflict and fate, taps into the universal human desire for what is unattainable. This longing is rooted deep within human nature, exemplified by the allure of forbidden love. The concept of Eros—passionate love marked by both pleasure and pain—drives the characters' actions, particularly as they yearn to overcome the obstacles in their path.

This essay argues that the power of "Romeo and Juliet" lies in its portrayal of desire and the yearning for unity, which reflect fundamental aspects of human experience. The conflict and separation of the lovers create emotional tension that fuels the narrative, with the tragic ending amplifying the bittersweet sadness of their love. Ultimately, the story's timeless appeal stems from its exploration of idealized love, its psychological complexities and the way Shakespeare crafts a romantic fantasy that transcends logic and reason. The play continues to captivate audiences due to its emotional depth and the human tendency to seek what cannot be had.

Whitson-Hester School of Nursing

Nursing

Graduate Student - Master's

Effectiveness of Simulation-Based Training on Undergraduate Nursing Peripheral IV Education

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Peripheral intravenous (PIV) catheterization is a fundamental nursing skill that requires technical precision and clinical judgment. However, traditional training methods often fall short in providing adequate opportunities for skills development. Simulation-based training (SBT) offers a promising alternative, providing a realistic and controlled environment to enhance students' knowledge, skills, and confidence.

The aim of this integrative review is to explore the effectiveness of SBT in improving undergraduate nursing students' PIV insertion skills. A comprehensive literature search was conducted to identify relevant studies published within the past five years. The findings suggest that SBT can significantly enhance students' knowledge acquisition and skill performance and reduce anxiety associated with PIV insertion. SBT can bridge the gap between theory and practice by providing repeated practice opportunities, immediate feedback, and a safe learning environment. SBT implementation in nursing education can positively impact patient care by improving the quality and efficiency of PIV insertion procedures. Further research is needed to optimize SBT methodology and assess its long-term impact on clinical outcomes.

Undergraduate Students

Maternal and Neonatal Outcomes for Home Births with a Midwife Versus Hospitals with a Provider

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Taking a natural holistic approach to pregnancy and delivery is becoming much more common for women who are or plan to become pregnant. Numerous women now consult midwives to create a pregnancy plan for the length of the entire pregnancy. The use of midwives and home births has increased in the past decade. Women often contemplate whether they should attend a hospital or have a home birth and midwife for their delivery and guidance. This literature review plans to compare the maternal and neonatal outcomes of midwife home births versus hospital births.

This study will use Google Scholar, PubMed, CINAHL, DOAJ, GALE, Nursing and Allied Health. The search terms to be used are: Hospital vs. Home births, Neonatal Maternal Outcomes, Hospitals and Birthing Centers, and Obstetrics vs. Midwifery. This focused literature review will search for peer-reviewed literature between 2008-2025, low-risk pregnancies for women under the age of 35, international studies, and studies exclusively in English. Exclusion criteria for this search include: High-risk births, studies conducted prior to 2005, and studies that did not include a licensed OB or midwife. This focused literature review aims to examine the positive and

negative outcomes for newborns and mothers when the birth takes place in hospitals versus homebirths.

Ewing Sarcoma

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Ewing sarcoma is an aggressive and rare cancer that occurs in children, adolescents and young adults. It is mostly found in bones and soft tissue and is a genetic mutation, not inherited. It has a high survival rate if caught early and treated aggressively. It is commonly misdiagnosed because it can present as sports injuries, growing pains or infections. This topic was chosen because a family friend was previously diagnosed with this cancer and unfortunately passed away. The purpose of this study is to determine why Ewing sarcoma targets specific age groups, understand the disease process, as well as how it is diagnosed, signs and symptoms, treatment and prognosis.

This focused review aims to learn more about Ewing Sarcoma along with its disease process, signs and symptoms, treatment and the percentage of children and adolescents with a good prognosis after treatment. This study will use PubMed, Eagle Online, and Google Scholar. The search terms to be used are: Ewing Sarcoma in children and adolescents, disease process, signs and symptoms, treatment, and good prognosis. The focused literature review will search for peer-reviewed literature between 2007-2025. Exclusion criteria for this search include: studies that are not peer-reviewed, written in English, any source written before 2008 and articles concerning adults with Ewing Sarcoma. This focused review aims to learn more about Ewing Sarcoma along with its disease process, signs and symptoms, treatment and the percentage of children and adolescents with a good prognosis after treatment.

How Food Dyes Effect Children's Behavior

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The number of children/adolescents with behavioral health issues has been on the rise for over 25 years. There has been a drastic increase in diagnoses of ADHD, anxiety and depression, with a possible common link to the dyes that are used in foods, drinks and medicines for children. Although there is an increase in awareness of this problem, the main issue of diets in these children continues to be overlooked and not addressed as a potential solution to this issue.

The regular consumption of synthetic food dyes in children may increase the risk of developing behavioral disorders as opposed to children who do not consume artificial dyes. Studies have shown links between the consumption of artificial dyes and issues such as hyperactivity, restlessness, irritability and other behavioral concerns. This study will use the search engines: CINAHL, Google Scholar, and Nursing Allied Health. The search terms to be used are: food dyes, artificial dyes, behavioral effects, children, pediatrics, food dyes and behavioral health. This focused literature review will search for peer-reviewed literature between 2012-2025. Exclusion criteria for this search include studies conducted on populations older than 18, studies not researching food dyes consumed by children and studies that didn't focus on the behavioral impacts of artificial food dyes. The aim of this focused review is to observe how the repeated consumption of synthetic dyes impacts behavioral health in children.

Support for Caregivers of Mental Degenerative Diseases

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Support for caregivers of mental degenerative disease patients is an overlooked issue in today's world. A study showed a total of 65% of those caring for people with an intellectual disability experienced increased burden, and 35% of carers of people with an intellectual disability and another condition experienced more severe loneliness. Deterioration of the caregivers' mental and physical health can negatively affect the patient care. Educating the caregiver population on resources, activities and programs designed to help them is crucial to benefiting both parties.

The aim of this focused review is to examine what opportunities are available and beneficial to caregivers with mental degenerative disease patients. This study will use Eagle Search, Google Scholar and CINAHL databases. The search terms that will be used are: caregiver burnout, caregiver strain, resources for caregivers and support groups for caregivers with mental degenerative disease process patients. This focused literature review will search for peer-reviewed literature between 2015-2025. Exclusion criteria for this search include: studies not peer-reviewed, articles written before 2015, studies that don't focus on support for caregivers with patients with mental degenerative diseases.

Evaluating the Effectiveness of Aromatherapy on Pain Management in Hospitalized Patients

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Pain is the most common symptom experienced by hospitalized adults. Pain management is often a controversial issue due to the misuse of narcotics and scheduled drugs. Many hospitalized patients experience pain from surgery, labor, chronic conditions and acute injuries. There are protocols in place that limit in-patient narcotics, creating a need for alternative and non-pharmacological therapies. Aromatherapy is a potential solution to this pain.

The introduction of essential oils for aromatherapy can help to decrease pain ratings in hospitalized patients as well as offer an alternative to patients who would like a non-pharmacologic approach to their pain. Scholars say that patients who receive opioid prescriptions after short-stay surgeries have a 44% increased risk of long-term opioid use. This review will focus on the use of essential oils for aromatherapy to decrease pain levels.

The search engines to be used are Google Scholar, CINAHL, and the National Library of Medicine. The search terms to be used are: pain, aromatherapy, pain management, essential oils, aromatherapy and decreasing pain levels. The focused literature review will include peer-reviewed literature between 2010-2025, hospitalized patients, and patients 18 years old and above. Exclusion criteria are studies that used another population other than hospitalized patients, studies that did not include aromatherapy as an intervention, articles written before 2010, and studies that do not focus on pain management. The aim of this focused review is to explore how aromatherapy has contributed to pain management in hospitalized patients.

Normothermic Regional Perfusion in Relation to Quality and Viability of Organs from Deceased Donors

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In normothermic regional perfusion, blood flow is reintroduced to the organs at normal body temperature after the heart stops beating. This mimics the conditions of normal circulation allowing for some organ function to be restored. The primary goal of this focused literature review is to examine if this practice reduces organ rejection from donor to recipient and potentially increases the pool of viable organs for donation after DCD/DBD. The review will use the search engines CINAHL and Google Scholar. The search terms that will be utilized: Normothermic regional perfusion (NRP), donors after circulatory death (DCD), and donors after brain death (DBD). This focused literature review will search for peer reviewed literature from 2015-2025. Exclusion criteria from this search includes: altruistic donation, xenotransplantation, autologous transplants, tissue donation and living donation. The aim of this focused review is to examine how restoring blood flow after death preserves organs for transplant. We will examine if the benefits of using NRP improves organ quality and viability during procurement.

How Does Accessibility to Prenatal Care Affect Expecting Mothers

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Accessibility to prenatal care is a problem that affects expecting mothers across the country. These issues can stem from: lack of transportation, finances, insurance coverage, lack of providers and lack of patient knowledge. The overall health of the soon-to-be mother can be directly impacted by the lack of prenatal care. Through the course of this focused review, we will be using Google Scholar, PubMed and National Institute of Health search engines. The key terms in this study include: prenatal care, mother, accessibility, finances, insurance, barriers, and physician accessibility. Inclusion criteria for this review include peer reviewed literature from the years of 2015-2025. Exclusion criteria of this review include articles that include care of the baby, studies that do not pertain to the mother and prenatal care and articles written before 2015. The goal of this focused review is to explore the issue regarding accessibility to prenatal care.

Physical Injuries Related to the Overuse/Misuse of Physical Restraints Within the Elderly Population in the Hospital Setting

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The use of restraints in the hospital setting has become an overall, widespread concern that affects different populations and healthcare settings all over the world. The elderly population is disproportionately susceptible to the use of restraints, specifically physical and chemical. Elderly patients are already at an increased risk for long-term negative health outcomes, and the misuse or overuse of restraints can further increase this risk. Some of the biggest reasons for restraining elderly patients may include disease processes impacting mental status, physical outburst related to mental status, polypharmacy and medication side effects. Researchers discovered that approximately one in 20 Emergency Department (ED) visits among older adults resulted in chemical sedation or physical restraint use, and increasing age was associated with increased restraint use.

The aim of this focused review is to educate the nursing population about ways to prevent physical injuries related to the use of physical restraints in the elderly population, as well as ways to reduce the use of restraints in the hospital setting. This study will use Eagle Online, Google Scholar, PubMed, ProQuest and CINAHL. The search terms to be used are: physical injuries from restraints, physical restraints, elderly, geriatric, and use in hospital. This focused literature review will search for peer-reviewed literature between 2015-2025. Exclusion criteria for this search include studies that are not peer-reviewed, studies that are not in English, and articles written earlier than 2015.

Comparison of Types of Analgesia Used for IUD Insertion

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Pain management for the insertion of intrauterine devices (IUDs) is a medical practice that has not yet been standardized. Women receive different treatment from gynecologists at varying facilities, including prophylactic nonsteroidal anti-inflammatory drugs (NSAIDs), local anesthesia in the form of Lidocaine, and sometimes no pharmacologic intervention whatsoever. This review will utilize Google Scholar, the Tennessee Technological University Volpe Library database, and Nursing and Allied Health databases. The search terms to be used are: IUD insertion medications, analgesia for IUD insertion, comparison of medications for IUD insertion, pain relief for IUD insertion and local anesthesia for IUD insertion. This review includes studies published between 2015 and 2025, covering a time period of nine years. Exclusion criteria for this review include: studies using a population other than females aged 15-49 (childbearing years), studies written before 2015, and studies that do not focus on pain management for IUD insertion. The goal of this review is to identify which

method of pain management most effectively provides comfort to patients having IUDs inserted, aiming for treatment to be streamlined across all clinical settings in the future.

Prevalence of Post-Partum Psychosis

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Psychosis in post-partum women is a developing topic that is being explored further in more recent years. It is important that we shine light on this topic as many women struggle with this issue when they give birth and are in the post-partum stage. Post-partum psychosis does not discriminate and affects wide variety of women daily. There is an assortment of treatment options available to women and vast ways to cope with this diagnosis. Post-partum psychosis is being seen in women increasingly and we must find out the different causes of this illness to help prevent or help cope with it if it occurs. This study will use Eagle search, Google Scholar and Nursing and Allied Health databases. The search terms to be used include postpartum, psychosis, mental health, prognosis, treatment, women's health, family, infant, neonatal and suicide. The focused literature review will search for peer- reviewed literature between the years 2010- 2025. Exclusion material exclude; non-peer reviewed sources, mental health prognosis that do not include psychosis, peripartum, and labor and delivery. We hope to achieve a better understanding of what postpartum psychosis is, who is at risk, ways to prevent it, signs and symptoms of it and treatment options for people who do suffer from it.

The Effect of Cardiac Arrest on Quality of Life

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Cardiac arrest poses many long-term systemic problems for patients which affect their quality of life. Research shows that in the United States there are roughly 290,000 in- hospital cardiac arrest incidences and 350,000 out-of-hospital cardiac arrest occurrences per year. Due to the presence of cardiac arrest within every specialty of nursing, nurses need to be able to educate patients on the side effects after cardiac resuscitation.

This focused literature review aims to examine the outcomes, long-term complications and quality of life following cardiac arrest. This study will use Google Scholar, ProQuest and PubMed. The search terms to be used are as follows: long term outcomes of cardiac arrest, quality of life after cardiac arrest and review of systems post cardiac arrest. This literature review will search for peer-reviewed literature between 2015-2025. Exclusion criteria for this search include studies focusing on quantity of life after cardiac arrest, articles published before 2015 and articles including people who have not experienced cardiac arrest.

Adult Coping Mechanisms Related to Pediatric Eating Habits as Influenced by Parents

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In the United States, obesity, diabetes and hypertension are on the rise. Studies indicate that 37% of adults acknowledge turning to unhealthy or excessive food consumption as a response to stress. In addition to this, it is known that one's dietary habits are developed during childhood, making the parental figure the highest influence on an individual's eating habits. This correlation highlights the need for early intervention for children because unhealthy dietary habits and coping mechanisms developed during adolescence that extend into adulthood.
The aim of this focused review is to examine how one's relationship with food is developed in their adolescence, and if they are more inclined to have negative coping mechanisms. This study will use Eagle Net, Google Scholar, PubMed, and CINAHL search engines. The following search criteria will be used: food disorders, trauma leading to eating disorders, adolescents, parental eating habits, outcomes later

in life, food as rewards in kids and food as a coping mechanism. This focused literature study will include articles that have been published between 2015 and 2025 internationally. Exclusion criteria will include: non peer reviewed, articles before 2015, and studies not approved by the Institutional Review Board. The aim of this focused review is to search for a correlation between the habits of parental figures, childhood trauma and if the way parents feed their children affect the child's food preferences or eating habits.

NOTES